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The Influence of Organizational Dependences and Planning Frameworks on (C&D) Waste Circularity in Sweden

Bosinuola Sherifat Razaq

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Bosinuola Sherifat Razaq

Department of Science and Technology, Division of communication and transport systems

Faculty of Science and Engineering

Linköpings universitet, SE-601 74 Norrköping, Sweden

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Supervisor:

Fredriksson Anna

Department of Science and Technology

Co-supervisor:

Janné Mats

Department of Science and Technology

Co-supervisor:

Linnea Eriksson

Swedish National Road and Transport Research Institute (VTI)

Faculty opponent:

Jamil Khan

Lund University

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Abstract

The purpose of this thesis is *to examine how organizational dependencies, legal frameworks and planning processes influence construction and demolition (C&D) waste circularity in the construction and demolition ecosystem*. As global population growth continues to drive increasing demand for construction, society is constantly faced with more transport needs, more emissions and more resource use. In this context, the circular economy principles promise a potential way to mitigate this by promoting the reuse of construction and demolition materials. Existing studies have noted that the construction industry can implement the principles of the circular economy, but the progress in practice remains limited; as such, there is an overarching need to increase circularity in the construction sector. Previous studies have made important contributions by identifying a wide range of barriers influencing construction industry circularity—spanning regulation, organization, material quality, and information sharing. These barriers are not isolated phenomena; instead, they are deeply embedded within networks of actor dependences shaped by organizational structures and planning frameworks (legislation and planning processes). Advancing construction circularity, therefore, requires a comprehensive understanding of how actors relate to one another, coordinate across the organization, and collaborate. In addition, addressing legislative barriers requires not only examining the legislation itself but also understanding how this legislation interacts with the practical realities of industry actors.

Therefore, this study follows the research questions:

RQ 1: How do actors' dependencies within the construction/demolition ecosystem influence the advancement of circularity?

RQ 2: How do planning processes and legal frameworks affect the advancement of construction material circularity?

To answer these research questions, the study has followed a qualitative approach. The study is based on semi-structured interviews, surveys, documents, and observations.

The thesis argues that dependencies are not static but dynamic over a project timeline, and that a limited understanding of shifting dependencies across organizational levels and actors (which is fluid) creates bottlenecks to advancing construction circularity. Internal fragmentation and knowledge gaps regarding material quality hinder strategic decision-making. To address these challenges, investment in material digital passports and better internal collaborations will enable increased circularity. For increased reuse, pre-construction and post-construction should be considered with utmost importance. Furthermore, existing legislation is too abstract to drive circularity in the construction industry; advancing construction circularity will depend on specific, strong, and aligned EU-level rules. The presence of multiple policy documents, and municipalities navigating this, creates complexity that challenges actors in the reuse of (C&D) waste. Overall, this study extends ecosystem theory to the complex, project-based context of C&D waste management and offers managers and policymakers a diagnostic tool to identify critical dependencies before projects begin, thereby increasing circularity. In addition, the thesis identified a governance gap in circularity implementation, evidenced by the absence of a dedicated role for C&D waste management at the municipal level.

Keywords: Circular economy, circular construction, ecosystem, institutional logics, institutional complexity, drivers and barriers

Populärvetenskaplig sammanfattning

Syftet med denna avhandling är att undersöka hur organisatoriska beroenden och planeringsramverk påverkar cirkularitet i byggsektorn. I takt med att den globala befolkningen växer och driver på en ökande efterfrågan på byggande, står samhället inför ett ständigt växande behov av transporter, ökade utsläpp och ökande resursanvändning. I detta sammanhang erbjuder den cirkulära ekonomins principer ett möjligt sätt att hantera dessa utmaningar genom att främja återanvändning av bygg- och rivningsmaterial. Tidigare studier har visat att byggbranschen har möjlighet att tillämpa principerna för cirkulär ekonomi, men att utvecklingen i praktiken fortfarande är begränsad. Därför finns ett övergripande behov av att öka cirkulariteten i sektorn. Forskningen har också bidragit genom att identifiera ett brett spektrum av hinder som påverkar cirkulariteten; från reglering och organisation till materialkvalitet och informationsdelning. Dessa hinder är dock inte isolerade företeelser; de är djupt inbäddade i nätverk av aktörsberoenden som formas av organisatoriska strukturer och planeringsramverk (lagstiftning och planeringsprocesser). Att driva på cirkularitet i byggandet kräver därför en bred förståelse för hur aktörer förhåller sig till varandra, koordinerar inom och mellan organisationer, samt samarbetar. Utöver detta innebär arbetet med att hantera lagstiftningsrelaterade hinder inte bara att granska själva lagstiftningen, utan också att förstå hur den interagerar med branschens praktiska verklighet.

Denna licentiatavhandling bygger därför på följande forskningsfrågor:

FF 1: Hur påverkar beroenden mellan olika aktörer i bygg- och rivningsprojekt möjligheterna att öka cirkulariteten?

FF 2: Hur påverkar dagens planeringsprocesser och lagstiftning arbetet med att återanvända material?

För att besvara forskningsfrågorna bygger avhandlingen på intervjuer, enkäter, dokumentanalyser och observationer i svenska bygg- och rivningsprojekt. Resultaten visar att aktörers beroenden förändras över projektets gång och att många organisationer har svårt att hantera dessa skiftande relationer. Bristande kunskapsdelning och osäkerhet kring materialkvalitet skapar flaskhalsar som hämmar återanvändning.

Ett centralt hinder är otillräcklig information om vilka material som finns tillgängliga. Därför framhålls digitala materialpass och bättre intern samordning som viktiga verktyg för ökad cirkularitet. Studien visar också att de mest avgörande besluten tas före och efter själva byggskedet, i planeringsfasen och efter rivning, vilket innebär att dessa faser behöver prioriteras. Lagstiftningen utgör ytterligare ett hinder. Reglerna för byggande och avfallshantering är ofta abstrakta och splittrade, vilket skapar osäkerhet och försvårar återanvändning. Kommunerna måste dessutom navigera mellan många olika policyer. Därför pekar studien på behovet av tydligare och mer samordnade EU-regler för att ge branschen bättre förutsättningar att arbeta cirkulärt.

Avhandlingen bidrar med nya insikter genom att kombinera ekosystemteori med den komplexa verkligheten i projektbaserat byggande. Den presenterar också beslutsunderlag som hjälper till att identifiera och hantera kritiska beroenden redan före projektstart. Avhandlingen visar dessutom på ett organisatoriskt glapp: många kommuner saknar en tydlig funktion som ansvarar för cirkularitet och hantering av bygg- och rivningsmaterial. Sammantaget framhåller avhandlingen att ökad cirkularitet inte bara kräver tekniska lösningar eller ny lagstiftning, utan även förbättrat samarbete, kunskapsdelning och förmåga att navigera i komplexa organisatoriska och juridiska strukturer.

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Bosinuola Sherifat Razaq

Norrköping , April 2024

List of papers

Included in the Thesis

Paper 1

Razaq, B., Janné, M., & Eriksson, L. (2024,). *Circularity of Aggregate Materials in the Construction Sector - Drivers & Barriers* The 36th annual Nofoma Conference, Stockholm, 13–14 June 2024,
Stockholm. http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-205557

Paper 2

Razaq, B., & Fredriksson, A. (2026a). Navigating the dependencies in construction circular ecosystems: studying the Swedish C&D aggregate reuse planning. Submitted to the *Journal of Cleaner and Circular Bioeconomy*. Previously presented at the 36th Nofoma conference, Stockholm in 2024.

Paper 3

Razaq, B., Eriksson, L., Janné, M., & Fredriksson, A., (2025). Assessing Legal Frameworks and Planning Processing for Construction Circularity among Swedish Local Authority. *Working paper* previously presented as a conference paper at the Swedish Transport Research conference 2025.

Not Included in the thesis

Paper 1 (Updated version)

Janné, M., Eriksson, L., & Razaq, B. (2026b). Petals of Circularity: Institutional fields shaping the organizational landscape of aggregate materials. Submitted to "*Cities*" Journal.

Contributions

Paper 1: All authors contributed to writing the original draft and data analysis, but Janné and Eriksson did the data collection.

Paper 2: Razaq is the main author responsible for the analysis and writing. Research design and data collection were done by both authors.

Paper 3: Razaq is the main author, responsible for research design, analysis, and writing. Data collection was done by all authors.

Not Included in the thesis

Paper 1 (Updated): Razaq contributed to writing the original draft, data analysis, but Janné and Eriksson did the data collection and took the main responsibility of finalizing the paper.

Table of Contents

1. Introduction

This chapter outlines the motivations for the study, including the research background, identified gaps, research purpose, and research questions. Together, this chapter establishes the foundation of the study and clarifies its contribution to the ongoing discourse on the transition toward circular material use.

1.1. Background

Rapid societal growth driven by urbanization has increased the demand for construction projects to accommodate the growing population UN (2025). This growth in construction activities has intensified environmental pressures, contributing to higher emissions, increased transport, and the depletion of natural resources. The construction industry contributes significantly to global climate change, accounting for about 21% of global greenhouse gas emissions (UNEP, 2024). In addition to its carbon footprint, the industry generates lots of waste (O'Grady et al., 2021), that are from construction, demolition, renovation, and maintenance works. The norm is that these wastes have been directed to landfills (Oluleye et al., 2022; Smol et al., 2015), despite holding significant reuse potential (Pacheco-Torgal, 2020). These wastes can be used in subsequent projects to increase resource efficiency and reduce transport needs. Specifically, their reuse can decrease the need to transport virgin materials from quarries to construction sites, as well as the need to transport waste materials from construction sites to landfills. In this study, these wastes are referred to as *Construction and Demolition* (C&D) Waste.

Despite their high potential for reuse, most (C&D) waste continues to be directed to landfills (Pacheco-Torgal, 2020). Approximately 35-65% ends up in landfills (Chileshe et al., 2018; Chileshe et al., 2013; Kabirifar et al., 2021). This is especially concerning given that demand for materials in the construction industry will increase by 2050, at least doubling current levels (Allwood et al., 2011). Consequently, reuse has become increasingly critical for enhancing long-term resource availability. According to the European Commission (2016), reuse is the best practice to manage construction material. To facilitate reuse, previous studies propose that the construction industry can provide significant value by exploiting the principles of the circular economy (CE) (Chartier & Pot, 2024; Oluleye et al., 2023; Oluleye et al., 2022; Smol et al., 2015; Wuni, 2022)—highlighting the importance of circularity in the construction industry.

Given its enormous environmental footprint, the construction industry should be a priority in the transition to CE (Anastasiades et al., 2020; Wuni, 2022). Historically, the industry had always embraced the linear economy in the production and consumption of resources (Guerra & Leite, 2021). The linear economy is commonly known as the "take-make-dispose" model (Anastasiades et al., 2020; Guerra & Leite, 2021). The construction industry takes virgin materials, builds a structure, and dispose of these materials at the end of their life (Guerra & Leite, 2021). On the other hand, the CE principle promises that resource value is retained and that resources are circulated, ensuring that fewer additional natural resources are needed to produce materials (Guerra & Leite, 2021). The CE is a regenerative system that replaces the "end-of-life" concept with resource reduction, reuse, and recycling. Within the construction industry, this entails a life-cycle approach that optimizes building longevity, enables design assembly, and treats buildings as material banks for future reuse (Kirchherr et al., 2023; Leising et al., 2017).

CE, I hear someone yawning—isn't that old already? We have been talking about that for years. Nevertheless, the critical question remains: Is the transition happening in practice? Why has the existing CE action plan failed to reduce tons of C&D waste generated annually across the globe (Oluleye et al., 2023)? Previous studies have sought to explain why the adoption of CE in the construction industry is still very restrictive (Giorgi et al., 2022; Oluleye et al., 2023; Wuni, 2023). They made important contributions that expand our understanding of different barriers influencing construction industry circularity—

spanning regulation, organization, material quality, information sharing, environment and climate on an overarching level.

While several barriers to circularity in the construction industry have been identified, this study concentrates on organizational practices and regulations governing construction activities. These barriers are not necessarily more significant than others; rather, they offer a valuable entry point through which different barriers are shaped and interconnected within the construction industry. To do this, ecosystem theory offers an analytical lens for understanding the network of actors, as well as actors' collaboration and dependences (Thomas & Autio, 2020). The construction and demolition (C&D) ecosystem is relevant to understand the organizational practices, as it involves different actors whose roles, responsibilities, relationships and dependencies influence how (C&D) waste is reused. In addition, institutional complexity theory is used to analyze how the existence of different legal frameworks influences the advancement of circularity within the C&D ecosystem. Without seeing the full picture of the interaction within the (C&D) ecosystem, we cannot understand the scale of the challenges or benchmark the benefits of potential solutions to circularity advancement in the construction industry.

1.2. Purpose and Research Questions

The purpose of this study is to examine how organizational dependencies, legal frameworks, and planning processes influence construction and demolition (C&D) waste circularity in the construction and demolition ecosystem. To fulfill this purpose, the thesis is guided by the following research questions.

RQ 1: How do actors' dependences within the construction and demolition ecosystem influence the advancement of circularity?

The barriers of circular materials are not isolated phenomena; instead, they are deeply embedded within networks of actor dependences shaped by organizational structures and regulatory frameworks (Fredriksson et al., 2026). Fredriksson and Huge-Brodin

(2022) also underscored that there is a dependence between subsystems within construction involving both public and private actors, and to make a change, several actors must simultaneously change their way of working. In order to understand the dependences between construction actors, it should involve a deeper investigation of the (C&D) waste organization structure, which includes how actors relate, coordinate, and collaborate.

RQ 2: How do planning processes and legal frameworks affect the advancement of construction material circularity?

In this study, we conceptualize legislation as a tool in the hands of planners (public actors) to guide and implement a targeted objective. This study discusses the Swedish planning processes and legislation in detail in Chapter (2).

Several legal and planning frameworks have been implemented across different countries addressing construction circularity. While these regulations generally aim to increase circularity, some have been reported to have conflicting effect (Dziedzic et al., 2025), making circularity more complex. Addressing regulatory barriers requires not only examining the legislation itself but also understanding how these legislations interact with practical realities of industry actors.

1.3. Scope

This thesis examines circularity within the construction and demolition ecosystem by focusing on how planning frameworks, as well as dependences and relationships between public and private actors, influence circularity. Planning frameworks in this study refer to the combination of legislation and planning processes within the (C&D) ecosystem.

This thesis analyses the relationship and dependencies between the public and private actors in the (C&D) ecosystem. The private actors include contractors, developers, transporters, and recycling companies, while the public actors include Municipalities and the County Administrative Board (CAB).

In addition, this study is geographically limited to Sweden, which serves as the context for examining the (C&D) ecosystem. The empirical focus of this thesis is aggregate reuse. Aggregate here refers to sand, rock, soil, clay, and stone from construction and demolition sites (Magnusson et al., 2015). Sweden serves as a relevant empirical context for examining circular material reuse, given its advanced circularity legislation. However, only approximately 10% of materials are reused in practice. This gap highlights the need to investigate how planning frameworks and organizational structures affect circularity. Chapter 4 further provides explanation of why the Swedish construction and demolition (C&D) ecosystem is relevant to this study.

The unit of observation in this thesis is the public and the private actors involved in the (C&D) ecosystem. The public actors are examined based on interpretation and implementation of planning processes and legislation, and the private actors are analyzed through their operational work processes and how they navigate the planning frameworks governing (C&D) activities.

