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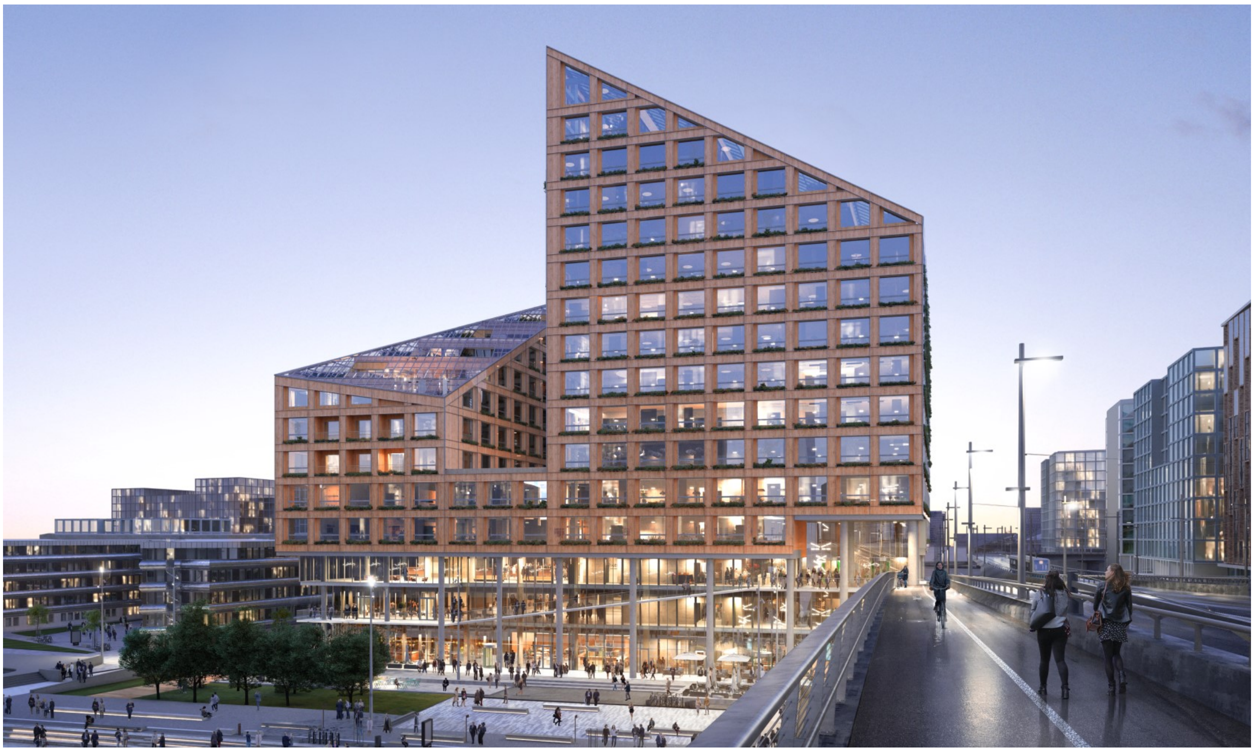

Figure 0.1: Render of the project Kaj 16. Picture: Vasakronan/TMRW

Information Needs and Barriers in the Construction Reuse Market

Developing a Framework for Information Structuring

Master's thesis in Design and Construction Project Management

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Cover: Render of the Kaj 16 project.

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Abstract

The construction industry is one of the largest contributors to waste and greenhouse gas emissions, making the transition towards circular strategies such as material reuse increasingly important. However, the implementation of reuse in Swedish construction projects remains underdeveloped, in part due to the lack of standardized information structures and workflows for reused materials. This study investigates the information needs of key actors in the Swedish construction industry to enable efficient handling of reused construction materials in digitalized projects. A qualitative approach was adopted, combining a literature review, a semi-structured interview study with 16 participants across 14 interviews, and a case study of the Kaj 16 project in Gothenburg. The findings confirm that contractors, reuse suppliers, designers and clients each have distinct information needs that must be met at different stages and points in time. Several barriers were identified as hindering efficient information flows, including inconsistent inventory practices, the absence of mandatory information criteria on reuse platforms, late involvement of key actors, and a fragmented market structure based on informal networks. Based on the empirical findings and identified barriers, a supplier information framework is proposed, structured around four process stages: inventory, condition assessment, market communication and integration. The framework specifies minimum information requirements per stage, distinguishes between baseline and complex element requirements, assigns role responsibility and emphasizes timing as a critical dimension. The study concludes that the primary challenge for digitalization of reuse processes is adoption rather than technological availability, and that establishing clear information expectations at the procurement stage is essential for enabling more structured and systematic reuse in Swedish construction.

Keywords: reuse, Swedish construction, information Management, digitalization, reuse market, standardization, logistics, circularity.

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Sammanfattning

Byggindustrin står för stora mängder avfall och växthusgasutsläpp vilket gör det allt viktigare att hitta hållbara lösningar, till exempel materialåterbruk. Materialåterbruk i byggsektorn är fortfarande underutvecklat, vilket till viss del beror på avsaknad av strukturerad informationshantering och standardiserade arbetssätt. Följande studie undersöker effektiviseradet av informationsöverföring mellan viktiga aktörer inom den svenska byggindustrin. Studien är kvalitativt genomförd och bygger på en litteraturstudie, intervjuer samt en fallstudie av projektet Kaj 16 i Göteborg. Resultat visar att centrala aktörer har olika informationsbehov som behöver hanteras i olika stadier av projektet. Studien identifierade också flera hinder som försvårar effektiva informationsflöden, till exempel icke standardiserade verktyg och processer, brist på tydliga informationskrav samt en fragmenterad marknad som bygger på informella nätverk. Baserat på dem empiriska resultaten och hinder som identifierats så föreslås ett ramverk kopplat till informationsflöden, strukturerat kring fyra processer: inventering, skickbedömning, återbrukskommunikation samt integration. Ramverket beskriver relevanta informationsbehov i dessa olika steg, skillnader i produktkomplexitet samt möjliga rollansvar. Studien drar slutsatsen att en stor utmaning för digitalisering av återbruksprocesser är adoption snarare än teknisk tillgänglighet, och att tydliga förväntningar om information i upphandlingsskedet är avgörande för att möjliggöra ett mer strukturerat och systematiskt återbruk inom svensk byggindustri.

Nyckelord: Återbruk, svensk byggindustri, informationshantering, digitalisering, återbruksmarknad, standardisering, logistik, cirkularitet.

Acknowledgements

This master thesis report concludes five years of studying civil engineering in the department of Architecture and Civil Engineering at Chalmers University of Technology. The thesis was conducted during spring of 2026.

The completion of the thesis was made possible with the guidance and support from our supervisors. We would like to express our utmost gratitude to our supervisor Ahmet Anil Sezer at Chalmers for inspiring and guiding us throughout the whole process through many meetings and valuable feedback. We would also like to thank our supervisor Fredrik Olsson at Sweco, who has given useful advice and insights from his experience for the thesis subject. In addition, we are thankful to everyone involved in the Kaj 16 project and for the valuable conversations held at the Kaj 16 project office.

Lastly, we would like to thank all the interviewees who participated for giving us the time to share their experiences. We hope that your knowledge and expertise will guide the construction industry towards circularity with this thesis.

Anthony Foronda & Joel Erlandsson, Gothenburg, June 2026

Glossary List

Building Information Model (BIM)	A digitalized method for managing and sharing building information across design and construction stages to improve collaboration and information exchange.
Circular Supply Chain	A supply chain model where materials are reused, refurbished or redistributed instead of disposed of at the end of their lifecycle.
Digital Product Passport (DPP)	A digital system containing lifecycle, technical and environmental information about a product to improve traceability and circularity.
Construction Consolidation Centre (CCC)	An off-site logistics hub used to store, coordinate and consolidate construction materials before delivery to site.
Information Management	The process of collecting, structuring, storing and sharing information related to reused materials and construction processes.
Reuse Hub	A storage or logistics facility where reused materials are stored, sorted, refurbished or redistributed.
Reverse Logistics	The process of moving materials back through the supply chain for reuse, refurbishment, recycling or recovery.
StreamBIM	A cloud-based BIM platform used for viewing, sharing and managing digital building information and project models in construction projects.
Third Party Logistics Provider (TPL)	An external logistics company responsible for transportation, storage and coordination of materials within construction supply chains.
Virgin Material	Newly manufactured construction materials that have not previously been used in another project.

