CHALMERS
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Enabling Circular Construction Through Proactive Waste Logistics

The Role of Collaboration and Information Exchange Between Main Contractors and Waste Contractors

Master's thesis in Design and Construction Project Management

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CHALMERS UNIVERSITY OF TECHNOLOGY
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ABSTRACT

The construction sector faces a critical challenge due to its high material consumption and massive waste generation, making the transition toward a circular economy (CE) an operational necessity. While circular principles establish clear targets for closed-loop supply chains, practical execution relies on reverse logistics; the planning and movement of materials from the construction site back into the value chain. However, due to the industry'sfragmented nature, waste management is traditionally treated as a reactive support activity plagued by information silos and poor coordination between main contractors and waste contractors.

To explore how this interface can be improved, this qualitative single-case study investigates how collaboration and information exchange can be structured to enable proactive waste logistics. The empirical data was collected through a site observation and nine semi-structured interviews at a school construction project in Gothenburg, Sweden, representing the operational roles of the main contractor as well as strategic regional and national managers from a waste management contractor.

The findings identify major structural, organizational, and behavioral barriers on-site, including a lack of forward-looking material prognoses, late order-related communication, and a traditional view of the waste contractor as a passive service provider rather than an integrated logistics partner. Furthermore, the study highlights how centralized project budgeting and intense schedule pressures lead to local sub-optimization, where individual subcontractors lack direct accountability and discard mixed waste fractions into shared containers. To mitigate these challenges, this thesis proposes a comprehensive framework for proactive waste logistics emphasizing early involvement, real-time data transparency, a dedicated on-site logistics manager, and structured visual management. Ultimately, integrating the waste contractor as a strategic partner is concluded to be a fundamental prerequisite for bridging the gap between circular ambitions and the operational reality on the construction site.

Key words: Construction Logistics, Waste Logistics, Reverse Logistics, Circular Economy, Closed-Loop Supply Chain, Inter-organisational Collaboration.

Att möjliggöra cirkulärt byggande genom proaktiv avfallslogistik
Betydelsen av samarbete och informationsutbyte mellan huvudentreprenörer och avfallsentreprenörer

Examensarbete inom masterprogrammet Master' Design and Construction Project Management

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SAMMANFATTNING

Byggsektorn står inför en avgörande utmaning på grund av sin höga materialförbrukning och enorma avfallsmängder, vilket gör övergången till en cirkulär ekonomi till en operativ nödvändighet. Även om principerna för cirkulär ekonomi fastställer tydliga mål för slutna leveranskedjor, är det returlogistiken som är avgörande för det praktiska genomförandet , såsom planeringen och transporten av material från byggarbetsplatsen tillbaka in i värdekedjan. På grund av branschens fragmenterade natur behandlas dock avfallshantering traditionellt som en reaktiv stödverksamhet som präglas av informationssilos och dålig samordning mellan huvud- och avfallsentreprenörer.

För att undersöka hur detta gränssnitt kan förbättras urforskar denna kvalitativa fallstudie hur samarbete och informationsutbyte kan struktureras för att möjliggöra proaktiv avfallslogistik. De empiriska uppgifterna samlades in genom en platsobservation och nio semistrukturerade intervjuer vid ett skolbyggnadsprojekt i Göteborg, Sverige, som representerade huvudentreprenörens operativa roller samt strategiska regionala och nationella chefer från en avfallshanteringsentreprenör.

Resultaten pekar på strukturella, organisatoriska och beteendemässiga hinder på byggarbetsplatsen, däribland brist på framåtblickande materialprognoser, försenad orderrelaterad kommunikation samt en traditionell syn på avfallsentreprenören som en passiv tjänsteleverantör snarare än en integrerad logistikpartner. Dessutom belyser studien hur centraliserad projektbudgetering och hårt tidspress leder till lokal suboptimering, där enskilda underleverantörer saknar direkt ansvar och slänger blandade avfallsfraktioner i gemensamma containrar. För att mildra dessa utmaningar föreslår denna studie ett omfattande ramverk för proaktiv avfallslogistik med betoning på tidigt engagemang, datatransparens i realtid, en dedikerad logistikchef på plats och strukturerad visuell ledning. Slutsatsen är att integrering av avfallsentreprenören som en strategisk partner är en förutsättning för att överbrygga klyftan mellan cirkulära ambitioner och den operativa verkligheten på byggarbetsplatsen.

Nyckelord: Bygglogistik, avfallslogistik, returlogistik, cirkulär ekonomi, Closed-Loop Supply Chain, samarbete mellan organisationer.

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APPENDIX A I

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List of Acronyms

List of acronyms that will be used in the thesis listed in alphabetical order:

BREEAM	Building Research Establishment Environmental Assessment Method
CE	Circular Economy
CLS	Construction Logistics Setup
CLSC	Closed-Loop Supply Chain
CSCM	Circular Supply Chain Management
RL	Reverse Logistics
SCM	Supply Chain Management
SCO	Supply Chain Orientation
SLP	Site Layout Planning
TBL	Triple Bottom Line
TKA	Teknisk Kravspecifikation för Avfallshantering
TPL	Third-Party Logistics

1 Introduction

In response to increasing environmental regulations, the construction industry is undergoing a transition from traditional linear operations toward sustainable, closed-loop systems. This master thesis takes its starting point in this green transition, specifically examining the active production phase of a school project in Gothenburg. By analysing this specific project context, the study bridges the gap between high-level environmental ambitions and the operational realities on-site, demonstrating how circularity is fundamentally a challenge of logistical execution.

1.1 Background

The construction sector is globally one of the most resource intensive industries and stands for an important part of the world's total material consumption, energy use and waste generation. In line with increasing urbanisation and a constantly growing need of new infrastructure, the sector's environmental impact has been focused on by both legislators and international climate agreements. The adjustment to a circular economy (CE) has therefore transformed from being a visionary ambition to a necessity to meet global sustainability goals. Within a circular model, the goal is to break the connection between economic growth and resource consumption by eliminating waste through design and keeping materials within closed-loop systems (Ghisellini et al., 2018). Crucially, transitioning to such circular material loops fundamentally shifts how supply chains operate. It transforms the traditional linear flow of resources into complex networks that require precise logistical coordination to function.

According to Boverket (2025), the construction sector accounted for 39% of all generated waste in Sweden in 2022, which is equal to almost 13.6 million tons (Boverket, 2025). Although over half of the non-hazardous waste was recycled, the industry's environmental footprint remains significant. National environmental goals and directives from Naturvårdsverket (n.d.) highlight the importance of climbing the waste hierarchy, moving from energy recovery and landfill to increased reuse and sorting. However, climbing this hierarchy is not merely a regulatory or technical matter because it represents a major operational hurdle on the construction site. Sorting materials for reuse demands physical space, specialised handling, and structured tracking. Consequently, these environmental and resource-saving ambitions turn directly into a multi-faceted logistical challenge, where the physical movement and sorting of waste dictate the success of the ecological goals. To reach these circular flows there is more than a technical matter; it highly demands an improved collaboration and clear division of responsibilities between the stakeholders in the supply chain.

Circularity sets the goals for material reuse, while the logistical system physically enables the movement, sorting and tracking of the materials. Traditionally, construction logistics is defined as the process to ensure that materials and equipment are delivered to the right location at the precise time to maintain productivity (Agapiou et al., 1998; Ekeskär & Rudberg, 2022). In a circular construction process the logistical concepts must be expanded. It is not enough to focus on forward logistics, the focus needs to point toward reverse logistics. Reverse logistics includes planning, execution and controlling of material and information flows from the construction site back into the value chain to recycle value and ensure correct handling (Hosseini et al., 2015). Consequently, waste management needs to be rethought. It is not only a matter of environmental compliance, but more importantly, a logistical challenge that demands strategic coordination.

1.2 Problem Formulation

Despite the proven importance of construction logistics for both profitability and sustainability, the subject is often treated as a reactive support activity rather than an integrated part of the project's strategic planning. The sector's fragmented and project-based nature creates obstacles for long-term logistics collaboration (Janné & Rudberg, 2020).

Stakeholders in construction projects are often "loosely connected", which means collaboration for a short period of time without developing common standards or deeper trust between parties. This results in uncoordinated flows, lack of information sharing and recurring problems with unnecessary material handling on-site (Ruzieh et al., 2025).

One of the largest challenges for an effective waste management is the recurring information asymmetry between main contractors and waste contractors. To optimise the logistical process seamless transparency regarding critical data is needed, but today, communication is characterised by significant shortcomings (Le et al., 2025). Order-related information is often shared too late and forward prognoses such as expected waste volumes and specific collection requirements are rarely communicated. This lack of visibility limits the waste contractor's ability to optimise transport routes and resource allocation. This results in logistical bottlenecks on-site, where overloaded containers hinder production and spatial constraints prevent efficient waste sorting (Ruzieh et al., 2025).

Furthermore, a significant organisational gap exists in how waste contractors are perceived. Rather than being integrated as strategic logistical partners, they are frequently treated as pure service providers whose sole task is to remove waste towards the end of a process. This narrow view counteracts the principle of early involvement, which research identifies as a prerequisite for influencing logistical planning before operational problems arise (Brandão et al., 2021).

Clearly, waste generation and its associated transport needs are not isolated events but occur continuously throughout all project phases. Since construction transports account for approximately 10% of a project's total CO_2 emissions, the effectiveness of the construction logistics setup (CLS) is highly dependent on how these flows are managed across the entire project lifecycle (Sezer & Fredriksson, 2021). By failing to recognise the waste contractor's strategic role from the outset, the industry overlooks critical opportunities to optimise transport flows and reduce environmental impact during the active production stages, instead of just reacting to waste once it has already accumulated.

Consequentially, there is a significant discrepancy between the ambitious goals of a circular construction sector and the practical capacity to coordinate the logistical flows required to achieve them. There is a lack of knowledge in how the interface between the main contractor and waste contractor can be structured to move from a reactive to a proactive waste management. By investigating the success factors and the challenges in a specific construction project, the study can contribute to a deeper understanding of how information exchange and collaboration models can be strengthened to support productivity and circular material flows.

1.3 Purpose and Research Questions

The aim of this master thesis is to analyse how the collaboration between the main contractor and the waste contractor can be structured and integrated to enable proactive waste logistics. By identifying current limitations and critical success factors, the study aims to propose a framework for an integrated logistics setup that improves both operational predictability and circular material flows. To concretise the aim of this master's thesis, the following research questions were constructed:

- How do collaboration and information exchange between the main contractor and the waste contractor function today?
- Which are the barriers for establishing a proactive approach to waste logistics?
- How should the collaboration and information exchange between the main and waste contractor be structured considering the barriers for the proactive approach?

1.4 Scope

This study investigates logistical processes with a focus on information sharing, planning, and collaboration. To enable an in-depth analysis, the research is limited to a single construction project in Gothenburg: the construction of a new school. A central aspect of this case is that the waste contractor active at the project site differs from the waste contractor included in the interview study. This distinction is significant as the formal collaboration between the main contractor and the specific waste contractor interviewed is not yet fully implemented at the project site, which provides a unique opportunity to analyse the preconditions and future requirements for establishing an effective collaborative framework for waste management.

The investigation focuses on the relationship and collaboration between the main contractor and the waste contractor. Although subcontractors contribute significantly to the generation of construction waste on-site and are thus inherently included in the broader context of the project's waste management, they have been excluded from the primary interview study. The research specifically isolates the overarching management and coordination responsibilities held between the main contractor and the waste contractor. By maintaining this concentrated focus, the study effectively evaluates the structural boundaries and collaborative obligations of the primary contract holders who dictate the project's waste recovery framework.

Logistical flows are prioritised over technical solutions for chemical recycling or specific material properties, as these are regarded as external factors. The study is also delimited to on-site activities, as the construction site is where the main contractor exerts the most influence over the processes. Finally, to maintain a clear focus on the production phase, the study primarily addresses the construction stage; the demolition and end-of-life stages are excluded from the scope. While the empirical boundaries isolate the active production stage, theoretical strategies regarding the early involvement of the waste contractor are inherently included, as these early-stage decisions directly dictate the operational parameters and logistical efficiency of the active waste streams on-site.

2
Literature Review

This chapter provides the theoretical foundation for the study and aims to define the key concepts required to answer the research questions. By integrating perspectives from the circular economy, construction logistics and supply chain management, an understanding is developed of how these fields interact to influence the project's operational and environmental performance. The literature review initially explores the role of logistics in the transition to circular material flows, with a particular focus on reverse logistics as a method for recovering value from residual products. It further examines theories of inter-organisational collaboration and how third-party logistics (TPL) can act as a system integrator to increase the supply chain's resilience to disruptions. The chapter concludes with an examination of the structural, organisational and cultural barriers that currently hinder effective waste logistics, forming the foundation for the study's analysis of how information exchange and coordination can be proactively structured.

2.1 Sustainability and Circularity in Construction

The construction sector's environmental impact is often connected to its linear production logistics, where resources are extracted, used and finally disposed. This is called the "take-make-dispose" model, and it often conflicts with the national and global goal about climate neutrality and resource efficiency.