1.4. Disposition

Chapter 1 sets the background, purpose and research questions of this thesis. Chapter 2 outlines the contextual background. Chapter 3 presents the theoretical framework. Chapter 4 presents the research methodology. Chapter 5 presents the summary of each paper included in the thesis. Chapter 6 presents the discussions, and Chapter 7 presents the conclusion, limitations and further research.

2. Contextual background

This chapter presents the contextual background of the thesis. It begins by outlining the traditional construction industry project set up, followed by an introduction to circular economy and its strategies. The chapter then describes the construction and demolition (C&D) waste, and aggregate reuse within the Swedish construction industry. Finally, it describes the Swedish planning frameworks that shapes and influence these practices.

2.1. Construction Industry Project Set up

The construction industry project set up described here primarily reflect the traditional linear economy, although circular practices are increasingly being incorporated. Construction projects are typically structured into three phases: the pre-construction, on-site, and post-construction phases (Klinger & Susong, 2006). The preconstruction phase involves selecting project teams, developing schedules and milestones, and initiating material purchases, among other activities (Menches et al., 2008). The decisions made during the preconstruction phase are important, as organisational, logical, and technical conditions are determined. The on-site phase is when operational work is carried out. During this time, work is carried out in accordance with established schedules, which involves ensuring all the work milestones are met. The post-construction phase focuses on project closure activities, including reporting, documentation and handover. Although these phases are different, they should not be seen as isolated but rather coordinated to work together to achieve the project goals (Fellows & Liu, 2020)

A construction project involves the assembly of large volumes of materials originating from diverse sources, each requiring different kinds of processing, and the coordination of multiple specialized services (Dubois & Gadde, 2002a). These material and service flows create high levels of resource dependency among actors involved in construction activities (Yuchtman & Seashore, 1967). The interaction of resources, the sourcing and other services of people shapes the underlying organisational and operational conditions of the construction industry.

The construction industry is famous for its complexity, which is centrally linked to the temporary and fragmented nature of construction projects (Dubois & Gadde, 2002a). The life of a construction project is ultimately temporary, which means an organisational setup for a project starts and ends with the project. As a result, actors must be procured anew for every project (Dubois & Gadde, 2000), even when similar tasks are repeated across projects. The ripple effect of the construction industry's temporary nature is the inability to transfer experiences, routines, and problem-solving practices from one project to another (Meng, 2012). The temporary nature and the inability to transfer knowledge from one project to another have important implications for circularity in the construction industry. For instance, a solution developed as a team during one project is seldom applied in subsequent projects (Dubois & Gadde, 2002a). Moreover, the project's temporary nature implies that trust must be rebuilt with new members for the next project, further affecting collaborations that are essential to advancing circularity.

Construction projects are also autonomous, meaning each project acts independently without necessarily involving the parent company (Bygballe et al., 2010). This autonomy contributes to information silos and coordination problems, as knowledge gained within one project is not shared among the companies.

Furthermore, the construction industry project setup is also characterised by fragmentation, involving the participation of numerous specialised, often small firms (Fadiya et al., 2015). A construction project involves multiple actors, including main contractors, subcontractors, site managers, material suppliers, transporters, and waste managers. Fragmentation creates uncertainty within construction projects (Fearne & Fowler, 2006), and one major issue for companies working on the same project is coordination (Dubois & Gadde, 2000). A construction project depends on the alignment of multiple actors rather than being driven by a single decision-maker, which complicates efforts to implement change (Fredriksson & Huge-Brodin, 2022). As the number of involved actors increases, the more challenges there are in coordinating on the construction site. This lack of coordination hinders knowledge sharing and information exchange, a challenge to increasing construction circularity.

2.2. Circular economy

The Circular Economy (CE) has gained prominence as a practical approach for businesses to implement sustainable development (Ghisellini et al., 2016). It is regarded as the sustainability concept that has gained the most traction (Foundation, 2014), surpassing the green economy and the green growth concepts (Kirchherr et al., 2017; OECD, 2016; UNEP, 2011). Much of CE momentum has been driven by non-academic players (Schut et al., 2016), with many consultancy reports published by the MacArthur Foundation, Accenture, EY, and Deloitte (Kirchherr et al., 2017; Lacy, 2015).

CE focuses on maintaining and maximizing material value while benefiting both the environment and the economy (Yu et al., 2021). Over the years, it has emerged as the preferred strategy for developing production and consumption in the last decade (Hjaltadóttir & Hild, 2021). A widely recognized definition conceptualizes CE as an *economic system that replaces the "end-of-life" concept by reducing, alternatively reusing, recycling, and recovering materials in production/distribution and consumption processes* (Kirchherr et al., 2017). Within the construction industry context, CE has been further defined *as a life-cycle approach that optimizes the buildings' useful lifetime, integrating the end-of-life phase into the design and using new ownership models in which materials are only temporarily stored in the building, which acts as a material bank* (Leising et al., 2017).

The CE concept has been promoted across multiple sectors of the global economy, including the construction industry (Oluleye et al., 2023; Wuni, 2022), as a better alternative to the dominant economic development model of the "take, make and dispose" practices (Ness & Xing, 2017). Historically, the construction industry has always embraced the linear economy in the production and consumption of resources (Guerra & Leite, 2021) and still operates to a larger extent on the linear economy of low resource recovery and high consumption of natural resources (Anastasiades et al., 2020; Guerra & Leite, 2021). Such linear practices increases the risk of unsustainable development, including increased environmental degradation, raw material price fluctuations, and exposure to supply chain disruptions (Guerra & Leite, 2021).

CE strategies for the built environment emphasize reducing emissions and resource use through improved utilization of existing buildings, designing new buildings for flexibility and adaptability, and minimizing waste through material reuse and recycling (Foundation, 2021). Central to these strategies is the principle of retaining resource value by circulating materials within the economy, thereby reducing reliance on virgin resource extraction. From this perspective, discarded materials are no longer viewed as waste but as resources with continued value potential (Guerra & Leite, 2021).

The built environment plays a critical role in enabling circularity, as planning and design decisions strongly influence the feasibility of material recovery at the end of a building's life cycle (Guerra & Leite, 2021). Decisions made during the early design phase are crucial in determining the extent to which components and materials can be reused. However, the transition of the construction industry toward CE remains challenging. Existing industry structures, organizational processes, dominant philosophies, and market practices are often poorly aligned with circular principles, limiting the diffusion and effective implementation of CE (Guerra & Leite, 2021). Furthermore, end-user perceptions and acceptance have been identified as critical factors influencing the enactment of reuse practices within the built environment (Condotta & Zatta, 2021).

Empirical studies consistently indicate that CE is a difficult concept to establish in the construction industry due to a range of interrelated barriers. Cultural and market barriers are part of the long-standing resistance to changing construction stakeholders' mindsets (Wuni, 2022). In addition, knowledge, organization, and management barriers highlight a persistent gap between CE theory and practice. Although several studies have barriers to CE adoption in the construction sector, limited attention has been paid to how these factors actively shape the industry's transition toward increased circularity (Gherman et al., 2023; Giorgi et al., 2022; Oluleye et al., 2023; Oluleye et al., 2022).

Patterns across the literature demonstrate a maturation of CE research, with increasing attention towards identifying barriers, drivers, and strategies for implementation. However, gaps remain. Existing studies predominantly focus on identifying factors that hinder or enable CE adoption, rather than examining how these factors influence the operationalization of circular principles in practice. Consequently, despite the maturity of the CE concept, there is limited understanding of how its principles are operationalized within organizational and project-based contexts as the construction industry.

2.2.1. Circular Economy Strategies

Circular economy strategies describe the "how to" of achieving circularity and the concrete, context-specific practices through which circular economies are implemented (Kirchherr et al., 2017). These strategies are commonly conceptualized as *R-Strategies*. Kirchherr et al. (2017) identified ten primary strategies: refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover.

Refuse involves making a product redundant by abandoning its function or offering the same function with a different product. *Rethink* is making product use more intensive, for instance, bike and car sharing. *Reduce* refers to increasing material efficiency through consuming fewer natural resources. *Reusing* a discarded product which is still in good condition to fulfil its original function. *Repair* restores a product so that it can continue performing its original function. *Refurbish* restores an old product by updating it to the latest version. *Remanufacture* involves using parts of a discarded product in a new product with the same function. *Repurpose* is using discarded products in a new product with a different function. *Recycle* is the processing of materials to obtain the same or lower quality, while *recover* is energy recovery through incineration.

This thesis is centered primarily on reuse as a key strategy for managing (C&D) waste. First, according to the European Union waste hierarchy established under the Waste Framework Directive 2008/98/EC, reuse is prioritized above recycling, recovery, and other options due to its ability to retain material value with limited/no reprocessing. Second, existing studies identify reuse as one of the most effective strategies for managing (C&D) waste, alongside reduce, repurpose and recycling (Commission), 2018; Esa et al., 2017). Finally, reuse provides several benefits, including reduced costs, energy use, and greenhouse gas emissions; avoided landfill taxes and illegal dumping; extended landfill lifespan; and job creation. Reuse is also identified to create more value (Islam et al., 2019; Wang et al., 2018). For the above reason, reuse represents a relevant strategy for advancing circularity in the construction industry.

2.3. Construction and Demolition (C&D) Waste

Construction and demolition (C&D) waste is generated by the construction industry. It is defined as a mixture of different waste streams, including non-hazardous and hazardous waste generated from renovation, construction, demolition, maintenance, and deconstruction from buildings, roads, bridges, and other structures (EU, 2008; Gálvez-Martos & Istrate, 2020)**. Hazardous waste**: insulation materials and materials containing asbestos, lead, metals, and alloys. **Non-hazardous waste**: gypsum-based materials, mixed C&D materials including small quantities of organic wastes, bituminous mixture, tarmacadam and other tar products, wood, glass and plastic, mixture of concrete, bricks, tiles, ceramics, soil and fines, mixed C&D materials including small quantities of organic wastes

(Haitherali & G, 2023). However, the Construction Industry Council (2017) excluded wood, glass, and steel bars from C&D waste. The thesis focus is highlighted in red in Figure (1)

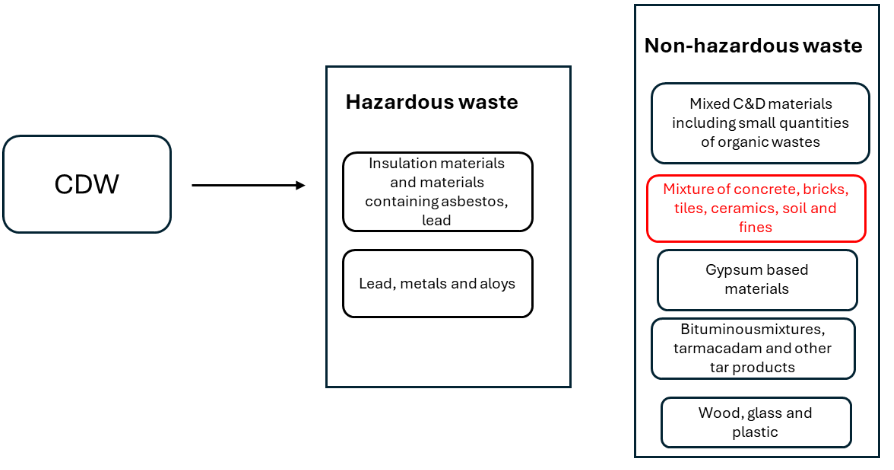

Figure 1: Construction and Demolition Waste. Adapted from (HaitherAli & Anjali, 2024)

Construction and Demolition (C&D) waste is heterogeneous, both in terms of material composition and in management practices (Gálvez-Martos et al., 2018), thereby creating challenges for circularity. According to Villoria-Sáez et al. (2020), the challenge of C&D waste is not only about how much is generated but also in how it is managed. The quantity and type of waste depend on several factors, including construction activity, construction materials, and population. For example, a road construction project will probably generate large volumes of excavated materials, and if no further use is known, it becomes waste. In contrast, demolishing a building yields more concrete and ceramic materials. The cleaner the material, the easier it is to handle permit approvals, whereas secondary materials are more complex to manage. This disparity of (C&D) waste, both in terms of material and management, affects the advancement of circularity in the construction industry. Furthermore, another challenge is the distributed nature of C&D waste generation (Gálvez-Martos et al., 2018). C&D waste is usually not generated at a specific site, unlike in other industries, such as manufacturing, where waste is generated at a specific production facility. The construction industry generates waste from temporary project sites, which complicates collection, awareness of availability, and coordination.

Aggregates, which are the focus of this study, include sand, rock, soil, clay, and stone from construction and demolition sites (Magnusson et al., 2015). Aggregates can be virgin or used/circular. Virgin materials are new materials from a quarry; they are finite resources taken from nature and have a higher CO2 footprint. In contrast, used/circular aggregates are materials from a previous project, may be contaminated, and can be crushed, sorted, and reused for other purposes, such as foundations, drainage, backfilling, or landscaping (Abedin Khan et al., 2024; Heidelberg, 2024).

2.3.1. Aggregates within the Swedish context

In Sweden, approximately 40-60 million tons of used/circular aggregate materials are generated annually, while up to 100 million tons of virgin materials are used annually, especially in railway construction, concrete production, and roads (SGU, 2021). This scale of material use explains the importance of increasing reuse, as systematic planning can enormously reduce the extraction of virgin materials.

The foundation of the circular economy is better resource management. For instance, recycling or reusing 1 ton of non-contaminated materials can save from 0.2 to 1 ton of virgin aggregates (Miljoinstitutet, 2023). Despite this potential, Sweden's economy remains largely linear and has a high consumption rate (Economy, 2022). Aggregates accounts for the second-largest share of landfilled waste in Sweden, at 60%, following mining waste (Miljoinstitutet, 2023). Such waste is generated not only during demolition and renovation activities but also in new building projects, where excavation generates substantial amounts of material (Miljoinstitutet, 2023).

Although reuse is beneficial for the environment, current practices remain limited. In Sweden, approximately 85% of the construction material supply consists of primary aggregates (virgin material) (SGU, 2019), largely due to their low production costs (Bertils & Elvingson, 2019). While Sweden has been successful in increasing energy recovery and reducing waste, performance in terms of reuse, reduction, and recycling in the construction industry has been relatively low (Byggföretagen, 2021). Reuse rates for aggregates are still only around 10% (Giorgi et al., 2022; UEPG, 2025), highlighting the need for action.

2.3.2. Circular aggregate use within the Swedish construction industry

Anyone who wants to use material in a construction project needs to find out several different things. For example, for aggregate to be reused for construction purposes, it is expected that the person who plans to use the materials obtain information about the properties and content, i.e., by sampling and testing (Fredriksson et al., 2023; Naturvårdsverket, 2010). The same applies to the person at an authority who works with the permit review of a proposal for the use of circular aggregate. As such, assessment has always been made by individual cases, which has led to uncertainty both for contractors and developers (Naturvårdsverket, 2010).

In practice, there are three ways to reuse aggregate: on-site with limited transport, in other external projects, and at a facility (Magnusson et al., 2015). The external use of circular aggregate is usually transported from its origin to a site where it can be used for other projects. They can be transported directly to a construction site, a recycling facility, or a materials terminal before being delivered to a construction project (Miljoinstitutet, 2023). Uncontaminated circular aggregate can be used on-site to level land, terrace the area, or create new surfaces for buildings and infrastructure. However, sometimes it is challenging to process and store these materials in place within the project (Miljoinstitutet, 2023). On-site use reduces the need to transport waste for treatment and materials from other locations, and sometimes, due to transport costs, materials that is not needed is used on-site, for example, for building noise protection when it is not needed (Miljoinstitutet, 2023). These uses are unnecessary and therefore not reused since they do not replace another material (Miljoinstitutet, 2023).