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1
Introduction

The introduction will provide background information for the study and present the thesis topic more in-depth as well as showcase the research questions and the limitations of the project. Additionally, the frame and scope of the project will be presented.

1.1 Background

The construction industry has a great environmental impact, accounting for approximately 50% of all extracted materials and being responsible for over 35% of waste in the EU. This sector also represents 5-12% of the national GHG (greenhouse gas) emissions from the material extraction, construction and renovation of buildings (European Commission, n.d.a). The growing concern has led the European Union to set a goal of becoming climate neutral by 2050 and to reduce the GHG emission by 55% by 2030. For these reasons, the construction industry must improve its efficiency and highlight the issues that exist (European Commission, n.d.b). In Sweden however, the GHG emission accounted for 22% in 2022 due to heating of buildings, production of construction materials and transport (Boverket, 2025).

Many companies now seek to lower emissions, to align with government requirements and gain other benefits such as acquiring sustainability certifications (Ajirotutu et al., 2025). Showcasing greater sustainability work for a project attracts both investors but is also vital for the tenants as this could lower the energy costs that is accompanied by lower $CO2$ emissions (Ajirotutu et al., 2025). These improvements also support Sweden's climate goals of zero emissions by 2045, which was adopted in 2017 (Swedish Environmental Protection Agency, 2026).

Along with the development of regulations and goals, circular economy (CE) has become a frequent topic, when discussing the future of the construction industry (D'Amato, et al. 2017). Circularity is an approach to sustainable development by reducing waste and utilizing various methods to reduce the environmental impact. The main approaches and concepts used are Reduce, Reuse, Recycle and Recover according to Kirchherr et al (2023). These concepts are meant to minimize waste and redesign the life cycle of materials and products to have a minimal impact and be used for a different purpose instead of being disposed of. This showcases the idea of CE, as it allows for a circular material flow instead of the traditional linear economy, which consists of clear end-products (Kirchherr et al, 2023).

Modern buildings in Sweden have an estimated life-expectancy of 100 years, and for this reason it is important to minimize waste during the deconstruction and construction of buildings (Boverket, 2024). Reuse is a circular strategy to not dispose of construction material and instead use it for another project if the material quality is reliable. Therefore, it will play a crucial role for the construction industry to adapt CE to minimize waste and lower cost. Despite advancements, the application of reuse contains various factors that restrict effective product handling, often exceeding budget for projects utilizing virgin materials (Kirchherr et al., 2023).

A main barrier for the implementation of reuse is the structure of the construction industry, consisting of many independent actors along with varied standards hinder the development of new and overarching workflows (Vararean-Cochisa & Crisan, 2024). An example of this is the digitalization of the construction industry, which has improved many areas and allowed for easier collaboration in both the production and design phases, mainly with the help of BIM (Building Information Modelling). However, this resulted in other complications, mainly by the disparities in knowledge between different stakeholders and additional costs for the competence development. This has led to stakeholders becoming conservative for its use throughout the construction stages (Vararean-Cochisa & Crisan, 2024).

The fragmentation occurs throughout the construction process and is mainly caused by the varied stages and processes, which makes it harder for the application of circular economy (Mohd Nawi et al., 2014). Additionally, it is difficult for companies to apply this and be economically viable as it would require independent actors to work collaboratively. The reuse market is currently not mature enough to compete with virgin material suppliers, consisting of ad-hoc and manual labor to purchase reused products. Contractors often need specific product descriptions, such as material properties, condition, dimensions, and certifications to utilize reused products in construction projects. However, reused products often lacks consistent information, creating uncertainty regarding quality and compatibility for construction projects (Sakthibala et al., 2025).

1.2 Problem formulation

The lack of consistent information and workflows hinders efficient information exchange and coordination when sourcing reused products. The ambition for reuse is often identified late in the project or is limited by procurement and design decisions. Therefore, contractors are perceiving reused products as a risk, as they potentially result in more time-consuming labor compared to using virgin materials (Sun et al., 2025; Ericsson et al., 2024).

Initiatives such as BIM and product databases could improve information management and help to structure information more effectively (Mjörnell, 2025). However, the information structure for reused products varies and remains unstandardized across suppliers and projects. As a result, it becomes difficult for contractors to assess and integrate products efficiently without clear frameworks explaining how information about reused products should be collected, structured and communicated (Mjörnell, 2025).

For these reasons, it is necessary to better understand and structure what types of information contractors and reuse suppliers require when sourcing reused products. In addition, what barriers currently hinder efficient information flows and how supplier information could be structured to accelerate reuse in construction projects. Addressing these challenges has the potential to contribute to more standardized information management and apply reuse effectively within construction supply chains.

1.3 Aim

The aim of this thesis is to investigate the information need from different actors to allow efficient handling of reused construction products in digitalized projects. This by understanding the current reuse supplier market in the Swedish construction industry and what hinders the right information from being available today. Based on the current reuse market, the goal is to propose a framework which provides the expectations for information of reused products to achieve higher efficiency. In conclusion, the overarching purpose is to create better communication between suppliers and recipients of reused construction products with clearer structure of what information is needed and expected with hopes of accelerating reuse in the Swedish construction industry.

1.4 Research Questions

For this thesis, three research questions have been formulated to analyze the aim. The research questions will focus on identifying the information necessary to which enables circular material flows in construction BIM-based projects and understanding factors that hinder information from being exchanged efficiently. Finally, the research questions will address possible improvements to communication and coordination between actors by clarifying the information expectations. The research questions are:

- What information do key actors need to enable efficient reuse material flow?
- What factors hinder efficient information flows when sourcing reused building products for construction?
- How can an information framework be structured to enable consistent, comparable, and digital-ready information for construction projects involving reused products?

1.5 Delimitations

The project will include the information exchange of reused products between different stakeholders in the supply chain from the suppliers to the construction site. Any processes affecting the collection, structuring and communication of information regarding reused components will be discussed. The information will be gathered from the case project Kaj 16 and its actors but also other informants from the broader construction industry. The proposed framework will not be tested in a project directly within the scope of the study. It will mainly contain information needs and barriers within the current market and possible recommendations. The study will not discuss the technical performance or environmental impact of reused products, only the information required to enable efficient implementation of reuse. Additionally, economic evaluations are outside the scope as the study will only assess qualitative data.

Due to national specific regulations and market conditions, the project is primarily relevant to the Swedish construction industry and this thesis will therefore focus on actors operating in Sweden, with more particular focus on the Gothenburg area. However, the results may also be applicable to similar contexts with comparable regulatory and market conditions. The study was conducted between January 2026 and June 2026.

2

Theoretical Framework

The theoretical framework section provides fundamental literature that will guide the project towards answering the research questions. Essential information will be presented that will help structure the study and complement additional perspectives gained from the qualitative approach.

2.1 Circularity

The definition of circularity varies and can be interpret in various ways and to clarify and address the different definition has Kircherr et al. (2023) compared 221 different academic definitions. The study shows that the concept has developed along with how industries work overtime and depends on the scholar's perspective at a specific time. The common definition of Circularity is to minimize waste by adopting measures to redistribute materials and products into the supply chain. However, there has recently come up an ISO standard that defines circular economy as "economic system that uses a systemic approach to maintain a circular flow of resources, by recovering, retaining or adding to their value, while contributing to sustainable development" (International Organization for Standardization, 2024).

Potting et al. (2017) provided the 9R framework, showcasing different circularity strategies to adopt circular economy, and reduce the environmental impact by minimizing waste production. Figure 2.1 showcases the methods in a list according to priority and their impact on circularity. Preferably should smarter manufacturing such as product sharing be above changing the life cycle of a product, as it is more environmental friendly to increase the number of users of the same product. Having a longer-life time such as reusing products will inevitably have a positive effect on the waste disposal amount but only if the product is still in good quality, therefore being the second category in the list. Lastly, other useful applications of products or materials are preferred, including methods such as recycling and recovery(Potting et al., 2017).

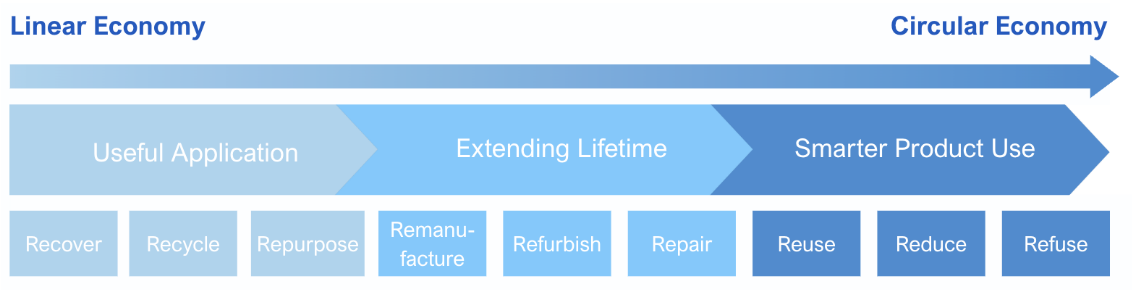

Figure 2.1: Showcasing the 9R framework (Adapted from Potting et al., 2017).