Pomponi and Moncaster (2017) describes that construction sector has difficulties to switch to a circular economy (CE). An important explanation is the sectors fragmented structure and project-based organisation, where several stakeholders collaborate during a limited period of time. This creates a gap between strategic sustainability goals and the operative reality on-site.

To handle these challenges, sustainability in the construction sector is often discussed through the framework Triple Bottom Line (TBL), which highlights the importance of balance the economic, environmental and social values (Elkington, 1997). However, in practise, there is often a conflict of goals between these dimensions. Economic factors, such as time pressure and short-term cost efficiency, tends to be prioritised above the environmental values (Ajayi et al., 2017). To mitigate this conflict, circularity is introduced as a strategic framework to decouple economic growth from resource consumption (Pomponi & Moncaster, 2017).

The concept CE within the construction industry is more than recycling. According to Ghisellini et al. (2018) CE is about eliminate waste through design and keep material in closed loops. In construction sector this means a shift from how material flows are understood. Traditionally, material flows are seen as converging, where they are transported from different suppliers to on-site for assembling (Vrijhoef & Koskela, 2000). Instead, in a circular system the material flows are needed to be seen as a part of a larger ecosystem where material can be returned to the value chain after use.

A tool to operationalise circularity in waste management is the waste hierarchy. This hierarchy prioritises strategies in descending order, as illustrated in Figure 2.1. The hierarchy ranges from the most preferred sustainable options; waste prevention and reuse to material recycling, energy recovery and, finally, landfill as the least desirable option. According to the industry organisation, Avfall Sverige (2022), this structure aims to steer resource flows upwards through the hierarchy to minimise environmental impact.

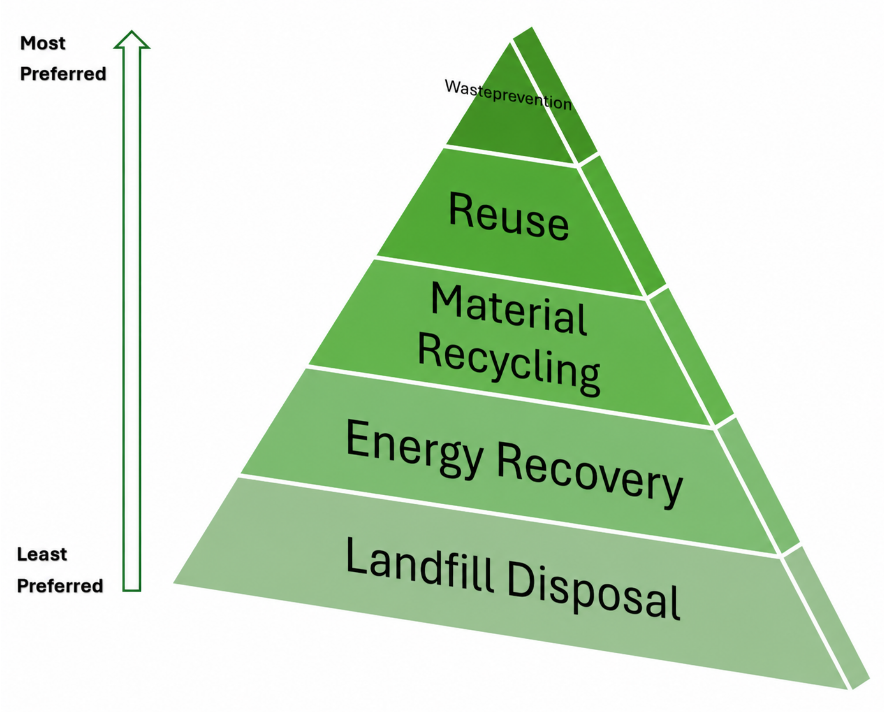

Figure 2.1: Waste hierarchy from least to most preferred (Adapted from Avfall Sverige, 2022)

While the structure of the hierarchy provides a visual categorisation, a closer examination reveals that moving upwards towards the higher-priority steps inherently demands a more sophisticated approach to managing material flows. Traditional waste management has typically focused on a linear and straightforward process involving the efficient removal of mixed materials from the construction site. Circular solutions, on the other hand, require an entirely different operating model characterised by a high degree of sorting, precise tracking, and continuous information sharing between all stakeholders involved. This increased management complexity is necessary to ensure that the material retains its highest potential value and can be successfully reintroduced into future production cycles (Ajayi et al., 2017).

The transition towards a circular construction sector needs a change in how the supply chains are organised. Circular systems demand that the supply chain can handle both forward and reverse flows (Genovese et al., 2017).

2.1.1 Legal Frameworks and Environmental Certifications

To drive forward the circular economy, the construction sector need to understand the legal frameworks and environmental certifications that regulate the industry. In Sweden, waste management is primarily regulated by the Miljöbalken and the Plan- och bygglagen, with a clear focus on the waste hierarchy, where the highest priority is to prevent waste and then prepare materials for reuse (Byggföretagen, 2020).

In addition to legal requirements, environmental certifications such as BREEAM and Svanen serve as important supplements to drive the industry forward. Svanen sets explicit requirements for optimal waste and resource management to promote a circular economy, including that at least 70 % (by weight) of non-hazardous construction waste must be prepared for reuse, recycling or other material recovery (Svanen, n.d.). Similarly, BREEAM drives development through strict requirements for traceability, documentation and detailed waste management plans (Sweden Green Building Council, 2025). These requirements necessitate a closer exchange of information and a clearer division of responsibilities between developers, contractors and waste contractors, which in turn creates a need for significantly more integrated working methods and logistics solutions than traditional approaches (Byggföretagen, 2020).

2.2 Construction Logistics and Reverse Logistics

Logistics is a critical component in construction which ensures that right items are in the right place at the right time (Agapiou et al., 1998; Ekeskär & Rudberg, 2022). Lambert and Cooper (2000) describe logistics as a subset of Supply Chain Management (SCM), where the two concepts fulfil distinct yet complementary functions. Logistics primarily focuses on operational activities, such as transport, storage, and physical material handling. In the construction sector, traditional forward logistics focuses on the flow of materials from the point of extraction to the construction site. This flow is typically characterised as convergent, as materials from numerous suppliers are gathered at a single location for assembly (Vrijhoef & Koskela, 2000).

However, this presents a logistical challenge that is often overlooked in the early stages. As materials are processed, waste is inevitably generated, necessitating a secondary flow that moves in the opposite direction. This shift from managing incoming resources to managing outgoing waste marks the critical transition from forward logistics to reverse logistics. Reverse Logistics (RL) is defined as the process of planning, executing, and controlling the flow of materials and information from the construction site back into the value chain (Hosseini et al., 2015). A core principle of RL is that it is not merely waste transportation, but a strategic process aimed at capturing value (Ghisellini et al., 2018; Hosseini et al., 2015). To achieve this value capture, a systematic integration with "downstream actors" is required. These actors include, for example, waste management contractors (who coordinate the physical collection and sorting) and recycling facilities or material processors (who ensure the materials are reintroduced into the production cycle). In CE, this means that materials are not regarded as waste but as a resource to be returned to the cycle.

In this context, it is important to distinguish between the concepts of waste management and waste logistics. Meanwhile waste management traditionally focuses on the technical aspects of materials handling, such as sorting categories, material treatment and compliance with environmental regulations, waste logistics includes the strategic planning, coordination and physical movement of these materials. In a circular construction process, waste logistics becomes the enabler that ensures information and material flows are synchronised between the main contractor and the waste contractor. By shifting the focus from sole management to integrated logistics, the potential for proactive measures increase.

Despite its importance, waste logistics is often treated as a reactive support activity rather than an integrated part of project planning (Ruzieh et al., 2025). This reactive approach leads to unnecessary material handling, uncertain flows and inefficient resource use. The problematic becomes worse by the construction sectors fragmented nature, which according to Janné and Rudberg (2020) hinders the establishment of long-term logistical collaborations. The optimisation of these processes depends on the seamless exchange of information, although there is currently a lack of transparency regarding critical data (Le et al., 2025; Ruzieh et al., 2025). Information relating to orders is often communicated at a late stage, and forward-looking forecasts of recurring waste volumes and collection requirements are almost entirely absent.

To fully integrate these flows into a circular context, the concept of a Closed-Loop Supply Chain (CLSC) is essential. A CLSC is defined as the integration of forward and reverse logistics to manage the entire life cycle of a product or material (Ghisellini et al., 2018; Le et al., 2021). Unlike traditional supply chains, a CLSC focuses on capturing value from the 'waste' generated on-site by reintroducing it as secondary raw material or reusable components in future projects.

In a construction context, this means that data from the reverse flow, such as waste volumes, material quality, and sorting efficiency, becomes critical input for the forward planning of procurement and design. Achieving a CLSC requires high levels of information transparency and a shift in the relationship between the main contractor and the waste contractor (Le et al., 2021).

This is often described as Circular Supply Chain Management (CSCM), where collaboration and integration between different actors become crucial. Especially the relationship between the contractor and the waste contractor is vital to making circular flows possible. As this chapter has highlighted, without working logistics and organisational integration, circular ambitions risk becoming strategic goals without practical integration into the construction project's execution.

2.3 Supply Chain Management and External Integration

For the complex supply flows to work in a circular construction process, a perspective that reach further the operative logistics are needed. Supply Chain Management (SCM) offers to integrate business processes and coordinate activities between different stakeholder in the value chain (Lambert & Cooper, 2000). A prerequisite for such integration is Supply Chain Orientation (SCO). While SCM refers to the actual activities and processes, SCO represents the underlying organisational "mentality" or predisposition to view the supply chain as a single, collective entity. This orientation implies that companies within the chain work strategically with trust, commitment, and shared goals to create competitive advantages (Lambert & Cooper, 2000). A strong SCO is a prerequisite for this, as it directs the organisational focus towards systemic sustainability rather than local optimisation (Jadhav et al., 2019).

One specific example of successful external integration in the construction industry is the long-term partnership between the window manufacturer NorDan and NCC (NCC, 2020). By working together on several projects, they have not only optimised delivery precision but have also jointly developed products to better suit the construction process. This partnership demonstrates how both parties can benefit from shared expertise to create added value. A similar logic can be applied to the relationship with the waste contractor, rather than being seen merely as a recipient of waste, they can act as a strategic partner who helps to improve material choices and packaging solutions, which ultimately reduces the total amount of waste (Janné & Rudberg, 2020).

To understand why collaborations like Nordan and NCC often are exceptions instead of common, an analysis of the depth in the relationships is needed. Gadde and Dubois (2010) differences between “low-involvement” and “high-involvement” in business relations. They mean that the structure of the construction sector historically has been majority of low involvement relationships, where stakeholders are kept at arm’s length to maintain flexibility and to drive down prices in individual projects. Circular flows and efficient waste logistics, however, require a high level of involvement, which entails shared adaptations of resources and activities as well as extensive information exchange.

The level of external integration is crucial for how well waste management can be proactive. Flynn et al. (2010) defines external integration as the extent to which a main contractor collaborates with its external partners, such as suppliers and waste management providers, to develop shared synchronised processes. This includes both strategic planning and operative decision-making. For a construction project this means that the waste contractor is seen as an integrated partner in the projects logistical system instead as a supplier of waste disposal. According to Marty and Tosi (2024), the systematic integration of these “downstream actors”, e.g. waste contractors and recycling facilities, is required in order to effectively close material loops and overcome the information silos that often hinder circular flows.

By integrating the waste contractor early, logistical plans can be optimised through their expertise before bottlenecks occur. As a strategic partner the waste contractor can act like a third-part logistics (TPL) that affects the decisions (Janné & Rudberg, 2020). Although, this form of external integration demands high visibility of information and that data shares in real time.

Despite the theoretical advantages, partnering in construction is hard to reach because of the project-based structure in the industry. This often leads to focus on short-term profits instead of shared strategic value (Bygballe et al., 2010; Gadde & Dubois, 2010). The construction fundamental characteristics and occurring work methods create barriers that often make it impossible to reach these ideal collaborations forms.

2.4 Barriers to Efficient Waste Logistics

Despite the theoretical advantages with integrated logistics and circular flows, the research identifies extensive barriers that hinder the implementation in practise. These can be categorised in structural, physical, organisational and cultural barriers.

2.4.1 Structural Barriers

The construction sector continues to be dominated by short-term, transaction-based relationships more than long-term collaborations, which contrasts the need of information sharing and common planning in SCM (Lambert & Cooper, 2000). The industry's "loosely connected" nature means that stakeholders rarely integrate after a project is finished, which counteracts the development of standardised work methods and long -term logistical systems (Dubois & Gadde, 2002).

One barrier is that the economic incentives rarely is coordinated between the stakeholders (Brandão et al., 2021). Suppliers and main contractors are often selected based on the lowest price rather than the total acquisition or lifecycle cost, which leads to high hidden costs for materials handling and logistics (Ekeskär & Rudberg, 2022). Furthermore, unclear distribution of responsibility leads to the stakeholders optimising their own processes instead of the total flow (Ruzieh et al., 2025).