In addition, there are discussions in Sweden of when an aggregate should be regarded as waste and when it can be classified as a by-product (Miljoinstitutet, 2023). Circular aggregate disposal is the simplest, least expensive, and has a short lead time in a construction project, which plays a huge role in the decision to transport the materials directly to a landfill instead of reuse (Naturvårdsverket, 2022). The possibilities to reuse aggregates depend mainly on the balance of demand and availability of these materials within the project, but also between projects (Magnusson et al., 2015). The degree of recovery and its replacement for virgin materials is dependent on their composition, which largely depends on the geographical location where the excavation took place and how they were handled during excavation (i.e., if not mixed with other materials) (Miljoinstitutet, 2023).

2.4. Construction Actors Planning Level

For efficiency in (C&D) waste management in the construction sector, there is a joint problem area that needs to be solved by different actors (Janné, 2020). However, these actors have different goals and focuses (Janné, 2020), which makes it difficult to unite views in circularity. These actors consist of three subsystems which include the local municipality (strategic level), the developer (tactical level), and the main contractor (operational) (Fredriksson & Huge-Brodin, 2022). The local municipality is empowered to hold the land use monopoly for its jurisdictions and is also the urban planning authority (Fredriksson et al., 2023). They are entrusted with long-term planning and detailed planning concerning land use within the urban area (Fredriksson et al., 2023). The developer is the municipality's contract partner and a client to the main contractor, responsible for the overall project planning, such as reducing disturbances around construction site, while the main contractor is responsible for coordinating and organizing activities on the construction site (Fredriksson et al., 2023).

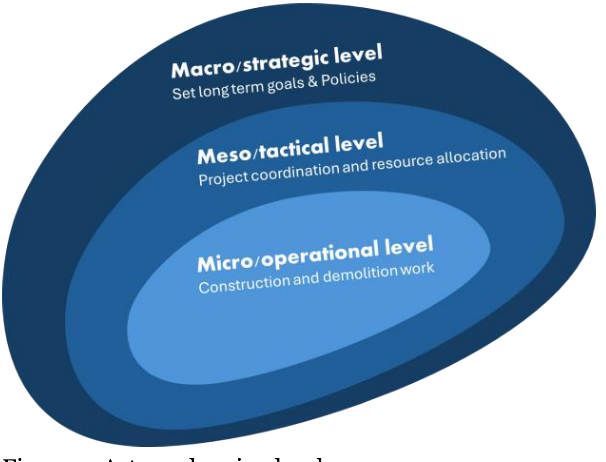

Figure 2: Actors planning level

2.5. Policy, Legislation and Planning processes

Friend et al. (2013) defines policy as a stance that shapes the context within which a succession of future decisions is made. Similarly, Tewdwr-Jones (2003) describes policy as formal statements of government intentions that guide decision-making (Tewdwr-Jones, 2003). Policy may be legally binding or advisory and can range from national strategies to local municipalities' legislation (Zittoun, 2016). Legislation is the authoritative and constitutionally controlled form in which law is cast and the procedure leading up to the enactment of it, and provides the basis and the framework for government action (Voermans, 2017). While national policies often establish overarching goals, local policy operationalizes these goals within their respective contexts.

Hill and Varone (2021) explained that in analyzing a policy process, it is important to recognize that policy will be used in different ways by different actors, often with the specific objective of influencing how others view their actions. They further highlight some attributes of policies: they are used in producing action, they are not expressed in a single decision but in a series of decisions, and policies invariably change over time. In this sense, policies function as leverage for national and local action and also as a stimulator of the advancement of the circular economy (HaitherAli & Anjali, 2024).

Planning processes, on the other hand, are structured steps of decision making that aim to achieve a defined policy objective, particularly, in land use planning and development control (Tewdwr-Jones, 2003). In the context of construction and demolition (C&D), planning processes are central because they guide decisions related to land use and resources flows (Stockholm, 2023). Planning processes involve several actors, including landowners, developers, investors, politicians and the public, who shape the built environment as they relate to each other and react to development pressure (Adams, 2012). Furthermore, planning processes can be seen as the process of applying reason to collective decision making (Adams, 2012). Effective planning processes ensure that policies are implemented coherently, and provide opportunities for monitoring, feedback, and adaptation (Faludi, 2000).

2.6. Legal frameworks and planning processes of (C&D) waste of Swedish municipalities

Table 1: Legislation References

Planning frameworks	References

EU directives (Waste Framework Directive 2008/98/EC	https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1537873850842&uri=COM:2018:656:FIN Waste Framework Directive 2008/98/EC
Environmental code (SFS 1998:808), Ch. 9 & 15	https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/#K15. Chapter 9 and 15
Environmental assessment ordinance (SFS 2013: 251). Ch. 29	https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljoprovningsforordning-2013251_sfs-2013-251/#K29. Chapter 29
Planning and Building Act (SFS 2010: 900)	https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/
National climate goals (SFS 2017: 720)	https://www.krisinformation.se/en/hazards-and-risks/climate-change/swedens-climate-goals/

2.6.1. Legal frameworks

EU directive (Waste Framework Directive 2008/98/EC): this is the main EU legislation governing waste management, whose main purpose is to protect human health and the environment while increasing the circular use of materials. This legislation provides the foundation for waste management across the EU. It sets a directive that at least 70% of non-hazardous construction and demolition (C&D) must be prepared for reuse, recycling, or repurposing. Although this legislation is legally binding at the EU level, it is not directly applicable; it must be translated into national law in the EU member states, leaving room for some flexibility—at least to a certain extent. In the Swedish context, this directive has been translated into the national law primarily through the Environmental Code.

Environmental code: The Swedish environmental code is centrally based on the EU directives. The Environmental Code regulates environmental protection and waste management in Sweden. The environmental code is prominent and central to Swedish environmental governance; it is more focused on pollution control and risk avoidance. Within the environmental code, waste is defined as "a substance or object that the holder disposes of or is obliged to dispose of (SFS 1998: 808; Chapter 15).

The environmental code also distinguishes waste from by-products. It defines a by-product as "*a substance or object that has arisen in a production process where the primary purpose is not to produce the substance or object, shall be considered a by-product rather than waste, if the continued use is ensured"*. This situations includes when there is already a market or demand for it (the substance or object can be used directly without any processing other than that which is normal in industrial practice) or the substance or object has been produced as an integral part of the production process, or the use referred does not conflict with law or other regulations and does not lead to generally negative consequences for the environment or human.

The environmental code indicates that the municipality is obligated to handle waste issues, while placing a responsibility on contractors/demolishers (SFS 1998: 808; Chapter 9). These private actors are required to ensure that waste undergoes complete treatment and to bear the cost involved. However, the environmental code did not provide concrete guidelines on how private actors can manage this waste to encourage reuse. Still, it stated that waste produced professionally should be handed over to someone who has a permit or has made the notification required for handling waste.

While the Environmental Code establishes the legal framework for environmental protection, it does not give detailed implementation guidelines. Instead, the municipality has the power to decide how to interpret the environmental code in accordance with its own local requirements. This is because there is significant variation among municipalities (for example, in terms of geology or environmental characteristics) across the country, and it is difficult to enforce this legislation given this variation.

The environmental code does not direct how to do things. It can be seen as a framework that sets boundaries for how to do things. It is left to each municipality to interpret it. However, the Environmental Protection Agency (Naturvårdsverket) provides guidelines for interpreting the environmental code. The Environmental Protection Agency follows the environmental code.

Environmental Assessment Ordinance: This legislation operationalizes the environmental code: it specifies which activities and operations require an environmental permit or notification, and what level of environmental review is required before a project starts. This legislation categorizes activities based on their potential environmental impact. In this legislation, activities are categorized into categories (A, B, and C) and clarify which authorities handle what in terms of issuing an environmental permit (SFS 2013: 251; Chapter 29). Category A activities have a significant environmental impact and must be handled by the environmental court. Category B indicates activities with moderate environmental impact and must be handled by the county administrative board, while Category C indicates activities with limited environmental impact and must be handled by the municipality.

Planning and Building Act (PBL): This focuses on future buildings and structural solutions. It focuses on where things may be built and how they should be built. The PBL describes how municipalities should plan for both the short- and long-term, including those owned by municipalities and those privately owned by individuals. Land use planning falls under the PBL. The municipalities do this through the comprehensive plan, detailed plan, and the building permit (SFS 2010: 900).

National Climate goal: This is a framework adopted in 2017 (SFS 2017: 720), and it contains the long-term Sweden goal that, by 2045 at the latest, Sweden will have no net emissions of greenhouse gases into the atmosphere and thereafter achieve negative emissions. In the construction context, it focuses mainly on reducing transport by optimizing construction logistics and material transport.

2.6.2. Actors in the planning processes

The Swedish planning processes involves the County Administrative Board (CAB) and the Municipality.

The County Administrative Board (CAB)

They are supervisory authorities not only for the application of the Environmental Code but also for planning-related matters. Sweden has 21 regions, each with a county administrative board that represents the national government at the regional level. The CAB has 21 authorities within the national government. The CAB takes orders from the national government. It is the national government that decides on what the CAB does. The CAB then supervises and regulates how the municipality interprets the legislation.

These boards work across several areas, including regional growth, infrastructure planning, community planning, and housing. Regarding (C&D) waste, cases are usually submitted to the CAB but are primarily assessed from an environmental protection perspective. At the same time, CAB holds responsibilities within urban planning and infrastructure and must work to ensure that the national environmental quality goals are implemented in local and regional planning processes.

Most importantly, CAB is responsible for supervising compliance with the Environmental Code. They also issue permits for quarry activities within their jurisdiction.

The Municipality

They are both a planning and supervisory authority, and also a developer. They wear multiple crowns. They plan for all the areas within their jurisdiction. This planning is carried out in accordance with the Planning and Building Act (PBL).

The municipality as a planning authority

Comprehensive plan (CP): The municipality must produce a comprehensive plan (SFS 2010: 900; Chapter 3), which includes a long-term development strategy. It presents a long-term plan for both land and water use. The CP is not a legally binding document as it is subject to update every 10 years. The CP serves as a guiding basis and strategy for building permit review, subsequent detailed planning, or planning in accordance with other legislation, such as the environmental code.

Detailed plans (DP): In contrast to the comprehensive plan, the DP is legally binding and governs land and water use within the municipality (SFS 2010: 900; Chapter 4). The detailed plan presents the land use associated with each planned project and what functions the land should serve. A DP describes what land should be used for (for example, housing, roads, green areas, industrial, etc.), not how to build, but what the result should be, i.e., what functions the land should have once development is finished. The DP usually have an implementation period between 5-15 years. During this time, the municipality has limited rights to make changes to the plan. However, in some cases, the DP can be changed before the period ends. The DP focuses on the final use of the land after construction is finished; it usually does not regulate construction methods, temporary activities, handling of Construction and Demolition (C&D) waste or environmental impact during construction. In other words, it looks at the destination and not the journey.

Because construction activities can affect the environment, separate approvals are required under the Environmental Code, including transportation, storage of CDW, and the risk of pollution. The DP does not cover these approvals. In summary, the DP is a document that outlines the finished look of a city, but it does not regulate construction activities or permit approvals. Construction still needs a building permit, environmental approvals, and must comply with other laws and regulations.

The building and demolition permit: This is a permit that a developer or responsible person must apply for with the municipality to carry out construction works in accordance with the DP guidelines (SFS 2010: 900; Chapter 9). Since you cannot start a construction works because there is a DP, a building or demolition permit is needed. The purpose is to allow the municipality to assess whether the construction complies with the DP. After that, the application is assessed based on the Planning and Building Act (PBL). A building permit usually has obligations such as the construction process, documentation, reporting, and technical conditions. It also includes strict rules that construction must begin within two (2) years of the permit approval and be completed within five (5) years. This is to ensure that approved projects are carried out and that the built environment develops in a predictable way.

Municipality as a supervisory authority

The municipality is a supervisory authority for environmental and health protection (Chapter 9 of the environmental code) and for waste management (Chapter 15 of the environmental code). Chapter 9 covers pollution, contaminated soil, noise, dust, and health risks. Chapter 15 covers how waste is classified, handled, reused, recycled or disposed of.

The environmental unit is the municipality's supervisory body, and they focus mainly on contaminants rather than assessing material quality or deciding how the material will be used. They also issue the permit for quarry activities.

Permit for quarry activities: This permit is regulated under the Environmental Code. This permit is issued by the county administrative board, by the Environmental Assessment Delegation (MPD) department. The MPD makes decisions on applications for hazardous activities under Chapter 9 of the Environmental Code. This permit is primarily focused on material extraction and disposal rather than on promoting the reuse of construction and demolition waste.

Furthermore, the municipalities may also participate through the planning processes under the PBL. The municipality may indicate whether an area is suitable for extraction activities.

Moreover, the division of authority for issuing environmental permits between the municipality and the county administrative board is that the municipality supervises less risky activities. While the CAB supervises activities requiring a permit or higher-risk activities.

The Municipality as a developer

Municipalities have the right to order and procure construction works, primarily because they own land and therefore build infrastructure. But they also follow the procedures like other developers. The implication is that they also need to apply for a building and environmental permit, just like other developers. Sometimes, the exploitation office can also be part of the development office. The exploitation office is responsible for managing and developing the municipality's land. They ensure that development aligns with public goals and agreements with private actors. There is usually an exploitation contract for contractors to sign before projects start. The contract is usually about how aggregates should be used. However, this depends on the municipality, as not all municipalities have this unit.

Mass-handling plans: These are planning documents used to manage excavated rock and soil materials from construction projects. This plan is a local policy, and not all municipalities in Sweden have one. A mass management plan reduces material disposal to landfills, ensures early planning for excavation and demolition materials, and has the potential to increase the demand and supply of circular materials.

3. Theoretical framework

This chapter presents the theoretical framework of the thesis and outlines the key conceptual streams that guide the analysis. Figure 3 shows the key focus of the thesis analysis.

In this thesis, I focus on two main areas: the circular ecosystem and institutional complexity. To illustrate how actors' activities occur, the Ecosystem Pie Model (EPM) is used as a visual tool that maps the relationships and dependencies within the ecosystem. Furthermore, previous research emphasizes that organizations operate under multiple institutional logics, which may be competing or conflicting, thereby creating institutional complexity (Greenwood et al., 2011). In this thesis, institutional complexity serves as the analytical lens for examining how different institutional logics shape the advancement of circular construction. Contrary to most previous studies, which usually begin by examining how multiple logics generate institutional complexity, this thesis conceptualizes institutional complexity as a phenomenon used to reveal, trace, and interpret the underlying logics (Furnari, 2019; Lounsbury et al., 2021) shaping circular material reuse. This approach avoids presupposing which logics are present and instead identifies them through the patterns of complexity within the ecosystem. Therefore, while ecosystem theory explains the dependencies among actors involved in circular material reuse, and institutional complexity theory provides insights into how multiple, sometimes conflicting, legal demands influence circularity within the ecosystem.