However, many scholars according to Kirchherr et al. (2023) agree that CE is commonly represented by the usage of reuse, recycle, recover and reduce which is essential to create a circular model. The 4R framework is also used in the European Union (EU) Waste Framework Directive validating its importance and common use in different academic sources (European Commission, n.d.c).

After conducting the study, Kirchherr et al. (2023), created an additional framework presenting three dimensions of CE consisting of Enablers, Core Principles, and Aims. Enablers are factors making CE more feasible and crucial to effectively implement any circular development. This consists of the stakeholder collaboration as the industry, policy makers, consumers and academia contribute to technological innovations and other capabilities. The Core principles are represented by the 4R-framework as the purpose is to utilize products for as long as possible in the material sourcing, production and consumption stages. The last dimension elaborates on what goals CE has, portrayed by environmental quality, economic development and social equity, which will then be beneficial for the current and next generation. Newer perspectives also mention the importance of observing circularity throughout supply chains as it is fundamental to achieve more comprehensive sustainable development (Kirchherr et al., 2023).

2.2 Circularity in the Construction Industry

The construction industry has in recent years started to adopt CE in various ways across the construction timeline, but is still not widely implemented (Guerra et al., 2021). Often encouraged by new and smaller companies compared to larger firms whose adoptions depend on their resources and ability to change. However, larger companies often invest in industry innovation by developing partnerships with other start-ups and innovative companies to incorporate circularity in their business model. This is also achieved by involving consultancy companies to explore additional business strategies. The involvement in CE is correlated to the feasibility to adopt the circular strategies as some are easier to implement than others. Therefore, more complex business models or circular strategies are considered a hinder towards new business opportunities and adoption by companies. Circular models and business strategies will remain underdeveloped until the complexity is reduced, and the concepts are well integrated in the industry (Guerra et al., 2021).

The economic perspective on circularity could be seen as more complex and multileveled adding to the barriers of circularity in the construction industry according to Khadim & van Marrewijk (2025). The study shows that even with great economic incentives and interventions, circular construction could still become more expensive than linear construction. Along with economic strain, the financial risk distribution is uneven in the industry as the contractor and client often receive limited financial benefits and bear the most risk. On the other hand, environmental and social benefits are evenly distributed across multiple stakeholders, which results in risk-bearers not being able to gain the return on value (Khadim & van Marrewijk (2025). Digital tools like BIM and LCA analysis could help improve and enhance waste management, but high cost, limited standardized data and interoperability issues limit their adoption and effective waste flow management (Hasibuan et al., 2025).

2.3 Reuse in the Construction Sector

As construction and demolition waste (CDW) makes up 25% and 40% of total waste production in various regions, the importance of smart circular solutions such as reuse is vital to minimize waste and the use of virgin materials (Sakthibala et al., 2025). The development of cities and infrastructure results in a growing amount of waste production causing environmental and logistical hindrances. Therefore, many sectors are in need of advanced waste management or need to incorporate circular economy which intends to minimize environmental impacts and improve the use of resources (Sakthibala et al., 2025).

2.3.1 Reuse Market

The north-west European countries have adapted reused construction elements, however, not to the needed extent according to Gobbo et al. (2024). Materials are mainly crushed or disposed of instead of reused, hindering an effective use of circular strategies. The study shows that it is mostly smaller elements that are reused such as windows, doors and other decorative products rather than larger elements (Gobbo et al., 2024). Sakthibala et al (2025), however, insist that there is a potential for greater reuse rates if the sector is further developed, possibly increasing the variety of products that could be reused. The reuse market is fragmented and consists of various suppliers, delivering different construction elements from different projects; however, the sourcing is often considered ad-hoc and traditional, compared virgin materials (Fox & Nyvall, 2024). Reused elements are showcased on websites or materialbanks that provide product information, functionality, aesthetics, and expected delivery, similar to a second-hand marketplace. These aspects are then rated based on the condition, and the marketplace offers pictures of the elements (Palats, n.d.). According to Mjörnell (2025) is reuse market currently informal and non-structured compared to virgin material suppliers who are more established. The market for reuse is also not large enough to construct entire projects as the supply for reused products is currently low, resulting in product sourcing difficulties for larger construction projects (Mjörnell, 2025).

2.3.2 Reuse Barriers

Inconsistent product quality and quantity is considered a barrier for the implementation of reuse in the construction sector according to Pittri et al. (2025). Construction stakeholders are often concerned about the reliability and durability of the materials collected from deconstructed buildings. The uncertainty also influences the decision-making and affects the encouragement to use reused products. Pittri et al. (2025) therefore highlight the importance of data collection of the products and performance of building over time, as this could help examine what factors affect building elements and create a greater understanding of material aging. The deconstructed elements also need additional standardized criteria that display the technical, functional, aesthetic dimensions of reused products (Mjörnell, 2025). Along with the inconsistent product quality, must also older materials be refurbished if it does not comply with today's fire and sound regulations according to Fox & Nywall (2025). The absence of this results in quality assessments being varied causing mixed data resulting in additional work (Mjörnell, 2025).

Mjörnell (2025) state that the sector needs standardized criterion like the aforementioned example that will help guide the industry and create systematic workflows enabling reuse. An example of this is Swedish building permits that does not allow for the needed flexibility to implement reuse as it must include detailed descriptions of materials. There is also no support from legislation such as the PBL to implement reuse which could improve various company's mindset and encourage circularity. Incentives are also non-existent for companies that utilize reuse and affects the company's motivation to improve the transition (Mjörnell, 2025).

Contractors also feel uncertain regarding the pressure from clients and regulations that require circular strategies to be implemented in projects according to Fox & Nyvall (2025). Designer and contractors are particularly worried in legal cases, as liability is uncertain when safety failures occur as a result of unclear warranties and standards (Condotta & Zatta, 2021). However, if the project includes three key aspects, namely, early planning and involvement; clear definition of reuse, and liability and quality guarantees, will their motivation to use reused products increase (Fox & Nyvall, 2025).

Along with varied product quality is the information management and knowledge of reuse underdeveloped and is insufficient to support the integration of reuse in the sector (Sun et al., 2025). The organizational structure of the construction industry is fragmented resulting in unstandardized data and interoperable digital platforms. Additionally, are poor and insufficient records of products common which causes knowledge gaps, adding to the barriers of reuse. This inevitably hinders the information exchange of the product's condition and its origin. There is also an emphasize on how information should be shared, as projects often have different stakeholder goals and strategies, since the industry is project oriented and fragmented. Conservative mindsets are often common in the construction industry, making it highly resistant to change, hindering the application of circular strategies. Uneven understanding is partly the reason for poor information flows with not many experienced in the reuse sector. Therefore, has Sun et al., presented a framework for the barriers and reuse decisions, which thereby are dependent on knowing, the history of products, their condition, compliance with safety and regulatory standards and lastly compatibility with design and construction plans. If any factor is absent, it will be possible for the stakeholders to turn to virgin materials due to the uncertainty and the risk of using reuse (Sun et al., 2025).

The increase in information complexity, according to Ericsson et al. (2024) is accompanied by more logistical obstacles and specialized solutions to guarantee an efficient application of reuse. The deconstruction phase is by itself complex and needs specialized skills to be conducted, as products must be carefully extracted to preserve their functionality. Thereafter, reused products need additional storage after deconstruction for refurbishments, sorting and inspection, resulting in additional work instead of direct disposal (Ericsson et al., 2024). The need for storage also increases the risk of damaged material according to Jimenez et al. (2025). The irregular size and varying number of products adds to the complexity, as the sorting becomes counterproductive. The added warehouse and specialized equipment results in additional costs limiting the economic feasibility (Ericsson et al., 2024).

2.4 Reuse Drivers and Enablers

This section will elaborate on what drivers and enablers there are that aid in the implementation of reuse. Drivers are external factors that motivate or push stakeholders towards the transition of reuse. Enablers, as stated in section 2.1 Circularity, are factors that allow for the transition towards reuse and help towards reaching the circular goals.