This fragmented structure and misalignment of responsibilities can be theoretically framed through the *Tragedy of the Commons*, a conceptual paradigm originally outlined by Hardin (1968). In a construction context, when a logistics or waste management setup is financed through a centralised project budget, the disposal infrastructure effectively transforms into a collective, unpriced utility. Consequently, individual subcontractors lack direct financial accountability for the waste volumes they generate. Driven by individual schedule pressures, actors tend to sub-optimise their local operational efficiency by discarding mixed, un-sorted fractions into common containers, ultimately depleting the collective environmental and economic performance of the overall project supply chain. This structural information asymmetry is further strengthened by the lack of real-time visibility regarding waste quantities and transport needs, which hinders proactive decision-making (Le et al., 2025; Ruzieh et al., 2025).

2.4.2 Physical and Operational Barriers

The construction sector's supply chains differ from traditional manufacturing due to their converging, temporary, and order-driven characteristics (Vrijhoef & Koskela, 2000). Today's construction sites are characterised by a high level of complexity, where physical site constraints and internal logistics create significant challenges that lead to project inefficiencies. A fundamental problem is the site's physical and spatial limitations, where existing geometry and obstacles dictate strict restrictions for the internal micro logistics (Hawarneh et al., 2021; Ruzieh et al., 2025).

The lack of space makes the actual available area rarely corresponds to the space needed for machines, materials, and temporary facilities, which is a critical factor in enabling on-site waste sorting (Wang et al., 2010). This leads to complicated and inefficient transport routes within the area. Efficient Site Layout Planning, SLP, is crucial to ease these limitations, although waste management areas are often de-prioritised in the initial planning for the benefit of production, which creates suboptimisation prerequisites for sorting (Hawarneh et al., 2021). In that type of environment, the forwards logistics are often prioritised to keep up the production tempo. Meanwhile reverse logistics are seen as a reactive support activity that prioritises when the material hinders progress or is considered to have high economic value (Hosseini et al., 2015; Ruzieh et al., 2025).

2.4.3 Organisational Barriers

An organisational barrier is the widespread lack of internal knowledge that recurring in the control of logistics and SCM in both developers and main contractors (Ruzieh et al., 2025). This lack of knowledge, in combination with logistics actors such as waste contractor often excludes from early stages, which undermines the possibility of effective coordination (Le et al., 2025). Furthermore, the interplay between financial regulations, can trust and power dynamics in strategic partnership create friction, as stakeholders tend to prioritise individual risk minimisation over collective efficiency (Koolwijk et al., 2022).

This creates a reactive interface where communication often happen first when the containers are full or problems already have occurred. The lack of direct communication channels between logistics service providers and subcontractors also creates unnecessary bureaucracy and information bottlenecks (Ekeskär & Rudberg, 2022). Furthermore, there is an inherent resistance to change among subcontractors who are accustomed to managing their own logistics, which makes the implementation of new, integrated logistics arrangements difficult (Fredriksson et al., 2021).

2.4.4 Cultural and Behavioural Barriers

Ajayi et al. (2017) highlights the existence of a "waste culture" within the construction industry, where waste is perceived as inevitable and secondary to cost and time performance. From a behavioural perspective, the workers behaviours are controlled by attitudes and experienced norms (Ajzen, 1991). If waste management is not perceived as a shared responsibility or as strategically important by the project management, the motivation to participate in coordinated logistics procedures remains limited. Reverse logistics is often viewed exclusively as a cost burden in terms of labour, handling and transport rather than a value-adding process, which leads to the function frequently being overlooked in favour of more production-efficient activities (Hosseini et al., 2015; Ruzieh et al., 2025).

2.5 Theoretical Strategies for Improved Collaboration

To address the identified organisational and logistical challenges, current research discusses several theoretical strategies that could potentially improve collaboration and waste management. These strategies offer an analytical perspective through which many of the barriers in the construction supply chain might be mitigated, though their application specifically to waste contractors remains an area for further investigation.

2.5.1 Early Involvement

A concept frequently highlighted in the literature is early involvement. The concept is based on the idea that logistics expertise should be integrated as early as the planning and design phase in order to proactively identify and minimise waste flows before they arise during production (Le et al., 2025). Within this framework, the discussion focuses on how decision-making in the early stages can influence material selection and construction methods to promote circularity. Examining this concept underscores the potential for restructuring the interface between the project's various stakeholders; however, its practical application specifically to the waste stream continues to be characterised as a challenge in industry practice(Brandão et al., 2021).

2.5.2 Waste Contractor as a Strategic Partner

To reduce the volume of construction waste and improve the efficiency of resource use, the literature highlights the need for a paradigm shift regarding how external stakeholders are integrated into the construction process. A theoretical approach is to re-evaluate the roles of subcontractors and main contractors, from being passive executors to acting as integrated, strategic partners in a circular flow (Brandão et al., 2021; Othman & El-Saeidy, 2024). Within this framework, it is proposed that early involvement enables expertise to be utilised to influence logistics plans and waste strategies before operational bottlenecks arise.

In this type of partnership, the waste contractor can assume a role similar to that of a third-party logistics provider (TPL). According to Janné and Rudberg (2020), a TPL solution in construction projects means that the logistics provider takes greater responsibility for coordinating flows and resources. In a circular context, this theoretically means that they can influence the choice of materials and packaging to reduce waste before it even reaches the construction site. By exploring the integration of the waste contractor as a TPL operator, one can study the conditions for a more synchronised and predictable logistics chain (Fredriksson et al., 2021; Janné & Rudberg, 2020).

2.5.3 The Role of a Logistics Manager

Meanwhile TPL partnerships focus on external services, the literature also emphasises the need for a dedicated logistics manager role within the project. In theory, this role acts as a link between production and external logistics providers. A logistics manager is described as a "system integrator" with overall responsibility for planning and managing both inbound and outbound flows (Ekeskär & Rudberg, 2022).

According to Fredriksson et al. (2021), the presence of a dedicated logistics function on the construction site can be essential for proactive logistics strategies to succeed. Without this function, there is a theoretical risk that waste management will revert to being a reactive activity where no one takes overall responsibility for coordination. The role of the logistics manager is intended to ensure that the exchange of information between the main contractor and the waste contractor takes place in real time, enabling optimised collection schedules and minimising the unnecessary material handling that often arises from a lack of coordination (Ekeskär & Rudberg, 2022; Ruzieh et al., 2025).

2.5.4 Visual Management and Operational Communication

In addition to organisational roles, the literature also discusses the importance of Visual Management in bridging communication gaps on construction sites. Visual Management involves the use of clear physical or digital indicators to communicate logistical instructions and targets in real time (Ruzieh et al., 2025).

In waste logistics, this may involve the use of standardised colour codes, clear signage and real-time data showing the fill levels of containers. According to the theory, visual management reduces the need for verbal communication and minimises the risk of incorrect sorting caused by ambiguity (Othman & El-Saeidy, 2024). By studying visual guidance as a logistical tool, it is possible to investigate how it contributes to creating a shared understanding between construction workers and the waste contractor, which in turn theoretically facilitates a more efficient flow of materials.

2.6 Summary

In summary, the literature review shows that there is a noticeable gap between theoretical models of the circular economy and the operational reality of construction projects. A clear gap in the research is the one-sided focus on technical solutions and material recovery rates, at the expense of the organisational and social mechanisms required to implement these solutions in practice. Although theories such as the Triple Bottom Line emphasise social sustainability, there is a lack of in-depth studies on how sustainable collaborations are actually managed and maintained in the fragmented and temporary environments that characterise the construction industry.

Furthermore, research on the inter-organisational interface between main contractors and waste contractors is limited. The literature often describes the waste contractor as a passive receiver rather than an integrated partner, meaning that knowledge of how shared incentives and external integration affect the efficiency of the reverse logistics flow is lacking. There is also a gap between high-level strategic objectives and the practical micro-logistics at the workplace. By examining this vertical flow of information and how inadequate visual management creates information silos, this study aims to help close these knowledge gaps and offer a deeper understanding of the circular interface.

3 Method

This chapter outlines the methodological choices that have formed the foundation for the study's results. The purpose is to provide the reader with a clear understanding of how the investigation has been structured, from the selection of the research strategy to data collection and the analytical process. By describing the approach transparently, the study's scientific rigour and the reliability of its findings are ensured. The chapter begins with a description of the abductive research strategy and design framework, followed by an explanation of the empirical methods and case context. Finally, it discusses how the data material has been analysed and how quality assurance and ethical considerations have been addressed throughout the research process.

3.1 Research Strategy and Design

The study has been conducted with a qualitative research approach. The choice of a qualitative method is motivated by the purpose of the study to create an in-depth understanding of the inter-organisational relationship and the communication pattern between the main contractor and the waste contractor. Since the challenges in waste management are rooted in organisational behaviours, informal processes and waste culture (Ajayi et al., 2017), a qualitative approach is more appropriate than a quantitative to capture nuances and barriers that occur in the daily collaboration (Bryman, 2016).

The work has followed an abductive approach, which means that theory and empirical have been developed parallelly and in interaction. By moving back and forth between empirical observations and theoretical frameworks, the understanding of both theory and the research topic is expanded (Dubois & Gadde, 2002).

The study started with a literature review to create a theoretical foundation and to enable the formulation of interview questions. During the empirical study new themes emerged that were not fully covered by the initial literature review. This led to additional literature being included, which illustrates the studies' iterative characterisation. This iterative process, often described as systematic combining, has been crucial in understanding how logistical theories are actually manifested in the practical construction environment (Dubois & Gadde, 2002).

To operationalise this strategy, the research design is structured around three interconnected components: an intensive literature review, empirical data collection through interviews and site visits, and a qualitative case study of a specific construction project. By integrating these elements, the study enables an in-depth exploration of the inter-organisational relationships and information flows between the main contractor and the waste contractor. The selection of this integrated design aims to achieve methodological triangulation, thereby enhancing the validity of the study by allowing different perspectives and data sources to illuminate the challenges and success factors in waste logistics from multiple perspectives.

3.1.1 Literature Review

The literature review constitutes the study's theoretical foundation and has been carried out to identify existing knowledge, concepts and research gaps in the fields of construction logistics, the circular economy and waste management. The process has been intensive and has followed an abductive approach, with searches being adapted as new themes emerged during the empirical study.

Initially, relevant sources were identified through the course literature and scientific articles that were previously covered in the course ACE130 Construction Logistics and Supply Chain Management. These sources worked as an initial theoretical starting point and contributed to limiting the field of research and to identifying important concepts and discussions.

Thereafter, systematic searches were carried out through databases such as Scopus, Google Scholar and Chalmers Library to broaden the theoretical foundation. The searches were based on combinations such as "construction logistics", "construction waste management", "circular economy in construction", "reverse logistics" and "waste governance".

The selection was based on criteria such as publication in peer-reviewed journals, a clear connection to the construction sector and with focus on organisational, logistical or collaboration-related aspects.

To further identify additional studies a snowballing strategy was also applied. According to Wohlin (2014), a snowballing search strategy requires a structured framework where the researcher utilises the reference list (backward snowballing) or the citations (forward snowballing) of a well-selected paper to find further relevant studies. In this study, backward snowballing was leveraged by examining the bibliographies of the initial textbook and lecture materials to uncover foundational peer-reviewed articles. Concurrently, forward snowballing was employed using Google Scholar to trace newer publications that had cited those core papers, ensuring that both seminal works and the latest contemporary advancements in circular supply chain management were fully integrated.

The literature review worked both as the study's theoretical framework and as support for the development of the interview guide (see Appendix A). Empirical findings from the interviews led to additional literature being included in the analysis, especially in areas related to knowledge transfer, division of responsibilities, and practical sorting solutions at the construction site.

3.1.2 Empirical Study

The empirical data collection was carried out using a combination of semi-structured interviews and site observation. This approach was chosen to enable methodological triangulation, whereby information from interviews can be confirmed or contrasted with practical observations at the construction site (Bryman, 2016).

The empirical study was executed through semi-structured interviews with representatives from the chosen construction project, in addition to the waste contractor selected for the future collaboration. Semi-structured interviews provide the researcher with the flexibility to explore the stakeholders' perspectives in-depth while keeping an open mind about the contours of the investigated topic (Bryman, 2016). The design and thematic structure of these interviews were guided by a predetermined interview guide (see Appendix A)

The respondents from the construction project were chosen to represent different roles in the production, thereby enabling multiple perspectives on the waste management process. To include an inter-organisational perspective, interviews with representatives from the waste contractor were also conducted. The selection from the waste contractor was limited to available and relevant people. A total of nine interviews were conducted.

In addition to interviews, one site visit was carried out. The observation aimed to create a contextual understanding of the practical implementation of the waste logistics. This was a passive observation designed to cross-reference the communicative patterns described in the interviews with the physical reality of the construction site.

To ensure a structured and objective evaluation, the observation specifically focused on three physical parameters:

1. **Signage and Information Clarity:** Evaluating the visual governance at the sorting areas, ensuring that labels were clear, color-coded, and legally compliant to prevent human error during disposal.
2. **Subcontractor Sorting Behaviour:** Observing how site workers and subcontractors interacted with the sorting stations in their daily routines, capturing informal habits and compliance levels.
3. **Container Contents and Contamination:** Conducting visual inspections inside the active waste containers to analyse the sorting quality, checking for mixed fractions or misplaced materials that could impede recycling potentials.