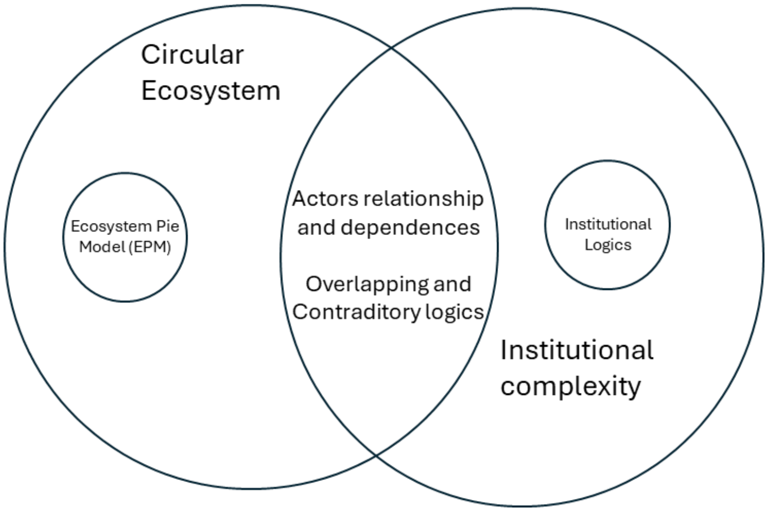

Figure 3: An overview of the theoretical focus of the thesis

3.1. Institutional Complexity

Institutions are made of durable social structures, symbolic elements, social activities, and material resources (Scott, 2013). Institutions have distinct properties that make them resistant to change and consist of different elements (normative, regulative, and culture-cognitive). These elements are the central building blocks of institutional structures, providing the elastic fibers that guide behavior and resist change.

According to Greenwood et al. (2011), organizations face institutional complexity whenever they confront incompatible prescriptions from multiple institutional logics. Scott (2013) argues that institutional complexity in organizations is rarely static; it is often shaped by processes within organizational fields. Scholars such as Dunn and Jones (2010) and Reay and Hinings (2009) further note that institutional complexity is particularly pronounced in organizations that deliver professional services, where different occupations that deliver value tend to be motivated and conditioned by distinct logics. By extension, the construction industry is an illustrative setting in which institutional complexity is at play. The construction projects typically involve a wide array of actors, each operating by their own professional norms, interests, and expectations. Despite working within the same project environment, these actors are famous for working independently. This independence contributes to the industry's complexity, as actors perform activities driven by their own agendas (Fredriksson & Huge-Brodin, 2022). This fragmentation amplifies institutional complexity, thereby complicating collective action towards circularity.

Greenwood et al. (2011) argue that society is constituted by multiple and independent logics, and the expectations of powerful external actors are often conflicting, vague, and in flux (Elsbach & Sutton, 1992). In a circular construction context, regulatory frameworks are typical examples through which institutional logics are played out in organizations. Lots of existing literature on barriers to circularity in construction emphasizes regulatory challenges, highlighting how regulations can be conflicting, overlapping, and sometimes confusing due to multiple rules addressing similar issues. This regulatory fragmentation contributes to decision-making complexity by increasing the number of possible action alternatives available to industry actors. According to Williamson (1973), when there are many possible decision alternatives over time, the decision tree becomes very complex, and it will become impossible to foresee and regulate all possible alternatives through contractual arrangements.

Dequech (2001) defined a complex system as one consisting of a large number of parts with different interactions and associated with the idea of a hierarchical system. Complexity affects the degree of information sharing, and it raises the cost of information (Williamson, 1973), as relevant knowledge is dispersed across actors and often unavailable when decisions must be made. In construction circularity, information costs are particularly high because multiple actors operate from different perspectives and at different times, each prioritizing different goals (Fredriksson et al., 2023). According to Dequech (2001), future conditions cannot be fully predicted in early stages, meaning circularity choices are often made under conditions of uncertainty. As a result, actors do not always know which alternatives to pursue to achieve these objectives, and so they instead adopt alternatives that are "satisfying" rather than an "optimizing strategy". This also suggests that the complexity of the decision environment is already present at the early stage of decision making, reinforcing the importance of engaging different stakeholders and reconciling their concerns at a project's early stage (Dablanc, 2007).

Multiple institutional scholars acknowledge that organizations are often exposed to multiple and sometimes conflicting demands (Greenwood et al., 2011). Many organizations find it challenging to align with strong environmental beliefs and rules because they operate in fragmented environments in which multiple independent groups and organizations make demands that are, at best/and uncoordinated (D'Aunno et al., 1991). Similarly, this summarizes the challenges affecting circularity in the construction industry today, which has always been described as structurally fragmented (Naz, 2022; Winch, 1998) due to a lack of integration between construction processes and organization. Thus, exposure to multiple institutional logic creates tensions that constrain collective efforts towards circularity, highlighting the relevance of institutional complexity as a theoretical lens for this thesis.

3.1.1. Institutional Logics

Institutional logics developed from neo institutional theory. Friedland and Alford (1991) are the pioneers of institutional logics, and they define it as a medium to study the interrelationships between individuals, organizations, and society. Thornton and Ocasio (2008) define an institutional logic as the *socially constructed, historical patterns of cultural symbols and material practices, including assumptions, values, and beliefs, by which individuals and organizations provide meaning to their daily activity, organize time and space, and reproduce their lives and experiences*. When several logics coexist within an organization, they give rise to institutional complexity, as diverse societal actors and interest interact (Greenwood et al., 2011). Institutional logics emphasizes the nestedness of levels of analysis, and the need to understand individual and organizational behavior as always embedded in and influenced by societal context (Thornton et al., 2012).

As noted by (Eriksson & Fredriksson, 2025), actors within different policy fields act separately from each other, which is a widely known problem concerning governance and planning on local, regional, national and EU levels. This fragmented approach reflects the reality of circularity implementation in construction where multiple and sometimes contradictory logics co-exist.

Thornton et al. (2012) describes that society is comprised of multiple institutional orders which have a central logic of both material practices and symbolic systems. The symbolic systems according to (Scott, 2013) refer to rules, norms and cultural cognitive beliefs—they are central ingredients of institutions; the material practices refers to a set of meaningful activity that are informed by wider cultural beliefs. Prior studies have embraced this perspective. Gluch and and Hellsvik (2023) used institutional logics to understand the intrinsic influence of multiple institutional logics on sustainability professionals. Vurro et al. (2010) highlights the interplay of market and policy-oriented logics in explaining different characteristics of cross-sector social partnerships.

Furthermore, Pache and Santos (2013) analyzed five resolutions to the existence of multiple logics in different contexts: ignorance, compliance, defiance, combination, and compartmentalization. Ignorance occurs when an organization is unaware of the influence of a particular logic. Compliance happens when an organization agrees with a logic; it involves the full adoption of a logic. Defiance occurs when there is total rejection, contradiction, or disappearance of logic. Combination is when organizations combine different conflicting logics. Compartmentalization is when an organization displays compliance for logic in one area and logic in another area.

Table 2: Resolution to multiple logics (Eriksson, 2016)

Resolution to multiple logics	Process and result
Blending	Combination and merging of different logics into one new logic
Replacement	A new logic replaces an old logic
Dominance	One logic dominates others
Compartmentalization	Different parts embrace different logics, and they continue to coexist as relevant for some actors but not for others

3.1.2. The ideal types of circularity in construction in relation to regulatory frameworks

One way to incorporate the core assumptions of the institutional logics into a theoretical framework and support theory development is by constructing a typology of "ideal types" to guide scientific inquiry (Doty & Glick, 1994). Thornton et al. (2012) argue further that ideal type is a first step in an analysis to help researchers avoid getting bogged down in merely reproducing the often- confusing empirical situation. Ideal types function as an analytical lens for examining empirical data, allowing identification and interpretation of the multiple or conflicting logics existing in an institutional field. The goal of using ideal types as described by (Thornton et al., 2012) is to provide a rich yet generalizable understanding of the varied processes that shape observed institutional outcomes. Thornton et al. (2012) explained that ideal types are not a description of an organizational field, but an abstract model to explain a phenomenon from its pure form. The use of ideal types is represented through a matrix in which X-axis outlines the institutional orders/logics that are relevant in a specific context, and Y-axis contains elemental categories or building blocks.

The institutional orders/logics include family, community, religion, state, market, profession, and corporation (Thornton et al., 2012). In the construction context, we have identified from literature two basic ideal types that exist in this institutional field. Therefore, we argue that the prevailing logics stem from state and market logic. The state logic is evident through regulatory frameworks that establish the minimum behavioral standards expected of organizations (Pesterfield & Rogerson, 2023). Simultaneously, market logic manifests in how industry actors respond to these regulations while pursuing profit-driven decisions. Furthermore, institutional logics are ideal types, according to Thornton and Ocasio (2008) analytical framework.

The state idea type of logic

The state logic involves the understanding of societal pressures to conform to legislature and regulations (Yin & Jamali, 2021). The state creates the legal apparatus to enforce or reinforce appropriate conceptions (Thornton et al., 2012)—here, the conceptions refer to the role and responsibilities of the industry professionals.

Due to the wave of circular economy, the government have broad powers of control over construction work which is then regulated by extensive policies (Hughes et al., 2015). These regulations helps to set minimum standards of behavior to which organizations are expected to conform (Pesterfield & Rogerson, 2023). Regulations often involve prevention and mitigation of negative effects associated with company's activities or the respect of shared principles or maybe set some minimum requirements about the expected contribution of the company to the society (Arena et al., 2018). It is customary for companies to be accountable to the state, either through formal contracts or moral obligations. Within the circular construction perspective, for instance, (Eriksson & Fredriksson, 2025; Fredriksson & Huge-Brodin, 2022; Fredriksson et al., 2023), the state logic have other three underlying logics: the development logic, urban planning logic and compliance and control logic. These underlying logics fall within the responsibilities of municipalities and the CAB. Municipalities act as developers, oversee both strategic and detailed land use planning, are responsible for approving building permits, and are also tasked with interpreting the Environmental Code. The CAB are also empowered to interpret the Environmental Code. Hence, the state is a key institution for this study.

The market idea type of logic

According to (Thornton et al., 2012), market logics involves decision making aimed at maximizing economic returns. The focus of the market logic on economic returns reinforces competition with other competing logics (Pesterfield & Rogerson, 2023). In the circular construction perspective, the competing logics is derived from the urge to make companies more sustainable. Sustainability-driven actions often involve costs which has traditionally been as non-contributing to profitability (Glavas & Mish, 2015). Market actors will usually draw on norms, institutions, logics and frames—which are usually external to the market (Mountford & Geiger, 2021).

Table 3: Ideal types of circular construction in relation to regulatory frameworks (adapted from (Gluch & and Hellsvik, 2023; Thornton et al., 2012)

Characteristics	State logic	Market logic
Root metaphor	Set minimum standards of behavior	Transaction
Basis of Mission	Compliance with mandatory measures	Profitability and resource efficiency
Basis of attention	Meeting environmental and societal goals	Fulfilling client needs
Sources of authority	Regulatory frameworks	Managerial mandate/ contractual agreements
Basis of strategy	Increase society's good	Increase profit

The **root metaphor** of state logic aims to establish minimum standards on how companies should behave, whereas market logic centers on conducting business and generating profit. This study examines how these competing logics interact and influence circularity in the construction sector. The **basis of mission** of the state logic is to ensure that companies comply with regulatory requirements, while the market logic focuses on maximizing resource efficiency and profitability. The **basis of attention** for the state is on achieving environmental and societal goals, whereas the market is primarily concerned with meeting client demands. The **sources of authority** of the state lie in the regulatory frameworks, while for the market, it is mainly managerial or contractual agreements. Finally, the **state's strategy** is to increase society's good while the market wants to make a profit.

3.2. Circular Ecosystem Theory

The construction sector has increasingly been conceptualized as ecosystems, as they can be seen as a network of interconnected organizations, emphasizing relational dependencies and joint value creation (Hannah et al., 2016). The ecosystem is an analytical lens through which a network of actors engaged in a collaborative value chain can be examined (Thomas & Autio, 2014).

Ecosystems can be categorized into three: innovation, business and industrial ecosystems (Harala et al., 2023). According to Aarikka-Stenroos and Ritala (2017), an innovation ecosystem refers to "*a set of actors focusing on value creation out of new innovations*". Business ecosystems "*refers to an interdependent and co-evolving set of companies that actualize a circular value proposition, with the focus on creating economic value*". Industrial ecosystems refer to "*regional communities of hierarchically independent, yet interdependent, heterogeneous set(s) of actors who sustainably produce industrial goods and services in symbiotic collaboration and resource use*". These categories can be analyzed at several levels, either spatially (i.e., global, national, regional, and local) or non-spatial (i.e., focusing on a focal company and its complementors and suppliers (Adner, 2006, 2016; Thomas & Autio, 2020). My primary focus in this thesis is the industrial ecosystems.

Furthermore, ecosystems consist of three core dimensions, namely, a network of actors, a governance system, and a shared logic (Thomas & Autio, 2020). The network of actors refers to compatibility, mutual adaptation and expertise in work processes and activities. The governance system involves the governing structure, membership control, and task coordination, while the shared logic means acceptance, trust and shared understanding. According to Asgari and Asgari (2023), collaboration among actors is a prerequisite for the success of an ecosystem and is also dependent on actors' roles and responsibilities (Moggi & Dameri, 2021).

The Ecosystem Pie Model (Talmar et al., 2020) serves as a comprehensive tool for showing ecosystem relationships and dependencies. This model captures and considers the dependencies among actors necessary to achieve a shared goal. Previous research, such as Hellström and Wrålsen (2024) and Harala et al. (2023), has used this model to study CE in business ecosystems.

3.2.1. The Ecosystem Pie Model (EPM)

EPM was developed as a strategy tool to map, analyze, and design ecosystems. EPM captures how actors within an ecosystem interact and create value (Talmar et al., 2020). This model incorporates seven key elements: resources, activities, actors, value addition, value capture, dependence, and risk.

The construction industry is structured around timelines and milestones, and this structure has been adapted to guide the analytical model used in this thesis. However, value addition, value capture, and risk have not been incorporated here, as they fall outside the scope of this thesis. Instead, the model is tailored to the construction context by integrating the construction timeline alongside elements such as actors, activities, resources, and dependences. This adaptation is important because these elements in the construction industry vary across the construction phases (Klinger & Susong, 2006), with each phase involving distinct processes and actors. In this thesis, the construction timeline refers to the pre-C&D, during C&D, and post-C&D phases.