2.4.1 Drivers

The EU provided the waste hiarchy in 2008, namely, prevention, reuse, recycle, recovery and disposal. In addition, construction and demolition waste recovery must the be 70% with the aim to prepare for reuse (European Parliament & Council of the European Union, 2008). In Sweden, as stated in the introduction, a goal has been set to reach net zero emission by 2045, encouraging industries to lower their (Swedish Environmental Protection Agency, 2026). Although there are no current incitements in Sweden for using reused products, the Swedish Tax Agency has implemented landfill fees and waste taxes to minimize the disposal of old building elements. The fee is 744 SEK/ton and was increased in 2025 to increase the encouragement towards reuse, showcasing continuous engagement from Swedish institutions (Jacobsson et al., 2025).

As previously mentioned by Fox & Nyvall (2025), contractors are pushed by clients to work with circular strategies, this is partly done by using green procurement according to Ahmed et al.(2024). This type of procurement often consists of environmental criteria, climate declarations and life-cycle requirements, such as conducting Life Cycle Analysis. The goal is to reduce waste by proposing certain criteria that needs to be met and showcase the emissions new buildings generate, often used in government funded projects (Ahmed et al., 2024; Sturesson & Gerhardsson, 2025).

Lastly, green certification such as BREEAM and LEED has become popularized by the adoption of stricter sustainability regulations and thereby the increase in market demand for sustainable buildings (Ajirotutu et al., 2025). They mainly consider energy efficiency, but also examine material selection and material waste reduction. Therefore, it is important to utilize material with low environmental impact from the material extraction, manufacturing processes, transportation, installation and deconstruction stages. Given examples by Ajirotutu et al. are products with high recycled or reused content and locally sourced building elements. It is common for certified buildings to include a waste management plan showcasing how the reduction of waste will be fulfilled, often including how recycled and reused products are used according to Ajirotutu et al. The benefits for acquiring green certifications are plenty, and often comes with higher attraction towards investors, as they are seen as profitable (Ajirotutu et al., 2025).

2.4.2 Enablers

Companies in Sweden adopting reused materials, are not given incentives which reduces the motivation to transition towards reuse (Mjörnell, 2025). Virgin materials are cheaper and has lower uncertainty regarding documentation and functionality. Additionally, there are extensive administrative work correlated to using reused materials. The current market favor linear construction: however, incentives could open the possibility of creating a functional and established market according to Mjörnell (2025). This could be achieved by reducing the VAT for reused products or changing the structure of rental valuation to consider reused products as a reward. Overall, the reuse market must consist of systematic producer responsibility and efficient logistics and storage (Mjörnell, 2025).

Mjörnell (2025) adds that the business models used for linear construction are not suitable for the reuse market. According to Wennersjö et al. (2021), many suppliers have changed their business model to adapt reused products. Contractors now see the opportunity to not pay the disposal fees and instead get paid for reselling the deconstructed products to other actors. Another proposal is that suppliers and producers of virgin construction materials receive deconstructed products for refurbishments and quality inspections, possibly providing warranties with their reused products (Mjörnell, 2025). It is therefore important for companies to collaboratively work with producers or reuse distributors to enable a structured reuse market (Mjörnell, 2025).

Correct procurement is also vital to ensure reuse is effectively used in construction projects according to Halling and Johansson (2023). Utilizing strategies to guide contractors and consultant towards the client goals is a key aspect in reaching circularity goals. Halling and Johansson argue that early collaboration and procurement of key actors such as contractors will determine the success of reuse. Setting high reused and recycled content as a requirement also help formulate correct procurement. However, the requirement must be placed in the right tender document and also allow for flexibility, if not, production will experience hindrances (Halling & Johansson, 2023). Mjörnell refer to various guides for correct procurement such as Vägledning – Policyer och styrmedel för främjande av återbruk på plats by Eriksson et al. (2025) and Återvinning och återbruk genom inköpsprocessen ger miljövinster by Upphandlingsmyndigheten. Sun et al. (2025) and Mjörnell (2025) stress the opportunity to enable systematic reuse market by developing technological solutions such as BIM, circular passports and shared databases, for instance Gemensam Datamiljö (GDM). The solution will then allow for transparency and help with digital material and product inventories creating greater traceability. These advancements must then be combined with government and organizational considerations to guarantee relevant data stays within the cloud-based platforms (Sun et al., 2025; Mjörnell, 2025). By encouraging industry collaboration for greater product exchange through technological advancements could the industry develop a structured market and efficient tracking/sourcing throughout the supply chain for reused products (Sakthibala et al., 2024).

Jimenez et al. (2025) state material information and traceability as a central area of need when maximizing reuse potential in construction projects. Reliable inventories, documentation and shared routines are named as solutions to this challenge. Interviewees from the study involved in the Swedish construction industry say they lack digital tools to effectively work with inventories of existing buildings. Inventories are often done with Excel and no standard way of structuring the information (Jimenez et al., 2025). The study also mentions culture as a factor for reused products not being prioritized. The authors argue that personal and organizational attitudes have substantial effect on integrating reuse. Established working methods, negative attitudes, prejudices and ignorance are seen as challenges to a positive culture in the generally conservative construction industry (Jimenez et al., 2025). Table 2.1 displays the common drivers, enablers & barriers.

Drivers	**Enablers**	**Barriers**
EU Regulations	Incentives	Inconsistent Material Quality
National Regulations	Suitable Business Models	Policy Allowing for Little Flexibility
Green Procurement	Procurement Enabling Collaboration	Uncertainty Regarding Liability
Climate Declaration	Circular Passports	Information Sharing Complexity
Green Certification	BIM	Logistical Complexity

Table 2.1: Common drivers, enablers and barriers when applying reuse in construction.

2.5 Supply Chain Management

A supply chain is defined as a network of multiple businesses and relationships that are not linear but integrate in various processes (Lambert & Cooper, 2000). By analysing the complete supply chain, one can capture the overall relationship between companies and the choices of processes. Offering the ability to observe the cross-company coordination and manage it is defined as Supply Chain Management. Supply Chain Management refers to the coordination of essential business processes, from the initial supplier to the consumers. The motivation for this is to examine the creation of value from providing information, products and services to the consumers (Lambert & Cooper, 2000), which is vital to examine how to effectively implement reuse (Kircherr et al., 2023). The introduction of reuse results in challenges for supply chain management, as the uncertainty regarding supply and quality and the increased complexity of coordination between multiple stakeholders hinders efficient material flows (Sun et al., 2025).

Lambert & Cooper (2000) present a conceptual framework that help identify what essentials is needed to manage and study a supply chain. It is defined by three main interrelated elements, Supply Chain Business Processes, Supply Chain Network Structure and Supply Chain Management Components (Lambert & Cooper, 2000). Supply Chain Business Processes refers to the change of adding activities into essential supply chain processes instead of handling individual orders or operations. Orders that were given to the suppliers were often periodically and had no visibility of the intended use. Having a periodic order caused rushed actions across the supply chain as companies react to sudden changes when trying to meet customer demands. A successful example of this is when there is a continuous flow of information creating an efficient product flow. This gives accurate and timely information to adapt if changes in customer demands occur. By managing the uncertainty in all the stages of the supply chain one can create an effective supply chain management (Lambert & Cooper, 2000).

The second element, supply chain network, explores what parts in the supply chain that needs to be managed (Lambert & Cooper, 2000). This is estimated by observing the complexity of the product, the availability of raw materials and the number of suppliers. It is important to also determine the extent and closeness of the relationship between different actors, as not every link should be equally coordinated. This is based on the circumstances of the relationship and the company's capabilities and value to the firms. Additionally, should members in the supply chain be identified to determine key roles that are critical to the supply chain where more resources and attention should be allocated. Therefore, should the network and relationships in the supply chain be closely examined to guarantee a comprehensive perspective of the members when analyzing the supply chain. The last element, Supply Chain Management Components, displays how to integrate management in different process links. This is done by applying structured and coordinated managerial activities across the supply chain. Exploring the conceptual framework and analyzing the three elements could help understand complex supply chains (Lambert & Cooper, 2000).