3.1.3 Case Study

The choice of a case study as research design is motivated by the need to investigate complex phenomena in their natural environment (Yin, 2009). Since efficient waste management and logistical coordination are affected by place-specific factors, the case study gives the analytical breadth required to understand how theories about proactive logistics work in practice.

The chosen case is the construction of a school in Gothenburg. This project was selected because it represents a production environment with a relatively straightforward logistical framework that has successfully achieved high outcomes in its waste management and sorting efficiency. By isolating a project where the physical constraints are manageable, the study can more effectively focus on and evaluate the underlying organisational and communicative dynamics, such as role distribution and proactive information sharing, without the interference of extreme spatial bottlenecks.

A central boundary condition of this case study is the dual nature of the waste contractor's involvement. The waste contractor currently operating and handling the physical containers at the active school construction site is not the same waste contractor company whose managers have been interviewed for this study. This specific setting was chosen deliberately. The formal procurement and collaboration model between the main contractor and the interviewed waste contractor is slated for future projects but is not yet fully implemented at this particular site. Investigating this project thus provides a unique predictive baseline; it allows the study to analyse the current site conditions and operational baseline, while simultaneously interviewing the future strategic partner to map out the preconditions, gaps, and mutual expectations required to transition into a fully integrated, proactive waste logistics framework.

3.1.4 Interviews

To provide context for the empirical findings, the targeted roles reflect the entire operational and strategic chain of waste logistics within the project:

- **Foreman:** Manages daily on-site work and directly oversees that subcontractors and workers adhere to sorting routines at the active workstations.
- **Machine Operator:** Handles the internal logistics on-site, including the physical movement of materials and waste from building structures to the centralised sorting stations.
- **Supervisor:** Coordinates weekly production schedules, ensures resources are allocated correctly, and manages the interface between the site's progress and waste removal needs.
- **Project Engineer:** Handles the administrative, contractual, and procedural planning, ensuring that procurement setups match the project's operational targets.
- **Sustainability Coordinator:** Sets up the project's ecological targets, monitors compliance with waste legislation, and analyses overall sorting statistics.
- **Waste Contractor Managers (National and Regional):** Oversee the strategic logistics setup, transport routing, resource allocation, and contract governance from the waste management side.

Organisation	Title
Main Contractor	Foreman
Main Contractor	Machine Operator
Main Contractor	Supervisor
Main Contractor	Project Engineer
Main Contractor	Sustainability Coordinator
Waste Contractor	National Manager
Waste Contractor	Regional Manager
Waste Contractor	Regional Manager
Waste Contractor	Regional Manager

Table 3.1: Overview of interview respondents

3.2 Data Analysis

The analysis of the gathered data was executed through a thematic analysis method, which is a systematic and iterative process for identifying, coding and categorising patterns within qualitative data (Braun & Clarke, 2006; Bryman, 2016). The choice of thematic analysis is motivated by its ability to handle research areas where the terminology often is broad and inconsistent, such as in construction logistics and waste management. By applying a thematic analysis, the study has been able to transform raw data from interviews and observations into relevant themes that address the study's objective.

The process started with getting to know the interview data where the transcriptions of the nine interviews were read-through several times to create an understanding of the collaboration and different perspectives. In accordance with an abductive approach the study's research questions were used to guide the structure during the process of coding. By using the research questions as a starting point relevance segments in the text could be identified and labelled with initial codes that directly answered the study's problem formulation.

This was followed by a phase where the identified codes were grouped into broader themes. These themes were sorted and divided into the study's respective research questions to secure the analysis become focused on explaining both the logistical challenges and the successful collaboration pattern in this case. This process meant a movement from specific text segments to broader themes, which made it possible to connect empirical findings and established logistical functions such as planning, communication and reverse logistics.

To strengthen the analysis, the themes were also mapped against the logistical challenges that were identified in the literature reviews, which made it easier to compare the empirical results with existing research. By dividing the themes through the research questions a clear common thread was created in the analysis, this ensures that the conclusions are directly embedded in the gathered data.

3.3 Quality Assurance

To ensure the academic quality of the study and that the results are reliable, four criteria for quality assurance are applied: credibility, dependability, confirmability, and transferability (Lincoln & Guba, 1985).

3.3.1 Credibility

The study's credibility is strengthened by the choice to use an empirical case study as the foundation. By studying an actual construction project in its natural environment, the real prerequisites and obstacles are captured, which theoretical models often miss (Yin, 2009). This makes the results reflect the practical reality that provides guidance in the sector instead of becoming theoretical speculations, which increases the study's authenticity.

One aspect for improving the credibility is the inclusion of multiple perspectives through interviewing representatives from both the main contractor and the waste contractor. There is a risk of a one-sided or distorted image of the collaboration if only one party is interviewed, therefore it is critical to highlight both sides in a relationship inside inter-organisational research. By representing both partners' perspectives, the study can identify both common success factors and differences in how communication and responsibility are perceived (Dubois & Gadde, 2002).

In addition, the credibility is strengthened by data triangulation, where the interview responses from the main contractor have been evaluated against the observations on-site. Confirming that the interview responses actually comply in practice on-site gives a higher degree of the validity of the conclusions drawn (Bryman, 2016).

3.3.2 Dependability

The dependability of the study is ensured through a logical, traceable, and clearly documented research process, enabling review by external parties. To strengthen this criterion, the decision to study a real construction project in its natural environment has provided a concrete and verifiable foundation that can be linked to actual events and existing documentation.

Dependability is further reinforced by the inclusion of perspectives from multiple sides of the inter-organisational relationship, meaning that interviews have been conducted with both the main contractor and the waste management contractor. By contrasting the views of these two parties on the logistics processes, the risk of relying on a single party's potential subjectivity or overly favourable representation of the processes is reduced, thereby creating a more balanced and robust dataset.

According to Bryman (2016), establishing dependability in qualitative research requires the adoption of an "auditing" approach, where the researchers ensure that complete records are kept of all phases of the research process in a transparent manner. To fulfill this methodological standard, each step of the research process has been presented openly to create the needed transparency for high reliability. This includes a clear description of how the literature search was conducted with search words from academic databases, in addition to how the interview guide was designed based on the theoretical framework. The selection of representatives has been motivated by specific roles and practical experience, which ensures that the information that forms the basis for the analysis comes from persons with direct insight into the daily logistical flows. Finally, the coding processes and thematisation have been presented in detail to show how the study moved from raw data to conclusions, which makes the results a product of a thoroughly executed and traceable research rather than random observations.

3.3.3 Confirmability

Confirmability assesses to what extent the study's results can be confirmed by others and that they are not affected by the writer's own opinions or preconceived assumptions (Bryman, 2016). Therefore, an abductive approach has been applied where the theory and empirics have been integrated during the research process. This means that the conclusions were checked against well-known logistics functions, such as planning, communication, and reverse logistics.

The inclusion of perspectives from both parties has been important for confirmability. This made it possible to neutralise possible one-sided representations of the collaboration. The identified patterns in the data can be strengthened by the observations from the site visit, which creates a common thread between the responses from the main contractor and the practical reality in the chosen case.

3.3.4 Transferability

Since the construction sector often is characterised by project-specific solutions and temporary organisations, it is important to give a detailed description of the chosen case to give the reader the possibility to judge the results' transferability (Bryman, 2016). The strength of the study recurring transferability is that it investigates a project that logistically is relatively uncomplex but shows high levels of success in its waste management. By studying such a successful case, a framework is created that is more available and transferable for a large amount of construction projects, instead of focusing on mega-projects with unique prerequisites.

The inclusion of perspectives from both the main contractor and the waste contractor contributes to the transferability, this highlights universal collaboration patterns and distribution of roles that exist independently of the project's size. By framing the work as a representative example of how clear communication and proactive routines can compensate for shortcomings in construction projects, other stakeholders get the opportunity to identify similar success factors in their own activities. Although the case is specific to Gothenburg, the detailed account of the logistical links and inter-organisational benefits means that the findings can serve as a guide for similar initiatives within the wider construction sector.

3.4 Ethical Considerations

The ethical considerations in this study have been guided by established principles for qualitative research, specifically focusing on the ethical guidelines for interviewing (Kvale & Brinkmann, 2014). It was important to inform all respondents about the purpose of the study and how the collected data would be used for research purposes. Before each interview, the researcher clearly explained that participation was entirely voluntary and that respondents were under no obligation to answer all questions if they did not feel comfortable. This transparency is important for maintaining an ethical balance between the researcher's need for data and the individual's right to self-determination.

To ensure confidentiality, extensive anonymisation has been applied throughout the study. No names of individuals or specific personal data appear in the report. Respondents are instead identified solely by their professional roles and respective organisational affiliations in order to preserve the context without revealing identities. Given the focus on inter-organisational relationships and specific logistics processes, sensitive project data and internal corporate strategies have been managed with extreme caution to protect the commercial interests of the parties involved. All data collected has been stored securely throughout the study, and the raw data will be deleted once the study is completed to further ensure that no information can be traced back to individual persons at a later state.

3.5 Sustainability Considerations

Given that the study addresses waste management and the circular economy within the construction sector, it is directly linked to global and national environmental objectives. By identifying logistical success factors that contribute to higher sorting rates and reduced material waste, this work addresses the need for a more resource-efficient construction process. According to Ghisellini et al. (2018), the transition to a circular economy within the construction industry is critical to reducing the sector's environmental impact, and this study contributes practical knowledge on how proactive logistics coordination can act as an enabler for this transition. Furthermore, the study has taken social sustainability into account by highlighting how clear communication and the allocation of responsibilities can improve the working environment for the skilled workers who handle waste on a daily basis. The study's findings therefore aim to provide guidance that not only benefits the project's financial performance but also contributes to more sustainable development within the construction industry.

3.6 AI Declaration

In the production of this report, AI-based tools such as ChatGPT, Google Gemini, and NotebookLM were employed to facilitate linguistic refinement and structural organisation. It is emphasised that the entire research process, encompassing data collection, critical analysis, and the formulation of conclusions, was conducted independently by the author. No sensitive or confidential data were processed via these AI platforms, ensuring adherence to data privacy and ethical research standards. The author assumes full responsibility for the accuracy and veracity of the final document.

4
Results

This chapter presents the thesis's empirical findings. The aim of the chapter is to systematically present and synthesise the data generated through the case study of the school project in Gothenburg, the semi-structured interviews with representatives from both the main contractor and the waste contractor, and the site observation carried out.

The purpose of the results section is to provide an objective and detailed picture of the actual conditions, experiences and challenges identified in the collaboration regarding construction waste logistics.

The chapter is structured to directly address the answers to the study's three research questions:

- **Section 4.1** describes how coordination and information exchange between the construction project and the waste contractor function in current practice, with a focus on roles, communication channels and planning horizons.
- **Section 4.2** identifies and describes the critical conditions and barriers that currently hinder the establishment of effective and proactive waste logistics.
- **Section 4.3** presents the empirical findings regarding how future collaboration, division of responsibilities and information flows should be structured to support circular material flows and proactive working methods.

4.1 Coordination and Information Exchange Today

To establish a comprehensive understanding of the project's baseline waste management, it is critical to evaluate how data and operational requirements flow between the project's internal site management and the external waste infrastructure. The following subsections analyse the practical dynamics of day-to-day coordination by highlighting the communication pathways utilised on-site, examining the alignment between long-term theoretical logistics schedules and dynamic real-time site adjustments, and assessing the effectiveness of current quantitative follow-up mechanisms.

4.1.1 Communication Between Waste Contractors and Main Contractors

The information exchange between the stakeholders is characterised by a combination of formal planning structures and informal communication practices. The findings show that direct communication through face to face interaction, phone calls, and continuous dialogue remains central for handling operational issues related to waste management on site. Both workers and site management describe verbal communication as the most efficient way to provide instructions, solve practical problems, and correct sorting errors in real time.

At the same time, the interview results indicate that the formal information flow between the contractor and waste contractor is not always fully integrated into the daily production process. Although site layouts are established during the early project stages, updates regarding changed site conditions or modified logistics flows are not always continuously communicated to the waste contractor after the initial start up meetings. Since construction sites are dynamic environments where layouts, access routes, and waste collection points frequently change during production, insufficient communication can create logistical inefficiencies and coordination challenges for transporters and waste handling operations.

The findings further demonstrate that these coordination challenges are often managed through informal relationships and practical experience rather than through formalised routines. The waste contractor highlights that drivers and transport personnel frequently rely on their local knowledge of the project and their direct contact with workers on site to adapt to changing conditions. Consequently, the waste logistics process becomes dependent on personal communication and individual experience rather than systematic information exchange.

In addition, the contractor emphasises the importance of continuous communication and the inclusion of workers to create participation in the waste logistics. The results suggest that involving workers in discussions regarding sorting procedures and providing regular feedback regarding project performance creates greater understanding and motivation than solely giving instructions. Communication is therefore not only described as a coordination mechanism, but also as an important factor for creating participation and commitment to the waste management process throughout the project organisation.