Within the model, actors are defined as legally independent but economically interdependent entities that perform distinct productive activities within the ecosystem (Talmar et al., 2020). Resources refer to the assets available to actors for carrying out activities aimed at achieving shared goals (Hellström & Wrålsen, 2024). Dependences capture the extent to which the success of the ecosystem relies on specific actors, which may vary depending on their roles and level of involvement (Hellström & Wrålsen, 2024; Talmar et al., 2020)

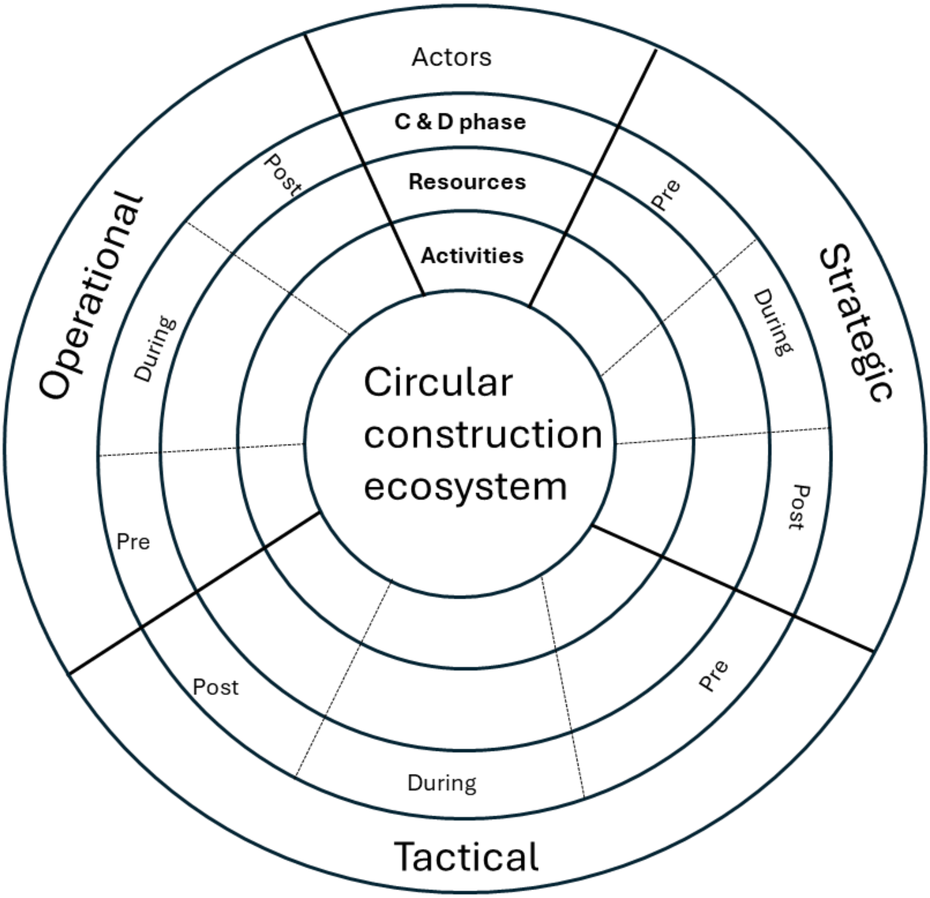

Figure 4: The ecosystem pie model (adapted from Talmar et al. (2020)

4. Research Methodology

This chapter presents the research design, process, data collection, and validity and reliability of this thesis. Table 4 provides an overview of the three papers that are included in this thesis.

Table 4: Overview of the three papers included in this thesis

	Paper 1	Paper 2	Paper3
Title	Circularity of aggregate materials in the construction sector- Drivers and Barriers	Navigating the dependencies in construction circular ecosystems: studying the Swedish C&D aggregate reuse planning	Assessing Legal frameworks and Planning processes for Construction Circularity among Swedish Local Authority
Empirical focus	Drivers and barriers	Relationships and dependencies	Legal frameworks and planning processes
Purpose	to explore how drivers and barriers impact the circular use of aggregate materials	to increase the understanding of how the organizational barriers of CE implementation are dependent on the structure between actors, and their dependencies between the micro-level operational activities, and the meso- and the macro-level planning practices in the C&D ecosystem.	To examine how regulations and urban planning processes influence circularity from the perspective of local municipality.
Main findings	Both the private and public actors are central in advancing circularity. More importantly, all the actors do not share a common knowledge of	The study argues the relevance of actors' dependences in promoting circularity. It theorizes dependences as dynamic rather than static, shifting	The findings indicate that limited circularity is not only a legislative

	what aggregate materials are, leading to uncertainty regarding the reuse of aggregate materials.	across construction phases and actors. However, a lack of understanding of these dependencies among actors creates bottlenecks to advancing circularity.	issue but also an organizational one. Circular governance is fragmented across multiple municipal departments. In addition, existing legal frameworks and planning processes continue to support the linear economy, with the most used planning process at the municipal level focused on the extraction of virgin materials and the management of waste. As a result, current legal and planning frameworks remain insufficient to drive circularity practices in the construction industry.

Contribution	Paper 1 contributes to this thesis by laying the foundation for understanding the drivers and barriers influencing circularity in the Swedish construction and demolition ecosystem. It categorized these factors and provided an empirical basis for understanding the challenges and opportunities associated with implementing circularity within a complex, independent organization, such as the construction industry. It also contributes to academic literature by advancing research on circular economy practices (especially in project-based sectors) through empirical findings on the factors limiting the advancement of circularity.	Paper 2 contributes to this thesis by showing how actor dependencies and relationships evolve over a project timeline within the C&D ecosystem. The study reveals that aggregate reuse is influenced by organizational dependencies between actors operating at strategic, tactical and operational levels. By analyzing these relationships and dependences across the construction phases, the paper highlights how early planning decisions can influence circularity. Beyond its contribution to this thesis, Paper 2 extends the ecosystem theory by applying it to the complex, project-based context of C&D. In addition, it provides a diagnostic tool to help identify actor dependencies before any project begins.	Paper 3 contributes to this thesis by examining how governance influences the advancement of circularity within the ecosystem, identifying a governance gap within the municipality, and highlighting how misalignment between planning frameworks hinders circularity. The paper contributes to the academic literature by offering a governance perspective on circular practices, demonstrating that legal frameworks alone are insufficient to drive circularity. In addition, the paper also contributes by highlighting

			the role of municipalities as key coordinators within the construction and demolition ecosystem.

4.1. Research Design

The purpose of this thesis is to examine how organizational dependencies, legal frameworks and planning processes influence construction and demolition (C&D) waste circularity in the construction and demolition ecosystem.

This thesis examines dependencies and relationships within the construction and demolition (C&D) ecosystem. In order to study this, an in-depth case study is adopted, as it is well suited for exploring complex interactions between actors (Flyvbjerg, 2006). From an ecosystem perspective, success in circular economy implementation depends on the interaction and coordination of multiple interdependent actors operating within a shared organizational environment (Asgari & Asgari, 2021; Moggi & Dameri, 2021). The effectiveness of these ecosystem depends on how actors coordinate and collaborate their activities and resource flows (Adner, 2016). In the construction and demolition ecosystem, these actors include both the private and public organizations whose activities are interconnected.

Therefore, I frame this thesis as a case study of the Swedish circular construction and demolition ecosystem. Case studies are widely recognized for their ability to capture interaction processes, especially where phenomena are embedded in networks of interdependent actors (Dubois & Araujo, 2007; Easton, 2010). Furthermore, case studies are well-suited for studying complex organizational contexts, allowing researchers the ability to explore a phenomenon in a real-world context (Eisenhardt & Graebner, 2007), thereby creating the possibility to examine how relationships develop and how tensions are managed. In the context of this thesis, this case study design enables the capturing of the relationships and dependencies between actors and their work processes. It also allows the capture of public actors' planning processes and enables exploration of how legislative implementation interacts with industry practice.

To examine this ecosystem more closely, I focus on Swedish aggregate reuse. Aggregates are seen as the largest material fraction of (C&D) waste and are therefore recognized as a primary focus for advancing circular material reuse in the construction industry (Gálvez-Martos et al., 2018; Pacheco-Torgal, 2020; Tuladhar et al., 2020). Despite this recognition, existing studies argue that it has received limited attention in circularity efforts (Tuladhar et al., 2020), especially compared with other (C&D) waste (e.g., wood, glass, steel). This is noteworthy given that aggregates represent the most voluminous and most logistically challenging material flows to manage. As such, aggregate reuse provides a particularly relevant empirical lens for examining misalignment between processes among actors in the construction and demolition ecosystem (Fredriksson et al., 2026; Perkins et al., 2021).

Furthermore, Sweden is a relevant empirical setting to study the effectiveness of circular construction ecosystem compared with many other EU member states. Sweden is recognized for having relatively advanced legislation regarding circularity, although only 10% of reuse occurs in practice (Deloitte, 2017; Giorgi et al., 2022; UEPG, 2025). While circular economy transitions are influenced by multiple factors, regulatory frameworks play one of the central roles that influence how actors coordinate their activities and manage resource flows within the construction ecosystem. Also, during data collection for this thesis, common barriers participants often mention are linked to interpretations of legislation and permit processes. Moreover, since Sweden is recognized for well-established legislation within the construction ecosystem supporting circularity, yet low adoption persists in practice, studying Sweden construction and demolition ecosystem enables examining how legislation, planning processes, and actor dependencies interact, thereby influencing the advancement of circularity.

While the individual papers in this thesis are not designed as stand-alone case studies, they share a focus on Sweden, aggregates, and circularity. Each paper addresses a different dimension of the case: Paper 1 examines drivers and barriers influencing circularity in the construction ecosystem; Paper 2 focuses on organizational barriers and dependencies among actors; and Paper 3 (a working paper) examines legislation and planning processes influencing aggregate reuse in Sweden. Together, these studies provide empirical insights into how circular construction practices are operationalized within the Swedish construction and demolition ecosystem, thereby providing a deep understanding of the case.

4.2. Research process

The research process for this thesis was iterative. I moved back and forth between theory and empirical data, a practice similar to systematic combining (Dubois & Gadde, 2002b). Figure 5 presents a timeline of key milestones from the start of the PhD in August 2023 through to the licentiate seminar in May 2026.

I started my PhD with coursework while also working on data analysis for Paper 1. This paper was based on a research project where my supervisors had already collected the data. They gave me access to the dataset containing workshop and interview materials. Together, we analyzed the data, developed a conference paper (Paper 1), and submitted it to NOFOMA 2024 in Stockholm. The conference paper was subsequently developed into a journal manuscript, which was submitted to *Cities* Journal in February 2026.

With my background in Strategic Urban Planning, this initial study provided me with a comprehensive overview of the research field and enabled me to understand the circular transition of the construction industry. This experience also demonstrates the benefits of doing a case study for this thesis. According to Flyvbjerg (2006), case studies allow researchers to gain context-dependent knowledge (practical), which is central to developing competence in a specific field. In contrast, context-independent knowledge (pure theoretical) tends to keep researchers at a beginner level. The case study of the Swedish circular construction and demolition ecosystem enabled me to develop both practical and theoretical knowledge in this field.

Concurrently with Paper 1, data collection for Paper 2 started. This involved conducting interviews, visiting demolition sites, and participating in workshops together with my supervisor. The empirical material generated from this work served as the basis for a working paper, which was also presented at the NOFOMA 2024 conference. This study enabled a deeper understanding of private actors' operational activities within the ecosystem and provided detailed insight into how aggregates are managed at the operational level. The paper was later further developed and submitted to the *Journal of Cleaner and Circular Bioeconomy* in February 2026.

Paper 3 was developed subsequently and focused on legal and planning frameworks related to construction and demolition waste. This involves an extensive review of policy documents regarding waste management in the EU and, more specifically, in Sweden. An earlier version of this paper was presented at the Swedish National Transport Conference 2025 in Norrköping. In November 2025, a nationwide survey was distributed to all municipalities in Sweden to obtain a comprehensive overview of how the Swedish municipalities are working with Construction and demolition waste.

Throughout the PhD process, all three studies were continuously refined through internal seminars, doctoral workshops, and academic conferences, including the Triple F conferences, the VTI and Linköping University PhD conferences, and reference group workshops. These platforms provided critical feedback that sharpened the analytical focus and strengthened the theoretical contributions of each paper. As Flyvbjerg (2006) notes, concrete knowledge can be achieved through continued engagement with the studied reality and via continuous feedback from those studies. By the licentiate stage, I have completed more than 70 of the 90 ECTS credits required for the final PhD defense.

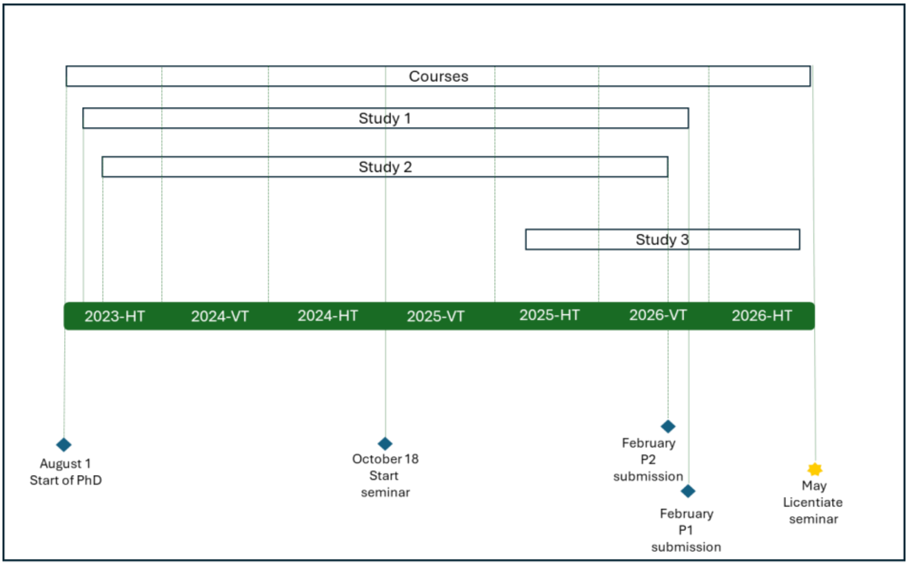

Figure 5: Research timeline and milestones

The three papers respond to the research questions in this thesis. RQ 1: How do actors' dependences within the construction/demolition ecosystem influence the advancement of circularity? RQ 2: How do planning processes and legal framework affect the advancement of construction material circularity? Figure (6) shows the connection between the thesis purpose, research questions and papers.

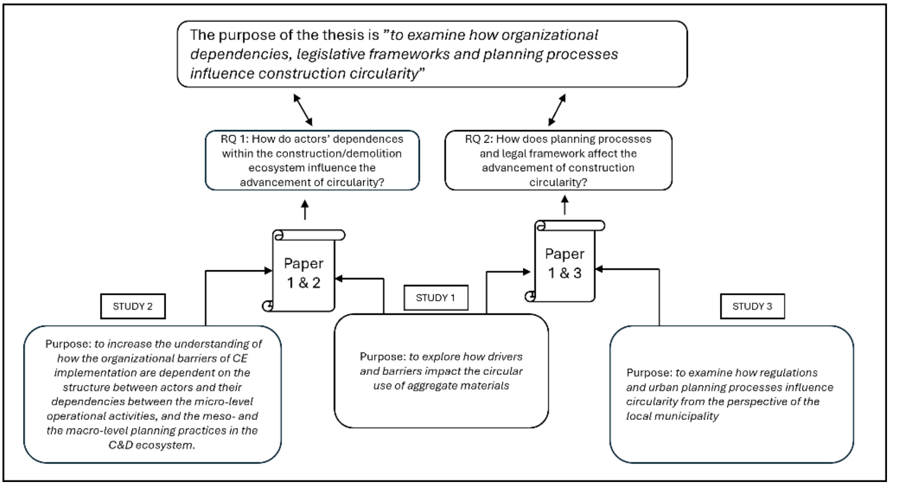

Figure 6: Study connection with papers

4.3. Research Data collection

This sub-section describes the data gathering methods for each paper.

Paper 1: Circularity of Aggregate Materials in the Construction Sector – Drivers & Barriers

The purpose of the paper is to explore how drivers and barriers impact the circular use of aggregate materials.

Existing studies have examined drivers and barriers to material reuse for circularity in the construction industry, but this study examined it in the Swedish context. Paper 1 provided an overview of the challenges and opportunities for advancing circularity in Sweden and, therefore, lays a foundational background for the other two studies (Papers 2 and 3). The unit of observation in Paper 1 is the private and public actors.