2.5.1 Linear vs Circular Supply Chain

The construction sector mainly operates through a linear supply chain model of extraction to disposal, resulting in high material use, waste generation and environmental impact (Nasir et al., 2017). Resources are firstly extracted then supplied for manufacturing, production and distribution of materials to the construction sites. After materials are used they are disposed of, generating waste at the end of the life cycle. This issue highlighted in Nasir et al. (2017) compares the linear model to a circular supply chain approach, the authors argue as a more sustainable alternative. The circular model ensures that materials retain their value by reusing them in new projects or be redistributed to manufacturers for refurbishments. Figure 2.2 also showcases used materials being delivered to circular service providers instead of disposal by utilizing circular strategies mentioned in section 2.1 Circularity by Kircherr et al. (2023). In figure 2.2, both the circular model and the linear model are visualized, demonstrating how circular flows are added again further back in the supply chain.

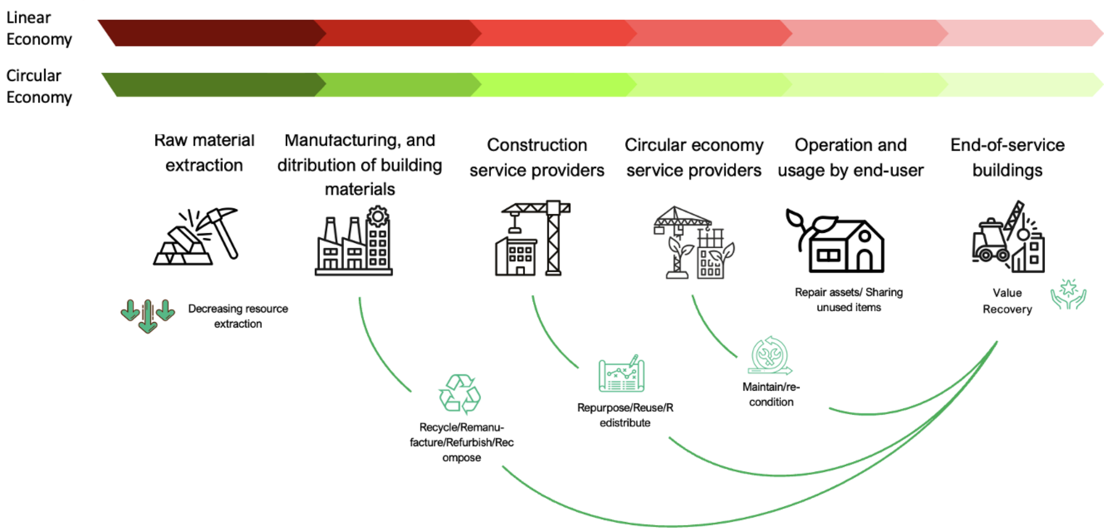

Figure 2.2: Linear and circular construction economy (Adapted from Noroouzzadeh et al., 2025).

2.6 Construction Logistics

Construction logistics can be defined as the planning, coordination and supervision of material flow to, from and within the construction site (Voigtmann & Bargstädt, 2010), often divided into off-site and on-site logistics (Brusselaers et al., 2022). On-site logistics refers to activities on the construction site such as moving larger masses, waste or building components. The logistics in this case are internal, showcasing the coordination and movement of materials and products on the construction site. On the other hand, off-site logistics represent all activities that are outside the construction site. This includes transportation from the manufacturer to distribution centers, storage facilities and to the construction site. The off-site activities involve a large number of suppliers, manufacturers, and other logistic companies that distribute products and materials to various construction sites (Brusselaers et al., 2022). While construction logistics encompasses material, resource and transport flows, this study places particular emphasis on the role of information flows.

Managing numeral material flows, equipment's and resources is essential to construction project planning and execution, ensuring deliveries occur on time, in the right place and in good condition. When supply chain activities are well integrated with site operations, construction projects can reduce delays, cost overruns and inefficiencies (Vrijhoef & Koskela, 2000). Furthermore, contractual structuring to favor long-term relationships over project-based organizations promotes knowledge-sharing together with improved logistical coordination (Sundquist et al., 2018). This type of structure could also improve on-site logistics by cooperation with third-party logistics providers.

In particular, the effectiveness of these logistics processes is highly dependent on how information is generated, shared and utilized between actors (Dixit et al., 2022). In contrast, inefficient construction logistics planning can result in damaged materials, inefficient resource use, excess waste and need for rework. Such problems are less prevalent in other production industries, where material flows are more predictable and controlled through advanced material-handling systems and permanent production facilities. However, the nature of construction projects being site specific, meaning the location is temporary until project completion, introduces extra complexity compared to regular line-production. While these industries can precision-plan the flow of material in a dedicated location, construction logistics often work with disadvantageous site locations and limited space (Dixit et al., 2022).

Historically, this complexity has contributed to a limited focus on developing of construction logistics (Dixit el al., 2022). Improvements in logistics efficiency were often perceived as having limited impact on project outcome. Furthermore, coordination between supply chain processes and on-site logistics are often inadequate due to the fragmented nature of the construction industry. Construction projects typically involve numerous actors making for complex coordination and communication. To better manage off-site logistics, have several measures been adopted to prevent congestions and better plan distribution, which is partly done by implementing a construction consolidation center (Dixit el al., 2022).

2.6.1 Logistics Coordination

To better manage and overcome challenges related to construction logistics, research and industry have developed tools and commonly implemented ways of working aimed at improving coordination, uncertainty and site-specific issues (Guerlain, 2019). Construction Consolidation Centres (CCCs) is a solution aimed at addressing challenges in construction, including limited on-site space and fragmented supply chains. Acting as off-site hubs, CCCs store, manage and consolidates construction material before delivery, improving control and vehicle loading as well as reducing transports (Guerlain, 2019).

Just-in-time is a delivery strategy which means scheduling materials, so they arrive on the construction site as close to when they are needed as possible, reducing need for storage on-site (Sezer, 2025a). Additionally, a checkpoint is a solution aimed at managing access of transports to the construction site by controlling queues. Checkpoints, often linked to just-in-time deliveries, helps organize, coordinate and reduce congestion for arriving transports (Sezer, 2025b). One possible approach when using a TPL is to deliver materials to the checkpoint during the day and transport them to the installation area after working hours. Good communication between the TPL provider and suppliers helps link on-site and off-site logistics and ensures that materials and products are packed and delivered correctly.

2.6.2 Reverse Logistics

The term reverse logistics can be explained as the process of moving material or products back to the manufacturer or supplier (Salas-Navarro et al., 2024). The reason is to retain value or ensure environmentally appropriate disposal, including activities such as refurbishment, recycling, remanufacturing, or reuse. In relation to reuse, reverse logistics enables recovery, inspection, storage and redistribution of products for secondary use as stages for reused products. In this case, construction sites can be considered the point of production, and by deconstructing material will the material flow be reversed as to when virgin materials were produced (Salas-Navarro et al., 2024). Enabling the return of material from demolition stages to subsequent projects provides a key functional process that supports a circular supply chain.

2.7 Reuse Material Flows in Construction

A research project on circular material flows with regards to construction logistics, four different possible scenarios have been identified on how reused construction products are handled (Bosch et al., 2023). These scenarios depend on the type of project, and the complexity increases of each scenario one to four as more actors are involved and coordination, organization, planning and control of material flows becomes increasingly complex (Bosch et al., 2023). Figure 2.3 depicts the four scenarios.

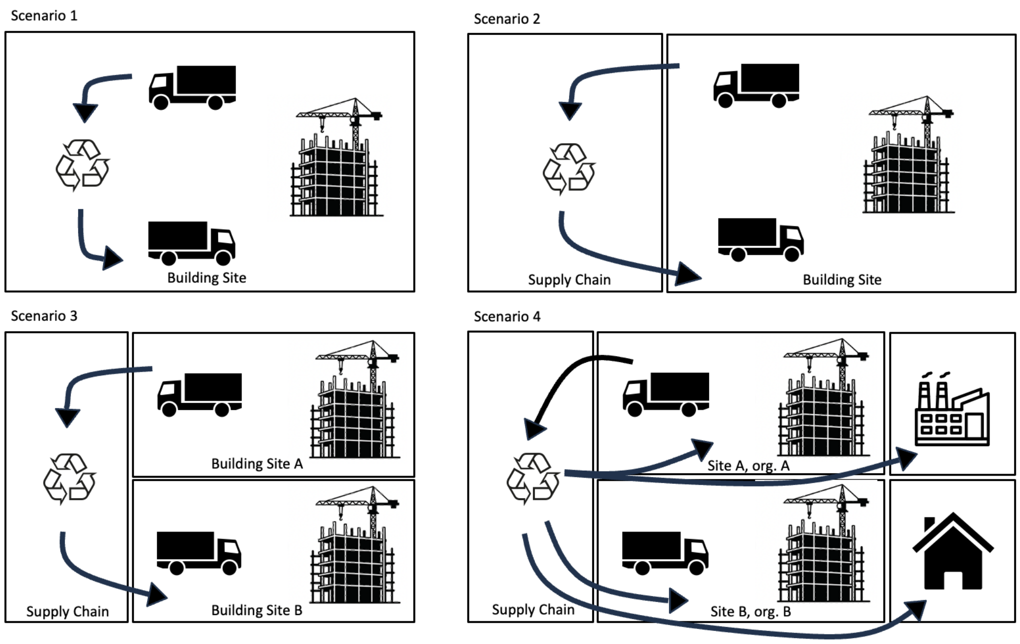

Figure 2.3: Showcasing the four reuse material flow scenarios (Adapted from Bosch et al., 2023).