A significant generation and demographic preference regarding communication channels is also observed. One of the Waste Contractors respondents note that older generations of site personnel significantly prefer personal telephone interactions and direct ad-hoc service, whereas younger engineers and coordinators view application-based ordering systems as a fundamental prerequisite for site efficiency. As one Waste Contractor bluntly states: *"The younger generation doesn't like talking on the phone either. They prefer either an email or an app, ideally"*.

4.1.2 Short-Term Operational Reactivity versus Strategic Site Planning

The results recurring the work methods shows a difference between the project's strategic planning and its operational execution. Meanwhile, the site layout plan (CLS) and the environmental plan constitute the theoretical planning and structure of the site, the results show that the practical day-to-day work is often dominated by reactive solutions instead of proactive planning. Workers at the site explain that as the tempo of production intensifies, waste management is increasingly viewed as a secondary activity, with the result that logistical needs are only addressed when they constitute a direct physical obstacle to production.

From the waste contractor's perspective, this reactive approach means that opportunities for route optimisation and resource efficiency are significantly limited. While main contractors aim for a predictable logistics chain, they are instead forced to take on the role of operational problem-solvers, responding at short notice to resolve any space constraints that emerge. The results show that the main contractor's need for short-term flexibility in the face of unforeseen waste volumes directly conflicts with the waste contractor's need for long-term planning for sustainable transport logistics.

In terms of managing these workflows, the Project Engineers highlight several positive aspects of utilising a centralised, shared logistics budget. They mention that when the main contractor controls and directs the entire waste logistics setup under one budget, it completely eliminates repetitive inter-organisational administrative coordination and minimises disputes over individual cross-charging. Furthermore, managing it centrally is described as much smoother from a spatial and site-planning perspective, as it allows the site management to exert a larger overall influence on container placements and total infrastructure flows.

However, the Project Engineer explicitly emphasise that for this centralised framework to function effectively without dissolving into carelessness, the site management must be prepared to actively *"set down their foot"* and strictly enforce consequences if subcontractors fail to live up to the established sorting targets. This operational challenge is confirmed by the Machine Operator who experience that even with continuous efforts, *"people get a bit lazy unfortunately sometimes. That's just how it is. There's no escaping it"*.

In summary, the results indicate that the lack of integration between waste management issues and regular production planning maintains a pattern of reactivity that hinders the project's overall efficiency. This highlights further from results that shows that the projects don't reach their waste goals often lack a clear integration of waste management in the production planning. When waste questions are not included in the planning and the daily work they instead tend to be handled reactively, which hinders the possibility to work proactively and efficiently.

4.1.3 Follow-ups and Performance

Both parties agree that quantitative data is of great value when it comes to follow-up and performance. Both parties describe the statistical feedback, including parameters such as fraction weights, sorting rates and cost breakdowns, as a well-functioning and essential part of the collaboration. This data-driven feedback is regarded as an indispensable tool for objectively measuring the project's performance in relation to set environmental goals and budget constraints.

Despite the statistical data being effective from a technical perspective, the results reveal a shared ambition for more in-depth, qualitative follow-up, which is, however, often limited by the fragmented project structure of the construction industry. A major barrier identified is the short time horizon and high staff rotation between different projects. The waste contractor describes that the main contractor's site management is often forced to shift its focus to the next project start before the current work has been fully reviewed, which creates a gap in the transfer of knowledge. One Waste Contractor Manager stresses that this rush represents a severe systemic weakness: *"It is difficult to achieve because usually today everything is so rushed from our customers' side so that this poor site manager... has already been assigned a new project when there are two months left"*.

Furthermore, from the waste contractor's perspective, it is emphasised that the lack of such evaluations constitutes a significant barrier to long-term development. They argue that more prioritised and thorough qualitative monitoring is required in order to translate quantitative statistics into actual behavioural changes and improved logistics flows. The comparison between the parties shows that whilst there is a shared desire for in-depth analysis, this is counteracted by an industry culture that prioritises the next project over the evaluation of the previous one.

In summary, quantitative monitoring appears to be operationally successful, whilst qualitative feedback remains an untapped potential due to the inherent time pressures of the project format. At the same time, the possibility to learn from experience is limited. One respondent from the main contractor highlights that even if environmental data and statistics are gathered, the fragmented structure and high tempo of the construction sector make it hard to execute. People with important roles can leave the project before it is finished and focus shifts fast to the next project, which makes it hard for organisational learning.

4.2 Prerequisites and Barriers for Proactive Waste Logistics

To understand why sustainable ambitions do not always translate into proactive field operations, it is necessary to examine the obstacles encountered during active production. This section outlines the structural and organisational friction between stakeholders, analyses the physical layout constraints on-site, and highlights the informational gaps and cultural habits that restrict material separation. By addressing these systemic factors, the underlying mechanics maintaining a reactive waste culture are identified.

4.2.1 Structural and Organisational Barriers

The results identify several deep-rooted structural challenges that hinder efficient waste management, where the stakeholder's perspectives highlight different sides of the same problematic.

A central barrier highlighted by the main contractor's site management concerns the asymmetrical distribution of expertise between the client and the main contractor. Respondents note that while large municipalities, such as Gothenburg in this case study, often possess dedicated environmental experts who drive stringent requirements, smaller municipalities frequently lack this internal expertise. This creates a general organisational barrier where the main contractor must take a consultative role to guide the client toward reasonable targets. However, in the chosen case, the presence of clear guidelines and expert stakeholders from the City of Gothenburg acted as a facilitator, highlighting that the clarity of requirements from the outset is a decisive factor for whether waste issues are prioritised or deprioritised in the early stages.

A prominent organisational barrier that has been identified is the "tragedy of the commons" in relation to the project's logistics budget. Several respondents from both the main contractor and the waste contractor describe, based on their previous experience, that this is a common phenomenon in construction projects. When the costs of waste management and container emptying are charged to a central project account, this often leads to a lack of individual accountability among subcontractors, where waste management is viewed as a collective service rather than a personal commitment. Without direct incentives for careful source sorting, waste logistics risks being deprioritised in favour of forward logistics.

In the case study, however, the main contractor has chosen to manage the logistics budget centrally as a strategic decision. By taking care of all the logistics setup and covering the costs, they can more easily influence subcontractors and set high standards for environmental performance, without getting stuck in discussions about the cost of each individual collection. However, the analysis shows that even though budget ownership is centralised at management level, the challenge remains in getting the individual worker to feel a personal responsibility for the waste. This suggests that the barrier is not merely financial, but rather cultural and operational.

Another barrier identified is the linear purchasing pattern of the industry, where waste management is often structurally isolated from design and material selection. Generally, waste contractors are presented with a “done deal” regarding materials with low recycling rates, which inevitably results in landfill. This structural isolation is illustrated by the waste contractor regarding unique architectural details that generate heavy waste streams without recycling options: *"If the question had been asked to us, we could have been prepared... it wasn't possible to recycle, instead it was a special landfill... If we had found out about that right from the start... then maybe they could have changed the facade cladding"*. In the investigated project, however, this barrier was partially mitigated by the client's strict technical requirements (TKA). These regulations dictate sustainable material choices and design for disassembly from the outset.

Despite these high-level strategic frameworks, a gap remains at the production level. Interviews with site personnel suggest that the vertical integration between early-stage design decisions and on-site waste logistics is not always visible to those executing the work. Furthermore, a structural conflict persists between production efficiency and waste minimisation. Even in a project with high sustainability ambitions, certain methods may be chosen based on time efficiency, potentially generating more waste. This highlights a foundational tension, where the design phase addresses long-term sustainability, the production phase remains heavily influenced by short-term operational goals and time constraints.

4.2.2 Physical and Logistical Limits

The physical environment and the logistical prerequisites appear as decisive factors for the success of the project, meanwhile the stakeholders focus on different sides of the logistics. Within the main contractor's organisation, there is a consensus that the physical space of the construction site acts as the project's game plan that sets the frames for how waste should be handled. The site management indicates that the site layout plan directly dictates the number of possible fractions and therefore often becomes the first step.

However, waste contractors identify a barrier in the form of so-called "failed collections" or "dry runs". These failed collections often occur because external logistics partners do not have access to updated site layout plans when the on-site layout changes during the duration of the project. The waste contractor emphasises that it is absolutely critical to be aware of the current physical layout in order to carry out collections efficiently. Even in cases where it is technically difficult to provide ongoing updates to drawings, the need for a dedicated logistics manager is highlighted as a factor of critical importance. By having a clear point of contact who can communicate obstacles or changes in real time, wasted trips can be avoided, saving time, costs and unnecessary carbon emissions.

Another critical internal logistical challenge highlighted by the production personnel is the vertical logistics. The waste transport from high floor levels to ground level is described as an important bottleneck. On the observation, it was noted that the use of smaller containers functioned as an enabler to address these spatial constraints. By placing smaller units closer to the actual work interface, the level of sorting increased as it simplified waste handling for the workers.

Polished data shows that while these smaller containers solve one problem, they create another problem in terms of internal logistics. The observation highlighted that it was difficult to establish individual responsibility for the transport of these containers to the main waste station. Instead of being a shared task, the machine operator had to take the main responsibility for moving and emptying them. This creates a dependency on a single role to maintain the flow, which was further confirmed by the machine operator who noted that workers often prioritise forward logistics over the removal of waste. The machine operator on-site describes the difficulties to get the workers to prioritise taking full containers to the waste station which results in containers being left standing and causing disruption to production. Therefore, for the main contractor the logistical barriers are mostly about the internal flows and how to optimise the use of the limited area to hinder the construction process.

4.2.3 Information-related Hinders

The information flows are identified as a critical prerequisite for a functioning waste management, although the results show a clear gap between the information provided and how it is received within the operational activities. The production workers from the main contractor highlighted the existing signage on the containers are often too technical and text-based, which creates uncertainties in how specific construction materials should be classified.

This challenge was clearly illustrated during the on-site observation, where it was noted that the signage on the containers was not adapted to the specific needs of the construction sector. The lack of intuitive and sector-specific guidance meant that workers often had to stop their work to ask for directions. Furthermore, the observation, combined with insights from the interviews revealed that when such knowledge was missing and no one available to ask, workers tended to dispose of waste in the wrong containers simply because they lacked the necessary knowledge of sorting. One recurring wish from the production is a transition to a more pedagogical and picture-based information on a more basic level, as explicitly stated by the Machine Operator: *"You can't be technical here. It's better to take a picture of it. I think more could have been done there... It needs to be a kindergarten-level thing"*. This seems necessary to bridge the language barriers that occur in projects with a high level of international workforce.

One barrier identified by the workers on-site is that information rarely reaches the people involved in the project's later stages. This means that information regarding waste logistics is often lost if new on-site workers do not receive a proper introduction. Production staff suggested the waste contractor to visit the site on multiple occasions to conduct educational and job-specific briefings. Without these briefings, an information gap may arise where waste handlers lack the knowledge required for correct handling, which increases the risk of incorrect sorting. The level of knowledge regarding waste management varies between projects and individuals. Meanwhile some shows a high understanding and engagement, others have a hard time understanding the purpose with sorting and sees it rather as a time demanding instead of a value created activity. However, this differs from on-site management, which clearly states that there is a comprehensive introduction for all employees, covering the company, the site and waste management.

As earlier discussed, the waste contractor highlights the absence of a follow-up meeting. While quantitative statistics are recorded right up until the end of the project, there is often no opportunity to gather qualitative and operational feedback. In practice, these evaluation meetings are rarely prioritised by the main contractor's site management, as focus and staff resources are often shifted to the next project before the current one has been formally concluded. For the waste contractor, this means that valuable feedback is lost, which makes it more difficult to address recurring information gaps in future collaborations.

The contrast in perspective becomes clear when the main contractor focuses on the need for simplified information at source during the production phase, whilst the waste contractor views the lack of continuous dialogue and joint evaluation as the primary obstacles to developing the collaboration. The information barrier is therefore not solely about what is communicated, but also about when and to whom, as well as the inability to close the information loop at the end of the project.

4.2.4 Cultural and Behavioural Barriers

The cultural and behavioural barriers appear as deeply rooted and are described by the respondents as one of the largest barriers to efficient sorting. A consistent result is that the engagement in waste issues varies considerably, depending on both the professional role and personal attitudes.

While environmental managers demonstrate a high level of knowledge and drive, the waste contractor perceives a gap in engagement further down the chain. However, findings from the project management suggest that this is not necessarily due to a lack of commitment, but rather a result of balancing environmental goals against the immediate pressures of the project's budget and schedule. This variation in perceived commitment risks sending signals that waste management is a secondary issue if not clearly communicated.

Furthermore, the results show that work methods on-site often remain highly reactive. In stressful production phases, the priority is on the progress of specific tasks, which can lead to sorting being viewed as a disruption to the construction work. This operational tunnel vision sometimes leads to workers taking the easiest route, such as using the nearest bin for mixed waste. This behaviour is occasionally reinforced by a scepticism regarding whether materials are actually recycled or merely incinerated. Interestingly, the results also suggest that the strategic sustainability framework set by the project management often functions as a "silent" enabler. Even if individual workers do not perceive their daily routines as strategically driven, the high standards maintained on-site indicate that the management's commitment has established a baseline that shapes the daily work environment more than the workers may be consciously aware of.