Paper 1 involves the collection of qualitative empirical data through 3 workshops and 4 interviews. These workshops include representatives from the county administrative board (CAB), the industry, the Swedish Transport Administration, and academia, all based in Sweden. Two workshops were held in person, and the third was held online. Furthermore, the interviews were conducted with the Swedish Transport Administration and were performed online. Table 5 presents the workshops and interviews with the respondents and focus.

Notes were taken during the workshops and annotated, interviews were transcribed and summarized (tasks that had been completed by my supervisors before I started my PhD journey). Thereafter, the data were then analyzed using thematic analysis, which identifies and analyses patterns or themes within the data (Flick, 2022).

For the analysis, we identified some initial themes of drivers and barriers based on the clustering statements of workshops 1 and 2. These initial themes (material quality, information sharing, finance, planning horizon, regulation, logistics, and environmental) were then compared with existing studies on drivers and barriers to the circular economy in the construction industry. This process ensured that the themes were expressed in terms consistent with the field; for instance, "finance" was changed to "economy". After this, the statement from workshop 3 was then added to the identified themes. The interviews were used to triangulate *and validate the findings across the three workshops*.

Table 5: Respondents and focus of data collection

Activity	**Respondents**	**Focus**
Workshop 1	County Administrative Board: • One regional architect • One sanitation expert • Two environmental protecti on experts • One nature conservation expert • One climate, energy and environmental strategist wit h focus on aggregates	Challenges and working practices in excavated materials issues connected to the supervisory authority assignment of the CAB. The workshop was focused around two prepared tasks; one mapping of organizations that are affected by or are affecting the CABs work on circular excavated aggregate materials, the other on how the CAB work with excavated aggregate material issues on strategic, tactical and operational planning levels.

Workshop 2	Municipality 1: • One project manager for municipal development projects • Two environmental adminis trators • One planning architect, • One long-term general planner • One group manager for the exploitatio n office	Challenges and working practices in excavated materials issues connected to the supervisory authority assignment of the municipality as well as their role as municipal infrastructure and housing developer. The workshop was focused around two prepared tasks; one mapping of organizations that are affected by or are affecting the CABs work on circular excavated aggregate materials, the other on how the CAB work with excavated aggregate material issues on strategic, tactical and operational planning levels.
Workshop 3	• Two mass coordinators from municipality 1 • One mass coordinator from municipality 2 • Three representatives from the CAB, environmental strategists(?) • Mass coordinator from the STA large projects department • CEO of the Swedish Rock Material Industry (SBMI) • Task manager from one of the largest main contractors in Sweden (MC) • Senior consultant • Logistics professor	Drivers and barriers for increased circularity of excavated aggregate materials. The workshop was focused on letting the respondents firstly identify driver s and barriers for increased circularity of excavated aggregate materials from their respective perspectives. The suggested drivers and barriers were then discussed in the larger group.
Interview 1	• Mass coordinator, STA large proj ects	Focus on the mass coordinators' work tasks in planning for the excavated materials handling in one of the

		largest infrastructure projects in Sweden.
Interview 2	• Strategist, STA	Focus on the STAs strategic work to reduce excavation and increase circularity and how the strategic level can support the more operational parts of STA.
Interview 3	• Project engineer, STA	Focus on how the excavated materials handling has worked in a large infrastructure project in southern Sweden.
Interview 4	• Project manager, STA large projects	Focus on how mass logistics and excavated materials handling is planned for in one of the largest infrastructure projects in Sweden and how the STA can work with the local municipalities in increasing circularity.

Paper 2: Navigating the dependencies in construction circular ecosystems: studying the Swedish C&D aggregate reuse planning

The purpose of the paper is to increase the understanding of how the organizational barriers of CE implementation are dependent on the structure between actors, and their dependencies between the micro-level operational activities, and the meso- and the macro-level planning practices in the C&D ecosystem.

Paper 2 examined private actors' work processes, as well as the relationships and dependences between private and public actors within the construction and demolition ecosystem. The aim is to identify the construction process phases where circularity is hindered and to highlight opportunities to enhance circular practices.

The paper involves the collection of qualitative empirical data through 4 semi-structured interviews, 2 workshop rounds, and on-site observations at two demolition sites. Table 6 presents an overview of the workshop and interviews, including participants' roles and the focus of each engagement.

The semi-structured interviews were conducted online, following an interview protocol that focused on four themes: circularity, work structure, background information, and lateness of action. To ensure reliability, transcripts were emailed to participants for verification. In addition, the two in situ workshops were organized to bring together key private actors identified in the ecosystem, including contractors, transporters, waste management operators, and system suppliers. These workshops served both as a data-collection platform and as a collaborative space for reflecting jointly on actor roles, relationships, and dependencies.

According to Atkinson and Coffey (2003), observations connect the researcher to the most basic of human experiences and provide direct insights into practices that may be overlooked or omitted during interviews and workshops. Conducting observation at these demolition sites gave me practical insights into how (C&D) waste is generated and handled. I also had the opportunity to interact with site workers. During the site visits, I took photographs and notes, which were useful for data analysis and for reflections during paper writing.

The empirical data were then analyzed using a qualitative abductive approach (Flick, 2022). Abductive analysis involves an iterative movement between empirical data and existing theory in order to generate new theoretical insights (Dubois & Gadde, 2002b). Rather than applying a strictly predefined coding scheme, the analysis aimed to develop a collaborative visual mapping process (Trochim & McLinden, 2017). Collaborative mapping is a structured, participatory approach that integrates input from multiple stakeholders to produce a visual representation of key concepts and their interrelationships.

During the second workshop, participants collaboratively mapped how actors interact within the construction and demolition ecosystem by developing an initial draft of an actor relationship diagram. This preliminary mapping was subsequently refined and incorporated into the EPM (Ecosystem Pie Model). The analysis focused on synthesizing participant insights and observations into a coherent narrative structure, which was then organized within the EPM framework.

Adopting a partially deductive approach, the EPM was then used to visualize the construction and demolition ecosystem. Concurrently, notes from the first and second workshops were summarized, and a content analysis was conducted to further interpret actors' roles and dependencies within the circular construction and demolition ecosystem. Insights from interviews and on-site observations were used to triangulate and strengthen the interpretation of actors' roles and dependencies in advancing circular practices.

Table 6: Overview of the workshop and interviews

Data source and actors	Job roles	Background	Focus
Interview construction consultant	Task Manager, Project Manager	Works mainly with traffic management during construction, and works mainly with road construction	Work processes and practice. Circularity problems, possibilities, and implications Issues with lateness of action, e.g., practical implications, affected activities etc.
Interview demolition contractor	Manager	They take care of soil, analyse it and try to make use of the material. They use the less polluted and landfill the high polluted ones	Work processes and practice. Circularity problems, possibilities, and implications Issues with lateness of action, e.g., practical implications, affected activities etc.
Interview digital consultant	Managing Director	They provide digital services for the construction industry, with focus on	Work processes and practice.

		infrastructure and building projects	Circularity problems, possibilities, and implications Issues with lateness of action, e.g., practical implications, affected activities etc.
Interview Municipal developer	Project Manager	Works with project containing road plans and have been doing this for six years. Previously been an environmental consultant for10 years	Work processes and practice. Circularity problems, possibilities, and implications
Workshop 1	Main contractor, transporter, waste management handler, system supplier traceability		Presentation from each actor on how they work and discussions focusing on aggregates handling and circularity issues. This continued for 3hrs insitu.
Workshop 2	Property owner, Demolition contractor, Main contractor, Transporter, Recycler, Concrete producer, Construction adhesives producer		Discussions on circular flows, reuse, recycling and remanufacturing. Discussions on the relationship between them as actors and visualizing this relationship with the help of the participants on a board through flow charts. This continued for 3hrs and 30 minutes on site.
Observations Demolition contractor	A demolition site in mid-Sweden	A family company established for 80 years. Support all types of activities related to demolition and groundworks including	Observations of the operational working processes on two different sites four hours at two separate days for the first demolition site, and five hours for the

		excavation, transport, storage, and recycling	second demolition site on two occasions.

Paper 3: Assessing Legal frameworks and Planning processes for Construction Circularity among Swedish Local Authority

The purpose of paper 3 is to examine how regulations implementation within urban planning processes influence circularity from the perspective of the local municipality.

This paper was motivated by the frequent reference to regulations by actors in the construction ecosystem, as well as by findings from existing studies on construction circularity. Insights from papers 1 & 2 highlighted the need to further investigate the legal frameworks and planning processes that shape (C&D) waste in Sweden.

To do this, a document analysis was conducted to capture the Swedish legal frameworks and Planning processes governing (C&D) waste. According to Bowen (2009), document analysis is a systematic procedure for reviewing and evaluating documents. Document analysis involves several stages, including skimming (a preliminary examination), thorough reading, and interpretation of the documents, often supported by either a content or thematic analysis. In this paper, a content analysis was applied, focusing on identifying and extracting information related to (C&D) waste. Thereafter, a nationwide survey was sent to capture how legislation and planning processes are implemented and interpreted at local municipalities, as well as how planning processes are organized in practice.

The questionnaire consisted of 28 questions, both closed and open-ended. It was accompanied by an email cover letter explaining the purpose and focus of the survey. The survey questions (in the appendix) were categorized into five thematic sections: background information; legal frameworks and local processes; collaboration and priorities; circularity drivers and barriers; and other information.

Prior to distribution, we conducted a pilot testing within the project reference group to ensure relevance and content validity. Thereafter, revisions were made based on the feedback received. The questionnaire was administered using Microsoft Forms, making the tracking of respondents, collecting and summarizing of the results easy to manage. The survey was conducted in Swedish, and the results presented in this paper are therefore translated.

Finally, of the 290 municipalities contacted, 64 completed the survey, yielding a response rate of 23 percent. Two (2) municipalities reported that no suitable respondents were available, while four (4) declined to participate in the survey. Table 7 shows an overview of the survey respondents.

Descriptive statistics and content analysis were used for the study. The survey responses were exported from Microsoft Forms to Microsoft Excel for further processing. The data was then screened and organized. Using pivot tables, single-option questions were analyzed using frequency counts and percentages to examine the dominant legislation and municipal processes. This step was also repeated for multiple-choice questions, and because participants could select more than one option, the percentages were calculated by dividing the number of municipalities selecting each option by the total number of respondents. The results were interpreted as the share of municipalities using a particular legislation or municipal processes.

Table 7: Overview of the survey respondent

Respondents' role	**No**
Engineers (Environment, project, waste, building)	7
Environmental (strategy, specialist, inspector, health protection inspector, coordinator)	10
Managers (Cleaning manager, property manager, head of unit, waste managers, technical manager)	20
Project leader	17
Sustainability specialist	3

Mass handlers	4
Others (social strategy, construction permit handler, property strategy)	3
Total	64

4.4. Research validity and reliability

The validity and reliability of case study research can be assessed using the criteria of credibility, transferability, dependability and confirmability (Bryman & Bell, 2011; Lincoln & Guba, 1986). Accordingly, this thesis addresses these four criteria as the basis for assessing the quality of the study.

Credibility

Credibility refers to the compatibility between a study finding and the reality that was observed. It includes data accuracy, respondents' perspectives, and how the data is interpreted (Polit & Beck, 2008). Credibility can be strengthened through respondent validation and triangulation (Bryman, 2016). This element has therefore been observed in this thesis through multiple sources of evidence, establishing a clear chain of evidence, and allowing key informants to review the research outputs. Respondent validation was conducted by sharing interview transcripts with the interviewees and allowing them to verify the accuracy of the data and provide clarifications where necessary. For instance, in Paper 2, when interview transcripts was sent, one of the interviewees did a minor revision by clarifying an aspect related to a pilot project on circular material reuse. In addition, the study's findings were presented in workshops, conferences, and to the reference group involved in this study.

In this thesis, data were collected from several sources, including interviews, surveys, workshops, and observations. The use of different sources enabled data triangulation, allowing findings to be corroborated across the empirical data. Such triangulation strengthens confidence in the trustworthiness of this study (Lincoln, 1985). For instance, the workshops provided an initial understanding of the drivers and barriers to circularity in the construction industry, which subsequently served as the foundation for this thesis. The interviews conducted during the data collection for Papers 1 and 2 validated the findings from the workshops in both Papers (1&2).

Furthermore, observations from the demolition sites provided concrete insights that complemented participants' perspectives from the workshops and interviews. For example, during the observations, it became evident that storage space represents a significant operational challenge when aggregates are intended for reuse, as there are limited spaces on the demolition sites to store, crush or clean the waste, and also the frequent move of trucks to and from the construction sites was evident. Conversations with site workers during these visits highlighted legislative requirements as a key constraint, also validating the themes already identified during the workshops and interviews.

Transferability

This involves the extent to which the findings of a study can be applied in other contexts, or to the same context at different times. To enhance transferability, researchers are encouraged to provide a detailed and rich account of the phenomenon studied, enabling readers to assess the applicability of the findings in their own context (Bryman, 2016). This thesis examines the Swedish circular construction and demolition ecosystem as a single case to generate insights into how organizational dependencies and planning frameworks influence the advancement of circularity. Although the findings are grounded in the Swedish context, they contribute to broader theoretical discussions regarding construction ecosystem coordination and governance. As argued by Flyvbjerg (2006), one can generalize from a single case, and the case study may be central to scientific development through generalization as a supplement or alternative to other methods. Accordingly, the insights generated in this study can therefore be transferred to other contexts where circular economy practices depend on coordination among multiple actors operating within complex systems, particularly in construction industries with a similar structure and processes to those of the Swedish construction industry. In addition, transferability is further enhanced through linking empirical findings to existing literature and theory (Eisenhardt & Graebner, 2007). For instance, thematic analysis in Paper 1 is linked to prior studies on drivers and barriers to the circular economy in the construction industry, while Paper 2 applies ecosystem theory to a project-based industry context. For Paper 3, transferability is supported by Flyvbjerg (2006) argument that, aside from generalization, case studies can contribute to scientific innovation even when they focus on a specific context. In this thesis, paper 3 examines Swedish planning frameworks; although the findings are based only on Sweden, they can be relevant to other countries with similar systems. They can also serve as a basis for comparative analysis with contexts different from the Swedish system, thereby extending their analytical relevance beyond the case itself.

Dependability

Dependability refers to the extent to which a study would yield consistent results if the same methods were applied in a similar context (Polit & Beck, 2008). According to Guba and Lincoln (1994), researchers should ensure that all study records are documented throughout the research process. In this thesis, dependability is supported through documentation of data and procedures, including the compilation of a database containing survey responses, interview transcripts, observation notes and photographs, as well as workshop notes and diagrams. Furthermore, the dependability of the thesis has been enhanced by continuous feedback and constructive criticism at conferences and PhD courses throughout the progress of this thesis. The study's dependability was also enhanced by presenting to the project reference groups at different times.

Confirmability

Confirmability means that research findings are based on the data rather than on the researchers' personal values, biases, or theories (Guba & Lincoln, 1994). In Paper 1, all authors worked together on data analysis to enhance confirmability and keep interpretations closely tied to the data. In Paper 2, workshop participants worked together to map how different actors interact in the construction and demolition ecosystem. Supervisors then reviewed and refined these interpretations. This step-by-step approach helps make the analysis more neutral and reliable. All findings and analyses are carefully documented so that the study's conclusions are clear and can be traced back to the data (Flyvbjerg, 2002).