In scenario one, the reusable products are handled within the same construction project and never leaves the site (Bosch et al., 2023). Similarly, in scenario two the products are handled within the same project but there is need for external storage or refurbishment off-site before being brought back to the same site. In scenario three there is reuse between multiple construction projects, within the same organization. The reused products go from one construction site, through the supply chain being stored or refurbished, and then reaches one or multiple different construction site(s). The final scenario also describes reused products that are transferred to a different construction site through the supply chain but also to other organizations or private markets. The reused products can be transacted through specific reusehubs (Bosch et al., 2023). However, Mjörnell (2025) elaborates on off-site supply chains, adding that products either go to reusehubs, building materials market or back to the original manufacturer for refurbishments and warranty, decreasing workload and complexity for the construction companies.

2.8 Sourcing Process for Reused Products

The application of reuse consists of various stages and processes to find a project and reach the construction site. The material flow is commonly presented as per figure 2.4 according to Gustafsson & Engström (2025). Firstly, materials in an existing building must be assessed to identify the construction inventory and the elements condition before demolition or renovation (Sakthibala et al., 2025). Important aspects to be documented includes dimensions, functionality, material type and condition, which will determine the potential for reuse and then be prepared for partial demolition. Partial demolition will not completely demolish the element and instead maintain the product's quality. However, the quantity of reused products will be limited as deconstruction will inevitably result in a decline in the products quality (Sakthibala et al., 2025).

Condotta & Zatta (2021) state that the reused product's technical condition must also be evaluated to determine if it meets regulatory and safety requirements such as fire rating and acoustic class. This involves visual inspection and could require additional testing depending on the material type, which then will be used to grade the product's condition (Condotta & Zatta, 2021). Documentation and information will be structured to prepare for integrating of components into different material banks developed by reuse suppliers (De Wolf et al., 2024). The material banks showcase component specifications gathered by conducting inventory and sometimes provide environmental data (De Wolf et al., 2024).

Matchmaking is another important process that is still developing according to Rose et al. (2018). Available products need to match project requirements, as well as technical and logistical needs, something that needs to be communicated through databases, market places and reuse hubs (Rose et al., 2018). Once correct products has been found, the sourcing process includes arranging logistical coordination and procurement (Nasir et al., 2017). This involves transportation, storage and delivery to the construction site. Reused products often require additional logistical planning as they often come from different locations and are available at uncertain and varying times (Nasir et al., 2017).

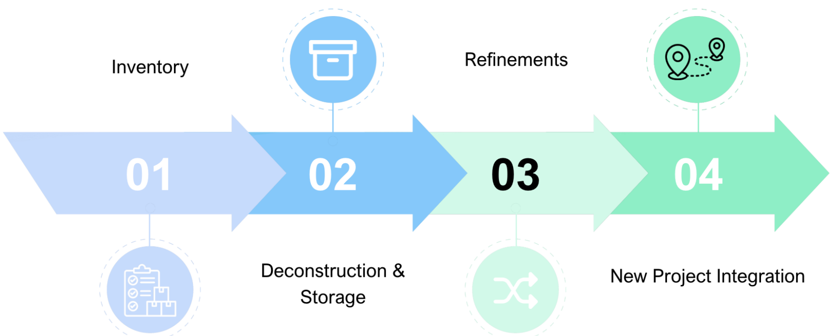

Figure 2.4: Process Model for Reuse (Adapted from Gustafsson & Engström, 2025)

2.9 Reuse Logistics

A study of the possibility of increasing reuse rate in the Swedish construction industry identifies barriers, enablers and need for development specifically connected to construction logistics (Jimenez et al. (2025). The study shows the need for a storage facility close to the construction site was critical to the implementation of reused products. That could mean project specific solutions, such as the client offering space or third-party actors. Also mentioned is the proposal of municipal storage facilities to enable reuse. The overall sharing of resources between organizations, actors and projects is pointed out to be a solution to maximize storage capacity and reduce costs.

Furthermore, the potential concept of combining inventory, sales, transport and warranty into new business models is examined and deemed to make reuse processes more efficient. This, due to actors complaining of high levels of manual labour connected to these named processes and high levels of insecurity in supply chains, for example regarding varying levels of quality and physical dimensions of products. Varying and not easily obtained information also makes identifying products more resource demanding. Jimenez et al. (2025) sees the limited players and defined logistical centers in the reuse market as a barrier to these issues and that the challenges still lie with limited demand on reused products.

The study also presents tips on how to structure the logistical work when implementing reused products. Suggested is to integrate reuse into existing logistics planning. A specified construction site layout plan for reused products (Å-APD) might be needed to manage storage, flow and handling of the material (Jimenez et al., 2025). If the construction project lacks storage areas for reused products, it is important to identify external logistical solutions early in the planning phase. Documenting of supply chains and logistics helps build experience for future projects. Also suggested are digital information handling and systematic inventories of existing buildings to help with product information and long-term traceability.

2.10 Information Management

For virgin materials, established systems exist for storing and sharing manufacturer product declarations digitally. The eBVD system is a Swedish industry standard functioning as a single searchable database, designed to enable traceability throughout the value chain (IVL, 2026). At European level, Digital Product Passports are emerging as a broader regulatory response to the lack of product transparency, mandating structured lifecycle documentation for an increasing range of product categories (European Parliament & Council of the European Union, 2024). However, for reused products both systems fall short. Once a component is deconstructed and re-enters the market, its original declaration no longer reflects its current condition, compliance status or remaining lifespan (Mjörnell, 2025). No equivalent standard currently exists for the second lifecycle of a product. Quality and accuracy of inventories of existing buildings in Sweden are varied (Mjörnell, 2025). There is currently no standardized and available data from demolitions and product inventories in the Swedish construction sector, and where inventories are conducted, their accuracy and quality vary(Ericsson, 2026). Ericsson (2025) found inconsistencies between estimated and reported quantities of reusable products in Swedish demolition projects which demonstrates current inventory methods risk giving a false picture of reuse potential in existing buildings. In practice, inventories are often done with the help of tools like Excel, generating additional manual work (Jimenez et al., 2025).

The lack of standardization extends to integration of BIM. Platforms such as StreamBIM used in the Kaj 16 project are increasingly used in the Swedish construction industry, however, adaptation of BIM remains uneven and often limited to early stages of projects. A central challenge for BIM integration of reused products is the absence of reliable product records and standardized product information, creating knowledge gaps that hinder efficient information exchange between suppliers and construction projects (Sun et al., 2025). Few actors have routines for documenting reused products into BIM-models (Jimenez et al., 2025).

2.11 Digital Tools Supporting Reuse Markets

Digitalization has been identified previously as being a key driver to improve efficiency within the construction industry. In this context, digital tools and information systems also play a critical role in enabling efficient management of reused material flows. Research identifies several emerging digital solutions which have been developed to support reused material flows and integrating these new solutions into existing systems such as BIM may facilitate the next step of development.

According to Hamidkhaniha et al. (2025), integrating Digital Product Passports (DPPs) or similar, with BIM can enhance product traceability in circular construction while also supporting early design decisions related to reuse and recyclability. The concept DDP refer to digital systems designed to document product properties and identity as well as providing technical and environmental information about a products lifecycle. The study conducted by Hamidkhaniha et al. show promise, but they also present several challenges, similar to those identified in section 2.2.1 Reuse Barriers. De Wolf et al. (2024) mentions the importance of understanding the supply chain of products and their properties when upscaling circular construction. To facilitate communication and collaboration among supply chain actors, De Wolf et al. finds increasing efforts in linking BIM platforms to reuse platforms and integrating DPPs. Better product traceability through use of RFID or QR tagging. The study further highlights the need for greater standardization in the implementation of DPPs, as well as enhanced collaboration with stakeholders and policy makers.