This focus on the single task is strengthened by a widespread culture of convenience, in which the physical obstacle, such as moving a container to the correct recycling point, takes precedence over the goal of reaching a high level of recycling. Both parties indicate a social barrier whereby skilled workers, particularly those with long experience, are reluctant to ask questions about new materials or sorting rules for fear of appearing ignorant in front of their colleagues. At the same time, a generation gap is identified as a relevant cultural factor, whilst older generations often lean towards traditional working methods, as noted by the Machine Operator: *"'This is how we've always done it.' But then you've always done it wrong... And no one has told you otherwise"*. On the other hand, the younger generation is described as being more naturally environmentally conscious and familiar with waste sorting, which is creating a gradual but slow shift in attitudes in the workplace.

To summarise, the results show that the cultural barriers are not primarily a matter of a lack of information, but rather of how individual priorities and a reactive focus on production rates prevent waste management from being an integral part of professional pride and daily routines. These behavioural challenges are strengthened by an established culture in the construction sector where time and costs traditionally are prioritised higher than environmental aspects. This creates a resistance against new work methods, where thorough sorting can be perceived as time demanding, despite it contributing to efficiency in the long term.

4.3 Future Structure for Integrated Collaboration

Transitioning from a reactive to a proactive waste logistics environment requires a fundamental restructuring of contractual relationships and operational roles. This section examines the strategies proposed by the empirical data to enable this transition, focusing on the early introduction of logistics expertise into design loops, the integration of the waste partner as a strategic resource, the assignment of clear on-site accountability parameters, and the structural integration of sub-contractor behaviors.

4.3.1 Early Involvement of Waste Contractor

The results show a strong agreement between the stakeholders, recurring one of the most crucial factors for a successful collaboration are the point of time for the involvement of the waste contractor in the project. The current practice is that the waste contractor is usually only brought in during the project's set-up phase, when site cabins are installed and the first containers are ordered. However, respondents from both the main contractor and the waste contractor point out that this late involvement limits the scope for strategic optimisation, as many important decisions regarding material flows have already been made.

A major point that emerged from the interviews with representatives of the waste contractor is their desire to be involved as early as the procurement and design stages. They argue that by providing advice at an early stage, they can influence the choice of building materials from a recycling perspective. One specific example highlighted by a Waste Contractor Manager outlines how early choice of material completely avoids landfill fractions: *"Many have the goal that they shouldn't have any landfill at all. But then you can't buy rock wool and glass wool insulation... instead maybe you should look at wood fiber insulation... That is organic material that can be sent out for energy recovery"*. Without this early dialogue, the waste contractor is often faced with a situation where they are forced to deal with materials that are difficult to recycle, chosen on the basis of technical properties or price, without consideration of long-term waste costs or environmental impact.

Furthermore, the results highlight that early involvement during the design phase can prevent costly and environmentally damaging logistical errors. The interviews reveal that architectural choices, such as those relating to façade design, can generate large amounts of waste requiring specialised disposal unless waste management expertise is incorporated into the design process. If the waste contractor had been consulted at an early stage, alternative material choices or formats could have been proposed to minimise waste volumes and ensure a more circular approach to waste management.

The main contractor's site management and supervisors share the view that early integration of waste management is desirable. It is emphasised that waste management should be viewed as a natural part of project planning from day one, rather than a separate service added at a later stage. By appointing responsible individuals early on and allowing them to collaborate with the waste contractor as early as the design phase, logistics arrangements and sorting targets can be better embedded within the project organisation. In summary, the results indicate that a shift in the waste contractor's involvement from production to planning is a fundamental prerequisite for achieving higher sustainability targets.

4.3.2 Waste Contractor as a Strategic Partner

The results show a clear intention to transform the relationship from a traditional customer-supplier model to a strategic partnership. Although, what is clear is that expectations regarding what this partnership involves vary depending on different parts of the organisation, creating a tension between the achievement of strategic objectives and operational support.

For the main contractor's management and environmental managers, the waste contractor is regarded as an indispensable expert resource for ensuring the project's environmental legitimacy. Here, the partnership is primarily about navigating complex legal requirements and certification schemes, such as BREEAM or Svanen. For management, the partnership is successful when the contractor's expertise guarantees that the ambitious sustainability targets are met through accurate documentation and traceable statistics. In contrast, the production side views the partnership through the lens of day-to-day operations. For them, a 'strategic partner' is defined more as a physically present actor on the construction site who acts as an educational resource and ensures a smooth logistics flow. Whilst management prioritises systemic control, the production side demands practical support and guidance directly at the containers.

Furthermore, a distinction emerges between the main contractor's view of the waste contractor as a reactive service function and the waste contractor's own ambition to act as a proactive decision-making support. The main contractor often values flexibility and good relations, which in practice means viewing the partner as an effective problem-solver who steps in when logistics fail. The waste contractor, however, argues that their main strategic benefit lies in acting as an advisor at source. They emphasise that a true partnership requires them to be involved early enough to influence material selection and logistics planning, which would prevent waste from arising in the first place.

4.3.3 Clearer Responsibility and Roles

The findings on how responsibilities and roles should be structured on a construction site reveal an interesting consensus regarding the need for a coordinator who is physically present on site, whilst at the same time highlighting a clear divide over the question of whom this person should represent. Both parties identify the lack of a dedicated on-site manager as a barrier, but their solutions reflect different priorities regarding control and specialist expertise.

The importance of this role was clearly validated during the on-site observation, where the environment was noted to be very clean and the containers correctly sorted. This high standard was repeatedly attributed in interviews to the presence of a dedicated logistics manager (in this case the machine operator) who took extensive responsibility for the waste flow. The main contractor strongly advocates an internal solution where the role is equal to a 'logistics foreman' or a dedicated machine operator who keeps an overall eye on the order of things. From the main contractor's perspective, the advantage of an internal resource is that they have in-depth knowledge of the site's specific dynamics and can navigate the existing hierarchy to set requirements for subcontractors. In contrast to this, the waste contractor highlights the benefits of an external party, either in the form of their own on-site staff or through a third-party logistics provider (TPL), to ensure an unbroken chain of responsibility where environmental issues are not deprioritised when production is under pressure.

However, the machine operator (responsible for the logistics) also highlighted a significant cultural challenge regarding responsibility. Despite the success of the current project, there is a perception that workers generally exhibit an indifferent attitude toward waste management, primarily focusing on forward logistics. The machine operator emphasised that for long-term change, it is crucial to ensure that every individual on-site feels personally responsible for the waste they generate. This suggests that while a central coordinator is effective for maintaining order, it may also inadvertently allow other workers to remain detached from their own waste management responsibilities.

As a practical method for strengthening this sense of responsibility, the proposal is put forward to personalise waste management by marked bins and containers for specific professional groups, or subcontractors. The main contractor regards this as a tactical tool to counteract the "tragedy of the commons", where the anonymous ownership of waste often leads to a lack of sorting discipline. By labelling bins with, for example, company names, clear ownership is established, enabling site management to trace incorrect sorting back to a specific party, thereby transforming a diffuse collective task into a measurable individual commitment. As explicitly suggested by the Foreman: *"Maybe their company name should also be on those fractions so that they feel the responsibility... That way, if it looks messy, it's quite obvious... It becomes easier for us to pinpoint where we need to make an extra effort"*. Whilst the main contractor primarily views labelling as a control mechanism to enforce contractual liability, the waste contractor emphasises that labelled bins enable them to provide more precise feedback and statistics directly to the relevant trade group. In this way, the information can be used for educational purposes rather than merely as a punitive measure.

At the same time, a significant practical limitation has been identified in this approach, as it requires more containers in areas where space is often extremely limited. The project engineer points out that, although labelled bins are in theory a good solution, the lack of space has meant that the project has instead attempted to solve the challenge through strategic choices made during the procurement phase. By prioritising subcontractors who already have strict internal requirements regarding the circular economy and sustainability, the need for extensive on-site physical control systems can be reduced. Despite these space constraints, the waste contractor emphasises that labelled bins, where space permits, make it possible to provide more accurate feedback and statistics directly to the relevant professional group.

A comparison of the parties' perspectives shows that the path towards clearer accountability lies in a combination of personal presence and traceable flows. While the main contractor views an internal "logistics foreman" as an extension of the current leadership to maintain order, the waste contractor sees an external specialist or a TPL solution as a prerequisite for moving the waste issue from the periphery of production to its core. Regardless of who holds the role, there is consensus that marked containers act as a bridge between the strategic goal and operational execution. This enables the person in charge on site to act proactively and direct efforts where they are most effective, breaking the reactive culture where waste management is seen as "someone else's problem". In summary, an effective structure requires that responsibility be made both visible and personal, whether through internal management or external logistics services.

4.3.4 Improved Information Flow

The result of how information flows should be structured shows that one of the biggest challenges lays within overlapping the gap between strategic planning and operational execution. Meanwhile both parts agree that the start meeting is an important environmental milestone, however the results show a discrepancy in how the information should be maintained afterwards. The main contractor sees a need to simplify the information at the source. This motivates mostly by the need to handle language barriers from an international workforce, where visual instructions seem to be most efficient way to minimise mis-sorting at the time.

The waste contractor, on the other hand, sees the information barriers rather because of a break in the digital communication chain. They point out that there are a wide range of digital tools, such as apps and customer portals, which could streamline logistics, but that these are often overlooked in favour of analogue channels of communication, such as telephone calls. The main contractor states that the apps and customer portals are not adapted to the construction sector and make it difficult to provide important information to the driver. As a result, the contractor uses ad-hoc communication instead.

The need for regular follow-up and a formal conclusion is a vital part of the future information structure. In this context, management explains that all new groups of workers receive an induction covering the construction site, waste management and the company, but it is interesting to note that this introduction is not mentioned by the production workers. While this could suggest an information gap, it is important to consider the duration of the project, where the respondents had been working on-site for over a year, the initial introduction may simply have been forgotten to mention due to the significant time elapsed since their arrival. The main contractor highlights the importance of the waste contractor visiting the site on several occasions to go over the instructions and adapt them to the different phases of the project. Meanwhile the waste contractor emphasises the lack of structured project closure meeting as a barrier to long-term improvement. This means that the waste contractor sees a meeting at the end of the project as a vital solution to improve the communication.

4.3.5 Partnering and Subcontractor Integration

Beyond technical solutions, the results highlight that the choice of delivery method, specifically Partnering, is a decisive factor in the project's waste management success. In a partnering arrangement, the traditional adversarial relationship between stakeholders is replaced by transparency and shared goals. For waste logistics, this means that the main contractor and the waste contractor can work towards long-term environmental targets without being hindered by the rigid contractual disputes over costs that often characterise traditional projects.

A critical aspect of this structure is the integration and management of subcontractors. In this project, the main contractor takes full responsibility for the logistics budget and infrastructure, such as providing all waste containers and handling equipment. While this centralises the costs, it serves as a strategic tool to steer subcontractor's behaviour. By removing the economic discussion regarding waste costs from the subcontractor level, the main contractor can instead focus on setting high operational standards and requirements for sorting. However, the findings also suggest that for this integration to be fully effective, the waste contractor must be an active part of the interface. Rather than just being a recipient of waste, the waste contractor functions as a quality auditor whose feedback (data and statistics) allows the main contractor to manage subcontractors more effectively, ensuring that circular ambitions are translated into practical compliance by all trades on-site.

5
Discussion

In the following chapter, the academic literature is synthesised and evaluated against the empirical findings in order to address the primary research questions. By contrasting established theoretical constructs with the operational realities of the case study, this analysis aims to deepen the understanding of the mechanisms governing current construction waste logistics and to outline a proactive management model. The discussion evaluates each research question individually, moving from an analysis of current informal communication habits to a mapping of systemic barriers, and concluding with the operational integration of the framework.

5.1 Collaboration and Information Exchange Today

The integration of a partnering model within the investigated school project reveals a fundamental departure from the construction industry's traditional procurement habits. Historically, traditional contracts have relied on what Gadde and Dubois (2010) describe as the arm's-length principle; a structural isolation that creates adversarial boundaries and severely restricts operational efficiency. By establishing a high-involvement relationship from the outset, the partnering arrangement in this case study provides the exact organisational baseline required to cultivate the long-term inter-firm learning demanded by Bygballe et al. (2010).

However, the empirical findings demonstrates an operational paradox: while the partnering model successfully removes contractual friction at the management level, it does not automatically eliminate behavioral reactivity at the production terminal. When this strategic collaboration framework encounters the high-pressure dynamics of the active construction site, personal human relationships and ad-hoc communication become both the vital mechanism for resolving daily logjams and a barrier to widespread development.

5.1.1 Strategic Alignment and Operational Reality

A major point in the literature is that a successful supply chain requires a shared attitude, or Supply Chain Orientation (SCO), in which all parties strive for systemic sustainability rather than local sub-optimisation (Jadhav et al., 2019; Lambert & Cooper, 2000). The results of the case study confirm that this orientation is deeply rooted at the management level, where strong horizontal integration prevails. The environmental managers and project managers share a clear vision of circular flows. However, when this strategic alignment is set against operational reality, the study's results provide an important nuance to the theory. While Jadhav et al. (2019) presents SCO as a cohesive prerequisite for sustainability, this study shows that proactive horizontal integration at the strategic level is insufficient if vertical integration is lacking at the operational level.