5. Summary of the appended papers

This chapter presents the summary of the three papers contributing to this thesis. First the purpose of the papers will be stated, followed by the paper findings, and then how the paper contributes to this thesis and academic literature.

Paper 1 focuses on drivers and barriers of construction circularity, paper 2 focuses on actors' work processes, relationship and dependencies, while paper 3 focuses on legal frameworks and planning processes.

Paper 1: Circularity of aggregate materials in the construction sector-Drivers and Barriers

Purpose: to explore how drivers and barriers impact the circular use of aggregate materials.

RQ1: What are the drivers and barriers of circularity of aggregate materials

RQ2: How are the drivers and barriers related?

To explain the impact of drivers and barriers on circularity, the study introduced mass logistics and the circularity of aggregate materials to provide background knowledge of the field of study, and thereafter introduced the organizational failure framework to understand the impact of drivers and barriers.

The findings indicated eight thematic categories of drivers and barriers impacting increased circularity, namely, regulation, organization, logistics, material quality, information sharing, economy, planning horizon, and environment and climate. These themes were both identified as drivers and barriers.

The study found that the interpretation of legislation is key, as it may be interpreted in favor of or against circularity. There are different pieces of legislation promoting different environmental goals, creating loopholes and barriers to advancing circularity. This often creates uncertainty for actors while trying to reuse aggregates, where private actors, rather than create new and innovative solutions of reusing aggregates, instead they send them to landfill, as it is seen as the fastest and most convenient option.

Logistics, particularly the reduction of transport work to and from construction sites, was identified as both a driver and a barrier. When aggregates can be managed close to the construction site, for example, through the service of an MLC (Mass Logistics Centre) that serves either a specific project or a wider region, transportation distances can be reduced. However, the establishment of such a facility is often constrained by limited available space in the urban area. This limitation is partly due to land-use priorities that favor construction activities over aggregate management, as well as low acceptance among local residents of the establishment of these facilities.

Furthermore, material quality was an important result because the participants for the study are the ones who have a mandate to promote circularity from their respective perspectives, but none could present material quality as a driver, but instead a chain of interconnected barriers linked to lack of trust, lack of standardized quality assurance and lack of demand for circular aggregates. To drive circularity, standard quality assurance must be developed to enhance the supply and demand of circular aggregates.

Paper 1 concluded that both the private and public actors are central in advancing circularity. More importantly, none of the actors shares a common understanding of what aggregate materials are, leading to uncertainty about their reuse.

Paper 1 contributes to RQ 1 and 2 by laying the foundation for understanding the drivers and barriers influencing circularity in the Swedish construction and demolition ecosystem. It categorized these factors and provided an empirical basis for understanding the challenges and opportunities associated with implementing circularity within a complex, independent organization, such as the construction industry. It also contributes to academic literature by advancing research on circular economy practices (especially in project-based industry) through empirical findings on the factors limiting the advancement of circularity.

Paper 2: Navigating the dependencies in construction circular ecosystems: studying the Swedish C&D aggregate reuse planning.

Purpose: to increase the understanding of how the organizational barriers of CE implementation are dependent on the structure between actors, and their dependencies between the micro-level operational activities, and the meso- and the macro-level planning practices in the C&D ecosystem.

RQ1: Who are the key actors involved in the organization of C&D activities on different levels, and what roles do they play?

RQ 2: How do the dependencies between these actors affect circularity?

Paper 2 introduced circular construction economy and ecosystem theory as a theoretical background. It applied the ecosystem theory to capture actors on strategic, tactical and operational levels and analyzes the dependencies necessary to manage to achieve circularity.

Figure (7) presents the operational timeline of activities within the construction and demolition ecosystem, showing actors relationships.

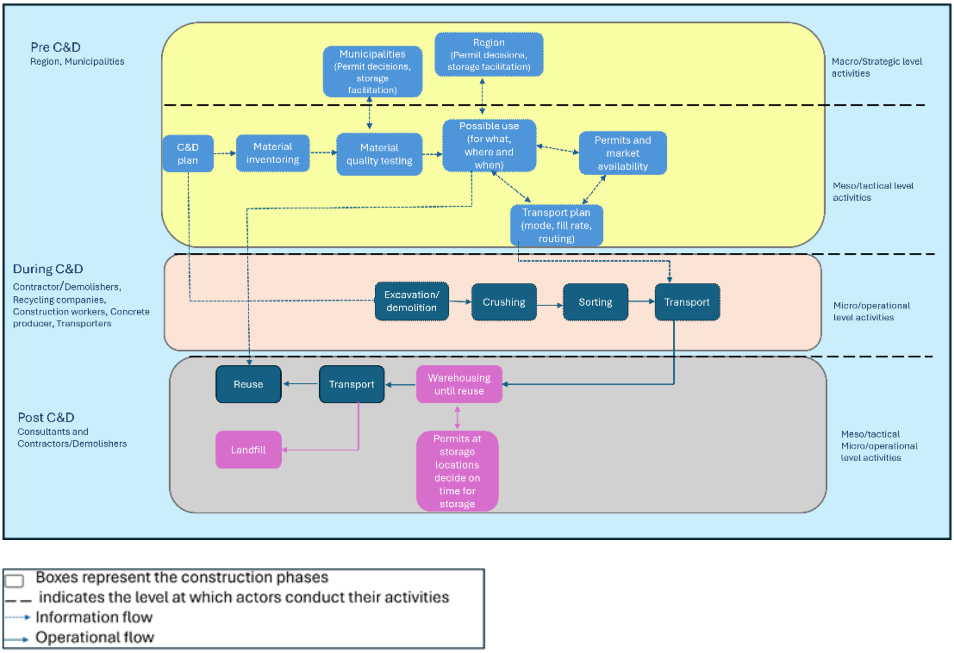

Figure 7: Overview of operational timeline of activities.

This timeline is divided into three phases: pre-construction/demolition (pre C&D), during (C&D), and post (C&D). Each involves different actors operating based on their professional roles and responsibilities.

The pre C&D phase involves strategic actors, tactical actors and contractors. Although these key actors are present at this early/planning phase, coordination challenges emerge particularly at the strategic level. Strategic actors operate in different roles, such as planning authorities, supervisory bodies, and developers. These various departments are not aligned or coordinated today, leading to fragmented decision-making during the planning phase. In practice, the planning authorities are the primary actor involved with project planning (they issue the building and demolition permit), while the environmental department may not be included at this stage. Earlier involvement of these actors could facilitate decisions regarding aggregate reuse and enable circular practices to be incorporated into project planning from the early phase. The C&D phase involves operational activities, including transportation, excavation or demolition, and the crushing and sorting of materials. The final phase, post C&D, concerns the subsequent handling of aggregates, which involves transporting materials to a temporary storage facility or landfills when an appropriate permit cannot be obtained.

The analysis further describes that there are time and sequential dependencies in the operational flow within the C&D ecosystem. Construction projects are centered on strict timelines, milestones, and budget constraints, which make coordination essential within the ecosystem. Increased circularity depends on decisions made earlier in the process (Pre-C&D), highlighting the need for more integrated planning and collaboration across the ecosystem.

A crucial element that empowers this operational flow is the site plan, which organizes how activities and aggregate handling occur during the project. The availability of storage space to manage different material fractions is particularly important for enabling circular practices. However, there is usually a space constraint on the construction site because different actors compete for the limited space. In addition, activities that can be carried out on the site depend heavily on the permits secured during the early phase (pre C&D).

One of the central issues identified in this study concerns permit processes. When subsequent aggregate use is unknown after a project finishes, the material is classified as waste. This classification requires an additional permit from the municipality's environmental department before the materials can be stored, which can be time-consuming and may affect project milestones and costs. Furthermore, efficient transport planning requires consideration of multiple factors, including transport modes, distances to storage locations and overall project time management.

Paper 2 concludes that actor dependencies within the C&D ecosystem are not static but shift over the course of a project. Limited understanding of these dependencies between levels and actors (which is fluid) creates bottlenecks for advancing construction circularity. In particular, the misalignment of roles and permit processes on the strategic level has resulted in different requirements across municipalities/county administrative boards, generating uncertainty for the private actors. The findings also emphasize the importance of the pre C&D phase. Decisions made during this stage can influence circular practices in the subsequent phases. Therefore, addressing barriers at the strategic level increases the likelihood that operational actors can reuse aggregates. Finally, the post C&D phase can play a key role in establishing an effective ecosystem, as materials generated from one construction process may become valuable resources for other projects.

Paper 2 contributes to this thesis by showing how actor dependencies and relationships evolve over a project timeline within the C&D ecosystem. The study reveals that aggregate reuse is influenced by organizational dependencies between actors operating at strategic, tactical and operational levels. By analyzing these relationships and dependences across the construction phases, the paper highlights how early planning decisions can influence circularity. Beyond its contribution to this thesis, Paper 2 extends the ecosystem theory by applying it to the complex, project-based context of C&D. In addition, it provides a diagnostic tool to help identify actor dependencies before any project begins.

Paper 3: Assessing Legal frameworks and Planning processes for Construction Circularity among Swedish Local Authority

Paper 3 examines how Swedish municipalities use legal frameworks and planning processes to govern (C&D) waste in order to increase circularity.

Purpose: to examine how regulations implementation within urban planning processes influence circularity from the perspective of the local municipality.

Obj 1: to describe the Swedish C&D legal and planning framework.

Obj 2: to elaborate upon the present state of the Swedish C&D legal and planning framework implementation among the local municipalities.

Paper 3 findings indicate that the Environmental Code is currently the most widely used legal framework, with 75.41% of municipalities reporting that they rely on it to address C&D waste. Other legal frameworks, such as the Planning and Building Act, the Environmental Assessment Ordinance, and the National Climate Targets, are relevant but appear to coexist with the Environmental Code and are applied according to the responsibilities of the actors; the EU directive (32.79%) is the least considered at the municipal level. However, results reveal a shift in how municipalities perceive the future relevance of these legal frameworks for advancing circularity. The EU directive (54.10%), primarily the “EU waste framework directive,” is seen as the main future driver of circularity. The Environmental Assessment Ordinance (52.46%) and Planning and Building Act (50.82%) come close. Meanwhile, the Environmental Code (24.59%), currently the most widely used legal framework, is considered the least likely to drive circularity in the future.

The study also examined the planning processes municipalities use to manage C&D activities. The findings show that the quarry activities permit (40.98%) is the dominant planning process at the municipalities. This is followed by the mass management plan (37.70%), the detailed development plan (34.43%), and the building and demolition permit (31.15%), while comprehensive planning (26.23%) appears to be the least used. Similar to the pattern observed with the legal frameworks, a shift was also observed in the planning processes. The quarry activities permit (49.18%), despite its current dominance, is considered the least relevant for driving future circularity. Mass management plans (60.66%) and building and demolition permits (60.66%) hold the highest future potential to drive circularity.

In addition to legal and planning processes, Paper 3 also found a governance gap in the municipal arrangement within the construction and demolition ecosystem. Only 11.48% of municipalities have a dedicated role for construction and demolition waste management, while the majority (88.52%) indicated that no such role exists. This suggests limited organizational capacity within the municipality to coordinate circularity within the C&D ecosystem.

Overall, Paper 3 concludes that circular practices in Swedish municipalities are currently embedded in environmental protection, rather than necessarily aimed at achieving circularity objectives. The strong reliance on the Environmental Code and quarry activities permits suggests that existing governance systems largely reflect the linear economy (take-make-dispose), rather than supporting the circular economy principles. The findings, therefore, indicate that advancing circularity in the construction ecosystem requires more than the existence of planning frameworks. Instead, it depends on the effective implementation and alignment of planning frameworks within all municipalities in the ecosystem.

Paper 3 contributes to this thesis by examining how governance influences the advancement of circularity within the ecosystem, identifying a governance gap within the municipality, and highlighting how misalignment between planning frameworks hinders circularity. The paper contributes to the academic literature by offering a governance perspective on circular practices, demonstrating that legal frameworks alone are insufficient to drive circularity. In addition, the paper also contributes to academic literature by highlighting the role of municipalities as key coordinators within the construction and demolition ecosystem.

6. Discussion

This chapter provides the answers to the research questions with the help of findings from the papers appended to the thesis. Finally, this section gives an overall concluding discussion based on RQs 1 & 2.

6.1. Research Question 1

How do actors' dependences within the construction/demolition ecosystem influence the advancement of circularity?

The findings from this research show that the advancement of circular practices within the construction and demolition ecosystem is influenced by the dependencies and relationships between actors operating across different levels in the ecosystem. The findings from Papers 1 and 2 show that circularity in the construction ecosystem is determined by the coordination of all actors and how they collaborate within the ecosystem (Fredriksson et al., 2026). Figure 8 presents an overview of the relationships and dependencies of actors using the Ecosystem Pie Model (Talmar et al., 2020).

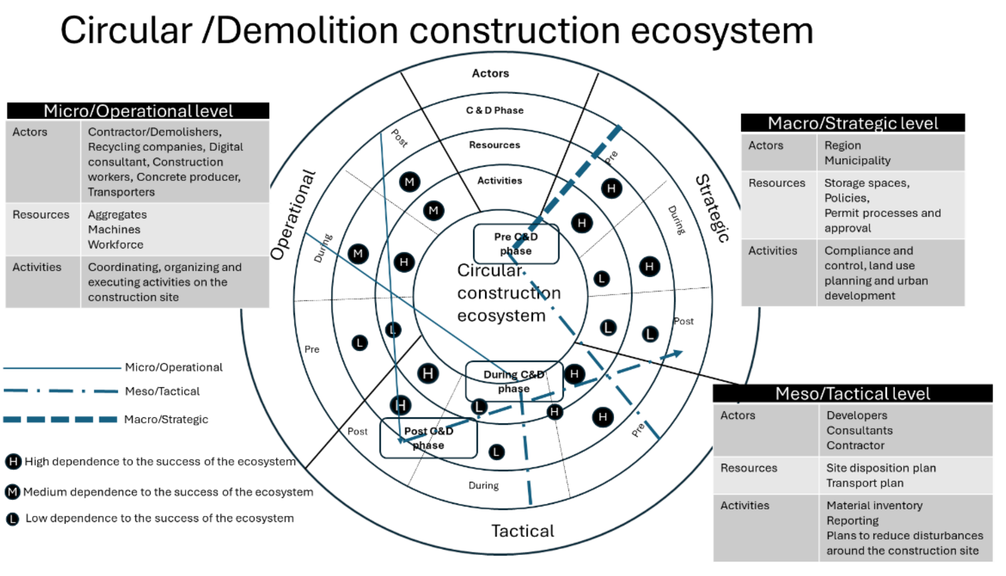

Figure 8: Overview of actor's relationship and dependences

All the papers included in this thesis identified several operational and legislative barriers, such as storage limits, unclear material quality, and limited information sharing. Strategic actors like municipalities often need reliable data on material quality and quantity before approving reuse, but private actors usually do not have this information early in the project. These uncertainties make decision-making difficult and slow down the adoption of circular practices. Furthermore, sorting aggregate on site can be challenging for operational actors because it might require extra time, which may disrupt regular construction activities. For instance, waste collection equipment and transportation related to sorting might disrupt other ongoing site operations. In addition, sorting may also require additional labor, as more employees might be needed to carry out waste separation, leading to higher labor costs for the contractors. These challenges may discourage contractors from engaging in the reuse of aggregates.