One established challenge with reuse in construction is the availability of products. One way of addressing this challenge is by improving inventory of existing building stock to enhance knowledge about buildings planned for demolition. Olumo (2025) suggests 3D scanning of existing buildings, together with digital inventories and optimization tools can help divert reclaimed construction material from landfills and instead reintegrate them into circular material flows. The technology is explained as using cameras and lasers to capture the physical world by detailed imagery to reconstruct into a three-dimensional model through software (Olumo, 2025). There are various types of scanners available, such as laser-based scanners or lidar. A common problem according to the author are time-consuming gathering and uploading of information for reused suppliers leading to less products being made available online. While such technologies have existed for over a decade, their application for reuse within the construction industry remains limited.

Another issue presented is information not being presented in a useful manner. A solution to these problems is identified as 3D scanning to allow for faster, more accurate information and better online accessibility. De Wolf et al. (2024), studying disassembly in Swiss construction projects, discusses scan-to-BIM, implying 3D scanning of existing buildings and creating a BIM model of the building. Results demonstrated effective cataloguing of products into expansive databases.

3
Method

This study is inclined towards qualitative research, including a literature review, interview study, and site observations. An abductive approach was chosen to help understand the topic and investigate how current information flows in the reuse markets are, which is elaborated in the research process. This section will also include ethical considerations and display the case study Kaj 16.

3.1 Research Approach

The study was based on a qualitative case study combining theory with real-life practice. A single case study was carried out to observe how theoretical barriers and opportunities are presented in real-life. This approach is particularly suitable for investigating contemporary subjects within its real-life context (Yin, 2014), which in this case enables in-depth understanding of the complex processes and relationships that characterizes the construction reuse process. There are currently various existing literature for reuse, logistics and digitalization. However, as mentioned, they are fragmented and heavily dependent on context. Exploring perspectives of experts and practitioners allowed the study to investigate the complex environments of reuse further, making this approach the most suitable.

The literature was applied and complemented by the real-life project Kaj 16 in Gothenburg. The case served as an empirical context to examine how circular strategies are implemented in practice. Business processes, supply chain links and key stakeholder's decision making, were deeply investigated to provide with practical challenges related to reuse. An interview study was therefore conducted to gain perspectives regarding the project and the construction sector. The interviewees are mainly related to the topics of reuse, logistics and digitalization which enabled the study to answer the research questions.

Since the study does not strictly test hypotheses or produce new theory from observations, it has followed an abductive approach meaning there were continuous interactions between the literature and empirical observations. As new information emerged through the interview process, the literature frame was expanded or adapted depending on the findings and perspectives of the interviewees. The concepts related to reuse application, and reverse logistics is still underdeveloped and reveal new information continuously.

The abductive approach helped the study by examining current practitioners' perspectives and theories and applying this to understand the concept of reuse and its hindrances and opportunities during its application. It allowed the interpretations of theory to be questioned or complemented from the empirical data to help discuss the findings.

3.2 Literature Study

The review of existing literature was conducted to examine and identify earlier studies and topics regarding reuse, circularity, and supply chains. The purpose was to gain a foundational understanding of the topics and to identify key and recurring themes for barriers and enabling factors regarding reuse and circular supply chains. The initial review helped guide where further investigations were needed and provided with an overview of current research.

The first stage of the literature review was conducted before the interviews to gain a broader background and theoretical foundation, which helped understand the information from the interview study. The existing literature was gathered from academic search engines such as Google Scholar, ScienceDirect, Research Gate and Chalmers ODR. To sustain high credibility and present data, information was mainly collected from academic papers 2017 and later. The articles were found by searching for relevant keywords such as reuse, reverse logistics, reuse procurement, reuse hinders, circularity. The literature study was written throughout the project scope as new information appears. This was thereafter confirmed or denied based on our own findings. As mentioned in the research design, the findings from the interview study resulted in adjustments in theoretical framework. The second information gathering was conducted similarly as the first stage of the literature review.

3.3 Case Study

The case study of Kaj 16 helped identify practical details of reuse. By exploring and identifying key roles between reuse suppliers and contractors, information regarding sourcing processes was generated as well as the project's structure. The case was particularly chosen for its ambition for reuse and digital approach, combining two complex construction topics. Data were collected by conducting interviews with key roles regarding reuse in the project as well as site observations. The site observations were conducted in relation to the case project external hub and construction site. Gained insights from Kaj 16 was used to investigate the broader construction sector and analysis of information needs and related challenges to reused material in construction projects.

3.3.1 Case Description

The case project Kaj 16 is a 16-story office and commercial building located in central Gothenburg with 12 of 16 stories constructed with timber and remaining stories with concrete. The main actors in the project are Vasa Kronan as the client, Vestia as the contractor, consultants from various companies and Rebygg as the collaborative reuse supplier. The vision of the project is to reach LEED platinum certification with the help of reused material from the previous existing building, thereby lowering emissions (Vasakronan, 2026). Another vision is to work 3D model-based, namely with StreamBIM, throughout the entire project. Kaj 16 will act as an introductory for the thesis subject, giving a practical example of a digitalized project with ambition of utilizing reused material.

3.4 Interview Study

Two meetings were held before the interview study, to better understand the project structure and its goals. This allowed us to decide which key roles and key links of the project structure was worth examining. During these meetings, the scope of the project was presented, as well as briefly explaining the reuse application of the project. A semi-structured interview was chosen to capture the perspectives and experiences of experts and to also allow for follow-up questions given by the complexity of reuse and the case project with multiple stakeholders. The location of the interviews were dependent on the interviewees schedule and were held either on Teams or in person.

Thereafter was the interview study divided into two separate rounds; firstly, key stakeholders and actors connected to Kaj 16 were interviewed to delve deeper into the structure and business processes. This helped the study to examine specific processes and lived experiences of reuse before reaching the second round of interviews exploring other key actors in the broader construction industry. The second round of interviews generated perspectives outside of the case project, resulting in a more nuanced and objective discussion about the possibilities with reuse. The interviews were conducted during the period of Feb 2026 and April 2026. In total, 14 interviews were held with 16 participants, with variety of roles (see table 3.1).

The interview questions were formed and based on the research questions. The questions were also slightly edited based on the respondent's role with the aim of conducting the interviews in 30-45 minutes. Apart from interviewee C3 was audio was recorded and available after the interviews to further examine the respondent's answers. The information was then be coded based on reoccurring themes and categorized depending on the relevance, in order to contribute to a nuanced discussion.

After conducting the interviews, some actors were not equally represented in the study due to not receiving any responses from the interview requests. In this case, it was the contractor role that could be misrepresented as a result of not having a large interview sample.

Interviewee	Company	Role	Date	Location
A. Consultants				
A1	COWI	Project Director	23/02/26	Teams
A2	Sweco	Project Manager	27/02/26	In person
A3	Akuro	Sustainability Specialist	12/03/26	Teams / In person
A4	Sweco	Business Manager	19/03/26	In person
A5	Sweco	Digital Strategist	12/03/26	In person
A6	White Architects	Sustainability Coordinator	30/03/26	In person
B. Contractor				
B1	Vestia	Business Manager	04/03/26	In person
C. Reuse Actors				
C1	Rebygg	Reuse Coordinator	30/03/26	Teams
C2	Bruksspecialisten	Project Sales	27/03/26	Teams
C3	CCBuild	Executive	24/04/26	In-person
C4	Ahlsell	Sales Manager	27/04/26	Teams
D. Public and Research Organizations				
D1	Gothenburg Municipality	Sustainability Coordinator	02/04/26	Teams
D2	VG Regionen	Sustainability Coordinator	31/03/26	Teams
D3	Lund University	Researcher	02/04/26	Teams

Table 3.1: Overview of interviewees.

3.5 Ethical Considerations

Before conducting the interview study, the recorded respondents were asked if they would approve for recording the interview. The respondents were aware of the interview's aim and what the transcriptions were used for. They were also informed of which information would be presented in the table such as their role and company to maintain transparency and trust. Citations in the results section were also disclosed to the interviewee before the publication of the thesis to guarantee that their statement was not misinterpret. Any unclear statements in the transcriptions were also manually examined by listening to the audio files.

The use of AI tools in the report has been limited to only support the search for relevant sources and to improve the grammar. The sources that were generated by AI were examined thoroughly to guarantee a high credibility. The interviews has not been shared with AI tools to maintain confidentiality and limit the data exposure. The transcriptions were performed with the teams transcription tool and was later deleted after the analysis of the results were conducted. The transcriptions were also only accessible to the authors.