An analytical gap arises where management plans for a Closed-Loop Supply Chain (CLSC) to recover value, while the trade workers operate within a linear production paradigm where waste logistics is viewed as a disruptive factor. This discrepancy indicates that the SCO models presented in the literature are often based on a homogeneous organisational culture, which, in the complex reality of construction projects, is instead fragmented into various subcultures with conflicting priorities.

The fact that this gap exists in current practice can be analytically linked to the construction industry's deeply embedded focus on forward-looking production and short-term financial management. In an environment characterised by tight deadlines and the risk of penalties for delays, a culture emerges in which anything that does not directly contribute to the physical construction is deprioritised. Despite the partnering model's soft values and management's environmental vision, the strict demands on production rates on the worksite remain, meaning that circular initiatives, which often require more time for sorting and planning at source, are viewed as a privilege rather than an integral part of the work. This means that the proactive decisions taken in the boardroom are diluted the further down the organisation they reach, as trade workers' incentives are linked to production rates rather than sorting rates.

5.1.2 Informal Communication and Personal Dialogues

A prominent feature of how cooperation and information exchange operate in current practice is the strong reliance on personal and direct communication. Although formal policy documents exist in the form of site layout plans (SLP) and environmental plans, the empirical results show that day-to-day coordination between trade workers and site management primarily takes place face-to-face at the production site. In the dynamic environment that characterises the construction site, immediate verbal dialogue is regarded as by far the most effective way of giving instructions, correcting sorting errors, and resolving logistical issues as they arise in real time.

This preference for direct dialogue is deeply rooted in the logic of the construction industry. As Le et al. (2025) highlight in their research, face-to-face dialogue and verbal discussions are often the preferred method for quickly building a shared understanding, providing immediate feedback, and resolving problems logically on the spot. This is also consistent with Dubois and Gadde (2002) established theory of the construction industry as a loosely coupled system. As construction projects consist of temporary organisations and fragmented supply chains, formal communication protocols often tend to take a back seat in favour of informal networks and direct, personal relationships.

5.1.3 The Role of the System Integrator

The results provide strong support for the theory that a dedicated logistics function is crucial to a project's success. Ekeskär and Rudberg (2022) describes the need for a "system integrator" who is essential for managing flows, and in the project under investigation, it is clear that the machine operator with logistical responsibility has been a direct contributing factor to the success of the waste logistics. By having a person acting as a link between production and the site management, the project has been able to maintain a high sorting rate and a clean workplace.

A critical point of discussion raised in the empirical data is whether this role should be internal to the construction contractor or belong to the waste management contractor. Whilst the literature on third-party logistics often emphasises the benefits of external specialists, as explained by Fredriksson et al. (2021), this study indicates that an internal system integrator has been successful in this case precisely because it does not create an additional communication channel. By avoiding an extra party in an already fragmented project, the risk of information disruptions is reduced.

Despite the clear value of the role, the analysis reveals a challenge regarding the operational division of responsibilities. Although the integrator is intended to act as a strategic and coordinating link, observations show that the person in charge of the project has had to shoulder a large amount of physical responsibility. It is evident that this single role has personally emptied or moved almost every container, creating a discrepancy between the role's actual purpose and its practical application. Instead of the logistical responsibility being distributed amongst the actors who actually generate the waste, it falls on a single individual. This means that the project's proactivity relies on personal dedication rather than being systematically embedded in the organisation's overall procedures.

The collaboration is currently very successful in operational terms thanks to the system integrator's presence, but there is a clear requirement to distribute operational responsibility within the collaborative framework to ensure that the role remains a steering and coordinating one rather than merely an executive one.

5.1.4 Quantitative Success and Qualitative Learning

The reliance on individual staff members and person-based logistics leads to the next analytical finding, which concerns the difficulty of translating operational success into organisational learning. Bygballe et al. (2010) emphasise that long-term collaboration and partnering should lead to learning, and the statistics from the studied project indicate quantitative success with a high sorting rate. However, a deeper analysis using theories of circular supply chains reveals qualitative stagnation. Theories in this field are based on the principle that the loop must be closed in terms of information, which means that data from the end of a process must be fed back to the beginning to enable future improvements. It is therefore not enough merely to recycle the physical material; there must also be a flow of knowledge regarding the underlying causes of the problems that have arisen during handling.

The collection of environmental statistics functions well from a quantitative perspective, but a deeper assessment highlights that qualitative learning and continuous knowledge transfer are restricted by the fast-paced nature of the sector. Because site management is pressured to move rapidly onto subsequent construction assignments as completion approaches, the structural capacity to close the qualitative information loop remains a significant vulnerability within the temporary project form. This prevents quantitative metrics from being translated into real behavioral modifications, showing that quantitative achievement is not automatically synonymous with qualitative framework development.

5.2 Prerequisites and Barriers for Proactive Waste Logistics

The analysis of the study's second research question reveals that proactivity is a complex balance between the project's strategic framework, the physical environment, and the behaviour of the on-site workers. A proactive approach requires greater resilience to anticipate disruptions before they affect production, a capability that is often lacking in the industry's reactive logic. According to Ruzieh et al. (2025), logistical shortcomings often result in up to a third of working time being wasted, making the examination of the identified barriers crucial to the project's actual productivity.

5.2.1 Economic Asymmetry and the Tragedy of the Commons

One of the most fundamental structural barriers to proactive waste logistics lies in the allocation of financial responsibility. As Ghisellini et al. (2018) highlight, clear financial benefits and incentives are a precondition for circular models to work in practice. However, the empirical results show that a situation similar to the "tragedy of the commons" often arises on construction sites when waste costs are centralised. When the cost of removal and landfill is charged to a joint project account rather than the individual subcontractor, the direct financial incentive for careful source separation risks disappearing.

This issue is confirmed by Ruzieh et al. (2025), who argue that unclear allocation of responsibility and a lack of transparency regarding waste costs lead to individual actors tending to sub-optimise their own processes to save time, which is detrimental to the project's overall environmental performance and finances. In the case study examined, the main contractor has made a conscious strategic choice to manage the logistics budget centrally. The aim of this choice by the project engineers is to be able to set a high standard and impose strict requirements without getting into financial discussions with subcontractors about the cost of each individual container.

However, the analysis shows that even though budget ownership is established at the management level, a challenge remains in getting individual workers to feel a personal sense of responsibility for waste. As incorrect sorting does not have a direct financial consequence for the person carrying out the task, waste management is often viewed as a collective service rather than an integral part of the work process. In environments with tight deadlines, the pressure to meet production times is therefore a more decisive source of negligence than a lack of knowledge, which underlines the need to make environmental work measurable at both individual and group levels in order to achieve genuinely proactive logistics.

5.2.2 Physical Constraints, Micro-logistics, and Internal Bottlenecks

The physical environment and site layout planning appear to be decisive factors in the project's proactive capacity. According to Hawarneh et al. (2021), the tendency to prioritise production over logistics areas for waste is a universal problem across the sector, which often results in sub-optimal transport routes within the construction site. In the case studied, this was addressed proactively through micro-logistics, where smaller containers were placed in direct proximity to the work stages. This physical proximity lowered the barrier to sorting that would otherwise arise due to long distances, thereby creating better conditions for correct material handling close to the source.

However, the analysis reveals that the solution to a spatial problem immediately created a new internal bottleneck in the project. The observations showed that the sub-trade workers consistently prioritised forward-looking production over transporting full bins to the central collection points. This creates a clear conflict between proactive planning in the form of small bins close to the work and reactive behaviour where bins are emptied only when they physically hinder the work in progress. As Hosseini et al. (2015) explain, return logistics is traditionally regarded as a secondary support activity, which in this case led to waste management coming to a standstill despite favourable physical conditions.

Here, the theory presented by Ekeskär and Rudberg (2022) on person-dependent systems is particularly relevant, as the responsibility for waste removal fell heavily on the machine operator who was responsible for the logistics. When other stakeholders on the construction site do not regard waste removal as part of their own tasks, the logistics framework becomes extremely vulnerable to disruptions. The theoretical advantage of micro-logistics therefore fails when it is not backed up by distributed ownership of the physical flow throughout the organisation. The conclusion drawn from this phenomenon is that physical logistics solutions require organisational counterparts to be sustainable over time, as a single individual cannot compensate for the lack of collective responsibility in the production chain.

5.2.3 Information Asymmetry and Visual Management

A significant barrier to proactivity is the difficulty of integrating the specific knowledge possessed by the waste contractor into the day-to-day work on the construction site. The findings reveal a clear gap between strategic planning and operational understanding, as the initial information often fails to reach the site staff. It is telling that none of those interviewed in the production team mention the project start-up meeting as a source of information, but instead highlight the occasions when personal guidance has been provided directly on-site by the machine operator or foreman as crucial. This suggests that the knowledge shared before work begins quickly loses its relevance if it is not followed up through physical presence and continuous support out at the production site.

The analysis also highlights an issue regarding the design of signage in the investigated case, as the information displayed at the containers is not perceived as being fit for purpose in relation to the specific needs of the construction sector. This lack of visual support places an increased cognitive burden on workers during the sorting process, which undermines the project's environmental ambitions. Interestingly, the empirical findings shows that the waste contractor intended for the future collaboration is considered to possess the appropriate tools required for effective visual communication. The challenge therefore lies not in the absence of a functioning system, but in ensuring that the correct type of signage is actually implemented and used in day-to-day operations to support the principles of Visual Management.

This lack of information sharing is highlighted by research conducted by Ruzieh et al. (2025), which emphasises that information often becomes trapped in administrative silos, thereby hindering vertical integration. Although information has been provided to all stakeholders prior to the project start, the results show that knowledge of waste management remains inadequate once production begins. This is a structural challenge where paper-based information provided in advance cannot replace the immediate guidance required to lower the barrier to correct behaviour. To achieve proactive logistics, a shift towards Visual Management is therefore required, where existing and adapted solutions are integrated into the physical environment to ensure that the information serves as an active decision-making support for those handling the materials.

5.2.4 Time Pressure and Waste Culture

The reactive nature of today's construction logistics stems largely from deeply rooted cultural and behavioural norms within the sector. Ajayi et al. (2017) describe a widespread culture of waste, in which waste is seen as an inevitable side effect that takes a secondary place to both time and cost. This culture manifests itself in the empirical data through a clear culture of convenience, where time pressure creates an operational tunnel vision among the workers. When the pace of production intensifies, the easiest route is often chosen, which means that waste is mixed so as not to interrupt one's own workflow. Based on Ajzen (1991) theory of planned behaviour, this can be analysed as the workers' actions being guided by the perceived norms on-site; if site management signals that rapid progress is more important than correct sorting, the motivation for proactive logistics will be minimised.

The analysis also reveals a demographic nuance in the form of a generational divide regarding attitudes towards environmental responsibility. Whilst the older generation often leans towards traditional working methods and established routines, younger workers demonstrate a more natural drive for environmental issues and sustainability goals. This suggests that the construction sector is undergoing a paradigm shift, but that barriers in the form of time pressure and a culture of convenience remain stronger than individual attitudes. For proactive waste logistics to become a reality, these behavioural barriers must therefore be addressed by making sorting a natural part of professional pride and daily routine.

Proactivity cannot be achieved solely through technical systems if the current norms on the construction site are contrary to environmental goals. If waste management continues to be viewed as an extra task carried out only when time permits, circular ambitions will remain secondary to the pace of production.

Visible leadership from the supervisor and foreman is therefore required to redefine what it means to work efficiently, where logistical order and correct sorting are valued just as highly as the physical progress of the construction. By integrating these values into the core of the project, resistance to change can be reduced and the conditions created for a more sustainable and proactive approach in future projects.

5.3 The Proactive Waste Collaboration Framework

To transform construction waste logistics from a fragmented support function into a proactive driver for closed-loop sustainability, this study proposes an integrated process architecture: The Proactive Waste Collaboration Framework. While previous sections discussed individual operational components, this section contextualises these insights into a formal, integrated framework composed of four interconnected pillars. This framework synthesises early contractor involvement, hybrid logistics support, qualitative feedback loops, and personalised accountability into a cohesive, reinforcing system, as visualised in Figure 5.1.

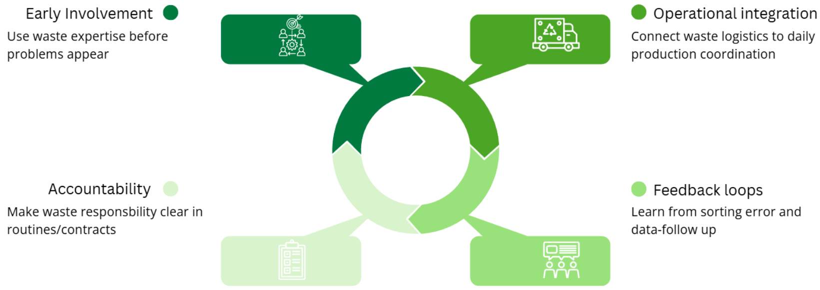

Figure 5.1: The Proactive Waste Collaboration Framework for integrated construction waste logistics.