Papers 1 and 2 showed that aggregate reuse relies on all actors in the ecosystem, such as municipalities, developers, contractors, and transporters, working together. However, these actors often do not align their work processes. Instead of collaborating, they usually act independently based on their own roles and responsibilities. For example, operational actors follow their usual routines and rarely work together on site. As Asgari and Asgari (2021) note, collaboration is necessary for a successful ecosystem. However, this is limited in the C&D ecosystem.

Furthermore, the misalignment of roles and permit processes at the strategic level creates further challenges for circular practices. The strategic actors work on different mandates that are not coordinated. As a result, private actors may face uncertainty about legal requirements and permit processes. According to Moggi and Dameri (2021), clearly defined roles and responsibilities of actors are essential for the effective functioning of an ecosystem. When such clarity is lacking, it creates bottlenecks in the ecosystem, especially when actors lack a shared understanding of how their actions influence circularity. Therefore, having circularity becoming a norm in the municipal planning process and allowing for better planning prerequisites for the contractors means that increased circularity can be achieved.

The operational actors are rarely coordinated during construction projects as they work based on their own agendas and preferred working practices. In addition, construction projects usually have strict deadlines, budgets, and milestones, which limit the flexibility needed for circular practices. Because of this, operational actors often focus on finishing projects and saving costs instead of reusing materials.

In summary, this thesis argues that achieving circularity will be difficult without effective actors' coordination across the ecosystem.

6.2. Research Question 2

How do planning processes and legal frameworks affect the advancement of construction material circularity?

The thesis finds that the progress of circular practices in the construction and demolition ecosystem depends heavily on the institutional environment of municipalities. In Sweden, municipal management of C&D waste is shaped by several legal frameworks and planning processes that often overlap or compete. This means municipalities must navigate different legislative logics, including environmental protection logics, urban planning logics, and the growing focus on the circular economy logics.

These different legislative logics reflect institutional complexity (Greenwood et al., 2011; Scott, 2013) that not only affects municipalities' decisions but also extends to the operational actors within the ecosystem. Private actors involved in construction projects must adhere to municipal interpretations of legislation and planning processes. As one interview participant for Paper 2 noted, "*It is not the same to do these permit applications in all municipalities, you have to put an application to fit the municipality that these concerns. Even if the same applications are submitted to different municipalities, they might probably read them differently*". This means that private actors will often have to navigate multiple legislative logics and obtain multiple permits when projects span several municipalities. This situation reflects how institutional complexity can create uncertainties that influence the implementation of circularity in the ecosystem.

The presence of multiple frameworks means municipalities must balance and integrate different institutional logics (Friedland & Alford, 1991) into their governance practices. According to Pache and Santos (2013), organizations operating under multiple institutional logics often combine or blend them to guide decision making. In C&D governance, environmental protection, urban development, and circular-economy logics can be combined into a new logic; for instance, environmental legislation can support circular practices by promoting reuse and prioritizing risk avoidance, thereby increasing the likelihood of circularity. Furthermore, within municipalities, these overlapping logics are further reflected in the multiple roles they play within the ecosystem. Each of these roles operates according to its different professional mandates and priorities. For instance, environmental departments tend to prioritize environmental protection and risk avoidance, while the planning departments will focus on spatial development. At the same time, circular economy objectives are gradually emerging as additional logic. As a result, the municipality operates within a system of multiple institutional logics that are not fully aligned. This institutional complexity creates challenges for coordinating circular practices. This organizational fragmentation can weaken coordination and the implementation of circular practices (Fredriksson et al., 2026). For circularity to increase, all municipal departments should work together, not in parallel, towards a shared circularity goal.

Furthermore, findings reveal a misalignment between existing legislation and the organizational capacity required to implement circular practices. Most municipalities do not have a designated role for C&D management. Despite the fact that relevant legal frameworks exist in Sweden, these frameworks are not fully integrated into most municipalities' planning processes. While the municipalities are responsible for interpreting and applying legislation, the absence of a designated role limits their ability to translate circular objectives into coordinated planning practices. In addition, the findings reveal that quarry activity permits remain one of the most commonly used planning instruments for C&D, which is traditionally oriented primarily towards the extraction of virgin materials and waste management. The continued reliance on these permits indicates that C&D's governance structures still promote the linear economy.

Overall, this thesis suggests that advancing circular practices needs more than just planning frameworks. It also requires aligning legislation, planning processes, and municipal roles, such as hiring a mass coordinator. If municipalities do not coordinate their work processes, private actors will keep facing legal uncertainties and barriers. Aligning all roles and processes across municipalities is key to improving aggregate reuse in the ecosystem.

6.3. Concluding Discussion

This thesis has shown that the advancement of circularity is influenced by the interaction between organizational structures and planning frameworks within the (C&D) ecosystem.

The dependencies between actors in RQ 1 highlight the importance of actor coordination in enabling circular practices within the (C&D) ecosystem. This aligns with previous studies emphasizing that coordination is essential for circularity in construction (Asgari & Asgari, 2021; Fredriksson et al., 2026; Fredriksson & Huge-Brodin, 2022). However, this thesis shows that such coordination is often limited in practice due to fragmented roles and project-based working structures.

In addition, RQ 2 shows that planning processes and legislative frameworks introduce another layer of complexity, particularly through overlapping institutional logics and unclear roles and responsibilities within the municipalities. These findings are consistent with prior studies that identified regulatory ambiguity and policy misalignment as barriers to CE implementation in the construction industry (Condotta & Zatta, 2021; Fredriksson et al., 2026; Ghisellini et al., 2016). However, this thesis extends this understanding by showing that regulatory ambiguity and policy misalignment are embedded within broader planning frameworks where competing institutional logics affect the effective implementation of circular practices.

These challenges help to explain why circularity of (C&D) waste in the construction industry, according to circular economy strategies and the EU waste framework, sounds promising and simple—prioritize reuse, then repurpose, then recycle—but in reality, it becomes messy. Although CE strategies promote a clear hierarchy, this hierarchy is not easily translated into decision-making within the current project setup for the construction ecosystem. Rather, the thesis findings point to a misalignment between circularity objectives and the existing structure of the construction ecosystem project set up. While Fredriksson et al. (2026) argue that misalignment between actors affects circularity, this thesis further extends this argument by showing that misalignment also exists between circularity objectives and the ecosystem in which they are expected to be implemented.

Furthermore, within the Swedish construction and demolition ecosystem, this misalignment plays out in how actors understand, interpret and engage with circular practices. A key issue that emerged from Paper 1 is the conceptual vagueness surrounding (C&D) waste, reuse, repurpose and recycling. In practice, the limits of these concepts are often blurred. Actors often use these terms interchangeably. For instance, the term “recycling” is often used, and actors label it as circularity, without necessarily knowing when each strategy should be prioritized. This lack of clarity is reinforced by the absence of aligned and clear planning processes, making it difficult for actors to determine which strategy should be prioritized in specific situations. As a result, circularity strategies risk being applied inconsistently. This supports the argument by Ghisellini et al. (2016) that circular economy strategies depend on specific context and cannot be applied the same way everywhere, and actors may apply these strategies incorrectly when they have only a basic understanding, thereby reducing the effectiveness of CE in practice.

In addition, the prioritization of circular strategies is influenced by the same organizational and planning processes constraints identified in this thesis. Actors interpret and prioritize reuse, repurpose, and recycling based on what is feasible within the project requirements. For instance, contractors can favor recycling because it aligns with existing waste management, and it is easier to integrate with project timelines. Recycling actors are often well-coordinated and supported by established infrastructure, making it the most available option in practice. In contrast, reuse and repurpose require early planning and actor coordination (Dablanc, 2007; Guerra & Leite, 2021)—conditions that are challenging to achieve within the current project setup of the construction industry. Figure 9 paints a bleak picture that decision making around circular strategies involves trade-offs that are shaped by structural constraints.

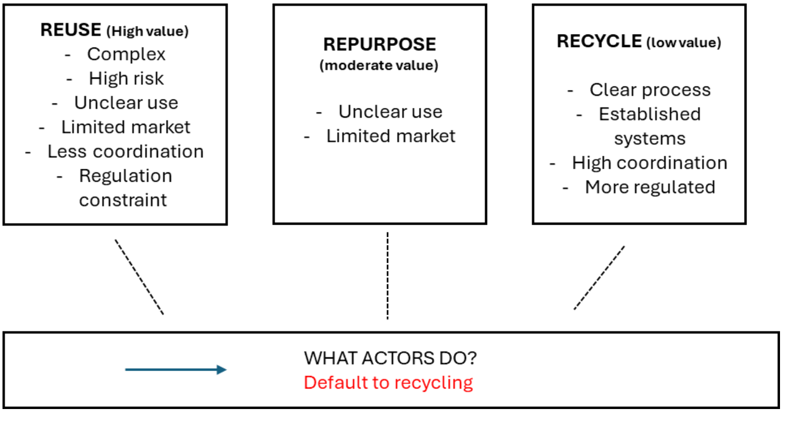

Figure 9: Behind the scenes of circularity decisions

Another challenge also lies in decision-making and responsibility. The empirical findings in this thesis reveal uncertainty regarding who is responsible for determining when waste can be reused, repurposed, or recycled. According to Condotta and Zatta (2021), reuse increases time and costs, and also increases end users' doubts. The question then is who evaluates material quality, who bears the cost of testing and storage, and who should be held accountable when reused material fails, and these questions still remain unresolved. All these questions remain unanswered, creating decision gaps in which actors overlook circular opportunities because no actor takes ownership. Even when actors recognize that reuse is possible, it increases costs and causes delays, and procurement contracts also do not necessarily reward circular performance. Actors may know that reuse is better but still choose recycling because it has a clearer path. Therefore, the distinction between reuse, repurpose, and recycling is not operationally clear in practice.

Taken together, this thesis suggests that the challenge of achieving circularity in the (C&D) ecosystem does not lie in the absence of CE strategies, but in the difficulty of embedding them within the existing construction project set-up. In addition, circularity requires alignment between actors, planning processes and legal frameworks.

7. Conclusion

This chapter concludes the thesis; it presents the theoretical and practical contribution, limitations and further research.

The purpose of this thesis is “to examine how organizational dependencies, legal frameworks and planning processes influence construction and demolition (C&D) waste circularity in the construction and demolition ecosystem. The thesis provided insights into how coordination among actors in the ecosystem and planning frameworks influence the advancement of circular reuse of (C&D) waste. In this thesis, I conclude that circularity is primarily hindered by legislation alignment, public actors’ coordination, coordination among private actors in the construction and demolition (C&D) ecosystem, and also in the difficulty of embedding circularity strategies within the existing construction project set-up.

7.1. Theoretical contributions

This thesis contributes to academic literature in four ways.

Firstly, the thesis extends the understanding of actor dependencies in the circular construction and demolition ecosystem. Papers 1 and 2 describe how the coordination of multiple actors operating at the strategic, meso, and macro levels can advance circularity. Paper 1 lays the foundation for the drivers and barriers influencing circularity within this ecosystem, while Paper 2 further advances this knowledge by showing how actors' dependencies shift over the construction phases. This thesis showed that decisions made in the early phases will have a strong impact on the subsequent phases. Therefore, this thesis contributes to the ecosystem theory and circular economy by demonstrating how circular practices are influenced by the coordination of actors across construction phases.

Secondly, this thesis contributes to research on institutional complexity and circular construction and demolition (C&D) ecosystem governance. The findings from Paper 3 show that municipal governance of C&D operates within a complex institutional environment characterized by multiple legal frameworks and planning processes. This thesis demonstrates that circularity is influenced not only by planning frameworks but also by interpretations and implementations within municipalities.

Thirdly, this thesis extends ecosystem theory within a project-based industry by highlighting the relationships and dependencies within the Swedish construction and demolition ecosystem. While the term 'ecosystem' has been commonly applied to other industries (such as the technological and business ecosystems), this thesis applies it to the construction industry. By examining the Swedish construction and demolition ecosystem, this thesis shows that circularity depends on the alignment of actor roles, legislation and planning processes.

Finally, this thesis shows that unclear definitions of reuse, repurpose, and recycling, along with unclear responsibilities and project constraints, lead actors to choose solutions that are operationally feasible rather than the most circular ones.

7.2. Practical contributions

This thesis provides practical insights for both public and private actors seeking to advance circular economy practices in the construction and demolition ecosystem. This thesis demonstrates that achieving circularity requires not only the existence of planning frameworks but also their alignment within the construction and demolition ecosystem.

The thesis emphasizes the need for improved governance coordination within the municipalities. The findings from paper 3 indicated a lack of a designated role for coordinating C&D management. Establishing a dedicated role (such as a mass coordinator) within the municipality could help improve coordination, align work processes, and facilitate implementation of circular practices. The thesis also highlights the importance of aligning legal frameworks and planning processes with circular economic objectives. Revisiting planning processes to support material reuse through mass management plans could advance circularity in the ecosystem.

Furthermore, the thesis offers a diagnostic tool that offers insight to both private and public actors, enabling them to identify critical bottlenecks that can hinder circularity in the ecosystem before a project starts.

7.3. Limitations & Further Research

While this thesis provides insights into the circular construction and demolition ecosystem, it is important to acknowledge its limitations. The limitations also provide a basis for identifying further research that can deepen the understanding of circular practices in the circular construction and demolition (C&D) ecosystem.

This thesis examines a single case study of the Swedish circular construction and demolition ecosystem, with a focus on the relationships among actors. Sweden offers a useful setting for studying circular economy initiatives, but conditions in other countries may be different. As a result, the findings might not apply to countries with different context compared to Sweden. Future research could repeat this study in other countries. Comparing Sweden with other countries could give more insight into how planning frameworks and organizational structures affect the advancement of circularity. However, this thesis is relevant for countries similar to the Swedish context.

This thesis applies ecosystem theory and institutional complexity to understand how relationships among actors influence circularity. While the institutional complexity was primarily used to analyze the role of planning frameworks, its application within the operational activities of construction projects was not covered in this thesis. Future research could further explore how institutional complexity manifests in construction actors' operations, especially in how they navigate multiple institutional logics in circularity issues. In addition, the limits of reuse, repurpose and recycling identified in this study need further research to develop clearer operational guidelines and regulations that can guide actors to select the appropriate strategies in practice.

The findings about planning frameworks in this thesis come mainly from a nationwide survey and an analysis of policy documents. This gives a general view of how municipalities use planning frameworks, but it does not show detailed differences in how each municipality puts circularity into practice. Future research will add to these findings by interviewing selected municipalities. For example, comparing small, medium, and large municipalities could show differences in governance, organizational structures, and ways of managing C&D waste.

Flyvbjerg (2006) argues that case studies can be subjective and may allow too much room for the researcher's own views. This thesis has tried to address this by using several data sources. In addition, the continuous discussions of the findings with my supervisors, conferences, the industry and public actors further contributed to refining the interpretations, thereby strengthening the credibility of the analysis. However, future research could confirm and expand on these findings.

Finally, while this thesis focused on key actors within the Swedish construction and demolition ecosystem, a crucial actor within this ecosystem has not been explored indepthly. The Swedish Transport Administration (Trafikverket), which is the largest developer in Sweden, plays a significant role in influencing circularity. Examining how Trafikverket incorporates circularity in their work can provide valuable insights into the advancement of circularity in this ecosystem.

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Department of Science and Technology

Linköping University
SE-581 83 Linköping, Sweden

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