5.3.1 Early Involvement within the Framework

A cornerstone of the proposed framework is that the waste contractor's expertise must be integrated well before physical assets are deployed on-site. Othman and El-Saeidy (2024) argue that the requirements for waste logistics must be established as early as the design phase in order to influence material selection and eliminate waste at source. This view is supported by Brandão et al. (2021), who argue that the greatest circular gains are achieved by allowing the waste contractor to review design documents based on the practical recyclability of components. The empirical data confirms that stakeholders view this early integration as an absolute necessity, as the waste contractor possesses unique market intelligence regarding fraction purity metrics that the main contractor lacks.

The procurement phase introduces a structural conflict when logistics experts are kept isolated from material purchasing loops. While respondents across both firms advocate for pre-production dialogue, standard processes frequently exclude the waste partner until site mobilisation, which matches Janné and Rudberg (2020) observations that external logistics partners are typically treated as isolated service vendors rather than integrated nodes in the supply chain.

To bridge this gap, the Early Involvement pillar of the framework mandates that the waste contractor transitions into an active advisory partner during the design stage. By reviewing material procurement contracts the waste contractor helps the project engineers systematically eliminate landfill liabilities before materials are purchased, transforming procurement into a circular gateway.

5.3.2 Strategic Partnering and the Hybrid Framework Architecture

With regard to the operational phase, Ekeskär and Rudberg (2022) and Fredriksson et al. (2021) argue that third-party logistics can mitigate widespread inefficiencies by transferring total flow responsibility to an external specialist. However, the case study nuances this external integration theory by exposing an inherent power struggle regarding on-site operational control. While the waste contractor seeks a proactive, strategic mandate, the internal production team heavily prefers an internal chain of command to maintain operational flexibility and manage sub-trades without external interference.

To resolve this operational paradox, the framework introduces a Hybrid Framework Architecture as its second core component. Instead of displacing internal leadership, the waste contractor functions as an embedded specialist resource supporting an internal systems integrator (in this case the machine operator). The waste contractor provides real-time materials guidance, visual management assets, and fraction auditing, while the main contractor's site staff retain formal supervisory authority over subcontractors.

This hybrid framework balances the external expertise demanded by literature with the localised, fluid problem-solving capacity required by practical site realities. It reduces institutional resistance against external actors, framing the relationship as a balanced exchange: the main contractor enforces daily site discipline, while the waste contractor maintains compliance with circular economic objectives.

5.3.3 Closing the Framework's Information Loop: From Data to Learning

A vital element of Circular Supply Chain Management within this framework is closing the data loop to achieve continuous organisational learning. While Le et al. (2025) and Ruzieh et al. (2025) champion digital visibility and real-time tonnage metrics as the primary solutions to logistical gridlocks, the case study reveals a critical gap: quantitative metrics flow flawlessly, yet qualitative learning regarding behavioral errors remains entirely absent.

This exposes a conflict between technical data tracking and the time-compressed nature of the construction sector. Even though data-sharing theoretically fosters system sustainability (Lambert & Cooper, 2000), today's reporting is purely one-way. Site management rarely allocates time to analyse waste statistics until the project concludes and the personnel disperse to subsequent project startups, causing valuable operational insights to be lost.

The Operational Learning pillar of the framework directly addresses this vulnerability by institutionalising qualitative evaluation loops into the active project rhythm. Rather than waiting for post-mortem statistics, the framework requires the main contractor and waste contractor to conduct joint "waste walks" and visual on-site reviews. By analysing physical sorting deviations in real time, the parties can immediately determine if an error stems from a layout constraint, generic signage, or intense schedule pressures.

This alignment is important given the differing operational priorities highlighted by the empirical findings. While the project manager emphasises the need for continuous feedback during production to maintain workflow efficiency, the waste management contractor stresses the importance of combining this continuous feedback with a formal debriefing after the project. Establishing an effective framework therefore requires striking a balance between these two perspectives. Relying solely on feedback during the production phase risks limiting long-term learning and continuous improvement from one project to the next, meanwhile relying exclusively on post-project evaluations fails to address immediate behavioural issues on site or operational inefficiencies. This ensures that quantitative reporting is paired with qualitative context, converting raw operational figures into actual behavioral modification and driving multi-project continuous improvement.

5.3.4 Contractual Incentives and Personalised Accountability

To ensure the long-term viability of the framework across highly constrained sites, financial and physical personalisation mechanisms must be established during the initial contracting phase, forming the final pillar of the framework: Personalised Accountability. Ghisellini et al. (2018) emphasise that clear financial visibility is a baseline prerequisite for the success of circular business models. To prevent the centralised budget from inducing a "tragedy of the commons" among sub-trades, the main contractor must codify precise performance expectations into the initial subcontractor tender documents.

To overcome severe spatial restrictions without demanding permanent, multi-fraction container setups, the framework proposes a flexible micro-logistics routine: personalised, time-bound asset allocation. Instead of deploying a static, highly crowded container array, specific mobile bins are temporarily dedicated and stenciled with the name of a single subcontractor during their peak material generation phases.

This mechanism directly addresses site spatial barriers through dynamic rotation rather than static expansion. By transforming anonymous containers into traceable assets, the framework increases sorting discipline at the immediate work interface. When paired with the partnering model's focus on mutual trust, this framework transitions waste logistics from an unpriced collective utility into a transparent, measurable, and highly professionalised operational function.

6 Conclusion

This chapter synthesises the study's theoretical framework and empirical findings by presenting definitive answers to the three research questions. The overall objective has been to investigate how collaboration and information flows between the main contractor and the waste contractor can be optimised to enable proactive waste logistics that support a circular economy. Following the answers to the research questions, the chapter outlines the study's theoretical and practical contributions, and concludes with a combined reflection on the project's limitations and recommendations for future research.

6.1 Answering the Research Questions

How do collaboration and information exchange between the construction project and the waste contractor function today?

The findings reveal a clear operational gap between strategic environmental goals and field execution. While upper management on both sides shares a long-term, trust-based commitment to circular material loops, this strategic alignment is heavily diluted by active production pressures. In day-to-day operations, communication relies almost entirely on personal, face-to-face dialogues and informal telephone contact rather than formal planning tools or the waste contractor's digital portals. While this immediate verbal exchange provides exceptional flexibility for the Foreman and trade workers to solve real-time logistical bottlenecks, it actively bypasses structured documentation.

Consequently, the project misses critical opportunities for systematic, multi-project learning. Furthermore, maintaining the interface relies excessively on a single person-dependent node, the Machine Operator acting as an internal system integrator. Because this internal asset must spend valuable operational hours physically moving bins and manually correcting subcontractor sorting errors, the role becomes reactive, limiting its capacity to drive systemic proactivity.

Which are the prerequisites for establishing a proactive approach to waste logistics?

Transitioning to a proactive waste logistics approach requires overcoming deeply rooted structural, physical, and cultural barriers. Structurally, a centralised logistics budget often creates "tragedy of the commons", as individual subcontractors lack direct financial accountability for the waste volumes they generate. However, the study shows that integrating explicit sorting targets and legal consequences directly into initial subcontractor procurement contracts effectively eliminates this economic asymmetry.

Physically, deploying micro-logistics in the form of smaller mobile bins close to the trade workstations is a critical prerequisite for lowering the behavioral barrier to correct material separation. Meanwhile, this visual and physical proximity fails if it is not supported by distributed ownership of the internal transport flow, as trade workers systematically prioritise forward production over moving full bins to the ground-level terminal.

Culturally, generic text-heavy signage increases the cognitive load of a highly internationalised workforce during fast-paced production phases. To break this culture of convenience, the main prerequisite is visible on-site leadership combined with simplified, construction-specific visual management.

How should the coordination and information exchange between the main and waste contractor be structured considering the prerequisites for the proactive approach?

To successfully enable proactive waste workflows, the interface between the firms must be operationally integrated through three collaboration mechanisms within a framework. First, the Waste Contractor Managers must be brought to the design table during early material procurement phases. This early involvement allows the waste contractor to screen the circular potential of components, such as insulation materials, and eliminate landfill waste before it ever arrives on site.

Second, the relationship must adopt a hybrid partnership model. The main contractor's field staff retain the necessary supervisory command to enforce sub-trade compliance, while the waste contractor assumes an active advisory role, providing job-specific worker training and visual management support directly to the internal system integrator.

Third, the partnership must institutionalise qualitative feedback loops, such as regular, joint "waste walks" during production. Supplementing automated quantitative statistics with real-time qualitative evaluation allows the parties to immediately identify the root causes of mis-sorting, closing both the informational and material loops.

6.2 Research Contribution

6.2.1 Theoretical Contribution

This study contributes to the academic literature on construction logistics and Circular Supply Chain Management (CSCM) by investigating the under-researched reverse material interface between main contractors and waste contractors. By shifting the geographical context outside of hyper-dense metropolitan infrastructure projects, the study expands the understanding of how reverse logistics can be systematically deployed. Furthermore, it adds a critical vertical dimension to the concept of Supply Chain Orientation (SCO) in construction; it demonstrates that high-level horizontal alignment between corporate boards is operationally insufficient if it is not supported by strict visual and contractual integration down to the field workforce.

6.2.2 Practical Contribution

For industrial practitioners and project engineers, this study provides a concrete roadmap to move away from transactional, arm's-length procurement toward strategic circular partnerships. It provides commercial justification for early waste contractor involvement, demonstrating that optimising material and packaging structures pre-construction yields severe waste minimisation benefits. Operationally, it offers field-tested guidance on deploying micro-logistics and visual sign matrices, successfully reducing the cognitive load on workers during fast-paced finishing phases and eliminating the internal transport bottlenecks that routinely paralyse site productivity.

6.3 Limitations and Future Research

Despite its strategic insights, several contextual boundaries limit the generalisability of this study, which in turn outline critical pathways for future academic inquiry. First, the reliance on a single case study of a school project in Gothenburg inherently restricts the direct transferability of the results to mega-infrastructure developments or heavily restricted inner-city environments with far more complex site geometries. Future research should therefore evaluate the proposed framework across varying project scales and densities to test its operational resilience.

Second, because the active construction site utilised a container supplier different from the specific waste firm interviewed for the strategic partnership, the operational resources and unique digital portals of the future partner could not be empirically observed in motion. Future studies must evaluate projects where the strategic partnership has been fully implemented to analyse whether specific boundaries of the partnership surface during execution.

Third, while the study establishes that sub-trades generate the vast majority of on-site materials, subcontractors were excluded from the primary interview loops due to scope boundaries. Omitting their direct perspective risks bypassing localised behavioral nuances regarding time pressures and informal site norms. Future inquiries should heavily incorporate the subcontractor's viewpoint, examining how joint key performance indicators (KPIs) and shared contractual incentives can be structured to foster distributed ownership of the sorting process.

Finally, this thesis isolated the active production stage, leaving the actual design loops unobserved. Future research should quantify the explicit financial and environmental returns of early waste contractor involvement through longitudinal studies, tracking reductions in landfill volumes and total transport movements across the complete project lifecycle.

7
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Appendix A

Interview Guide

Introduction

- Would you please briefly introduce yourself and describe your role within the organisation or project?

Current Situation, Roles, and Prerequisites

- Looking at the entire process from the moment material becomes waste on the construction site until it leaves the project or undergoes further treatment, how would you describe your or your organisation's role in that flow?
- What does waste management in a construction project mean to you, based on your role?
- What are your previous experiences with waste management or waste logistics in construction projects?
- Which organisational, logistical, or technical prerequisites do you consider most critical for waste management to function efficiently and sustainably?
- What information is currently shared between the construction contractor, the site organisation, and the waste management contractor?
- Which digital tools, platforms, or other communication channels are used to communicate regarding waste and waste logistics?
- To what extent is information about upcoming waste volumes or changing needs shared before the need actually arises?

Challenges, Barriers, and Methods of Working

- How do you perceive that waste management functions in this project, or in construction projects in general?
- What are the greatest challenges or barriers to achieving a smooth and seamless waste logistics flow?
- Does the organisation primarily work reactively, solving problems as they

arise, or are there proactive strategies in place to prevent problems and reduce waste?

- How is it determined when a container or skip needs to be collected or emptied?
- How does the logistical setup on the construction site affect the quality of waste sorting?
- How do you perceive the level of knowledge and the attitudes regarding waste sorting and waste management?
- How do you perceive that the division of responsibility functions between the different actors?

Collaboration, Follow-up, and Development

- How would you describe the current collaboration between the construction contractor and the waste management contractor?
- At what stage in the project should the waste management contractor be involved to contribute the most value?
- What role do you think the waste management contractor should ideally have in a construction project?
- How are waste management and waste logistics followed up on or evaluated today?
- How do you work with long-term collaborations or partnerships within waste management and waste logistics?
- From the perspective of your role, what could be improved to make waste management function better?
- If you were to design an optimal information flow for waste management from scratch, what would it look like?
- Is there anything we haven't discussed that you feel is important for me to take away from this?

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