4

Results

This section will present the results from the interview study, by firstly presenting the case and its structure. Thereafter results will be displayed based on reoccurring themes by analyzing and coding of interview transcriptions.

4.1 Description of Kaj 16

The project is procured as a partnering contract and is divided into three different stages, E1, E2 and E3. E1 represents the deconstruction and inventory of the older building, Kromet. E2 represents the groundwork and foundation, and lastly, E3 portrays construction of Kaj 16. The project is designed as a new construction: however, the goal is to reuse as much as possible according to respondent A2. The large scale of the construction project increases complexity, and includes various processes that were needed to study.

4.1.1 Sourcing process for reused products in Kaj 16

The product sourcing of Kaj 16 is divided into two separate material flows. The inventory was conducted to identify materials in the building and was also used to determine potential for reuse. This is needed to determine which products are going to be preserved. The material and products from the previous building, which was deconstructed, supplied other projects and was used in Kaj 16. Materials and products are also presented to architects and designers to assess the alignment with project design and functionality. The reused products is then refurbished or quality assured to be fully applicable for the new project. The products were stored in either of the two larger reuse hubs , as shown in figure 4.1, and are later used in the project.

Reused products were also gathered by searching in material banks and partnering with reuse suppliers and contractors to help match project needs. Files were given to the reuse supplier, containing information on different product aspects, such as acoustic and fire requirements. The complexity and variety of requirements is dependent on the material properties. Material properties for a simpler element, such as cable ladder, include width, type and article ID. On the other hand, doors, which is considered a complex element, with various aspects include jamb depth, acoustic rating, handing, material, dimensions, fire rating, designation, full/half-glazed and article ID. Additionally, the product search is also conducted by the contractor, locating reused products by networking and searching for deconstruction projects. Figure 4.1 depicts the two material flows for Kaj 16, showcasing the two previously mentioned hubs and their origin, along with the producer of virgin materials.

Characteristic facade elements from the older building will be reused, and concrete is crushed to ballast and used in the forming of concrete for the new building. In stage E2, around 300 were saved from Kromet and helped reduce the number of pole deliveries to 200, resulting in saving costs and minimizing environmental impact according to interviewee A1 & A2. In the construction stage E3, the ambition is to reuse doors, lights, ceiling tiles, carpets by utilizing two main hubs that act as storage for both virgin and reused products.

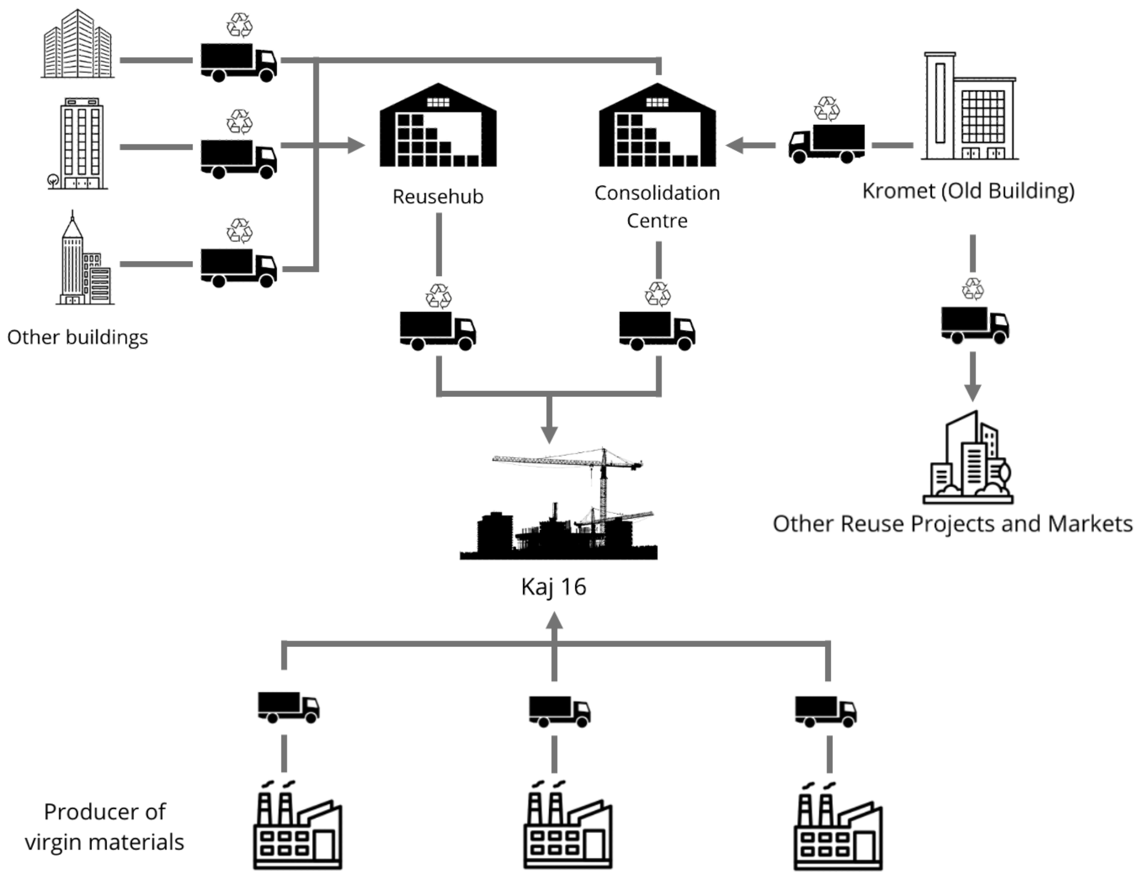

Figure 4.1: Material flow Kaj 16 (Own illustration)

4.2 Reuse Information Flows in the Swedish Construction Industry

The information need varies depending on the stage, which is shown in figure 4.2. The stages involve independent actors, who have different responsibilities, providing information differently. Although some processes are more standardized, the unstructured stages result in various complexities, affecting its following stages. Figure 4.2 represents the most common processes for the off-site activities. These stages either produce, process or distribute information regarding reuse internally or externally. To successfully implement reuse, products from the older project often pass through these four stages to reach the new construction project.

The inventory section is presented due to its importance of producing information regarding reused products and their functionality. The following step is condition assessments and refinements, as mentioned in the literature, the reused products needs an inspection of technical aspects, properties and dimensions. This is utilized to guarantee the products condition to be able to fulfill project requirements. Reused products must also be published or presented for contractors, buyers or other internal actors, to use the products for a new construction project, which is included in Reuse Communication. The logistic and production stage is displayed by how reused elements must enter the project organization and how information of reused components is delivered to the contractors.

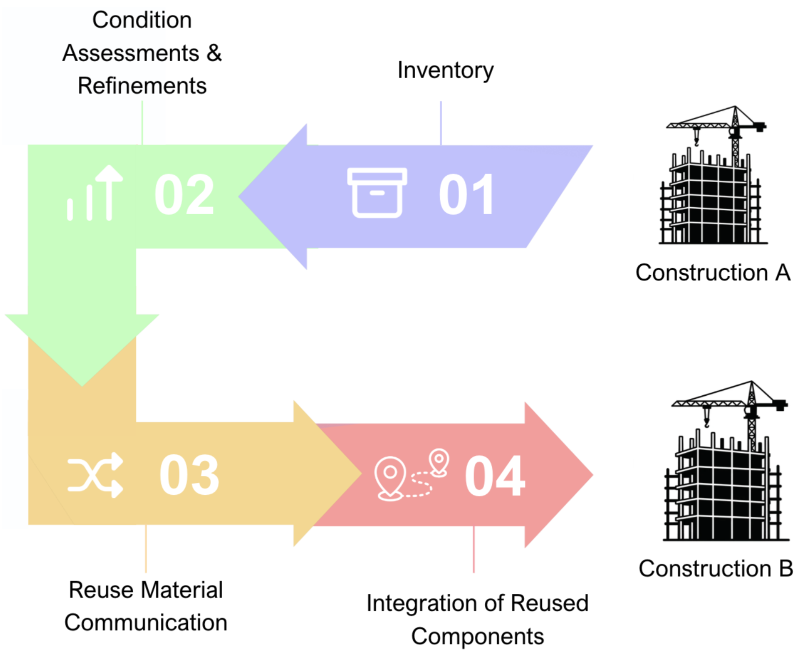

Figure 4.2: Process Model of Reused Material with Common Activities (Own illustration).

4.3 Information Demand for Key Roles

The implementation of reused products, as previously mentioned, involves multiple actors with different responsibilities and roles. Therefore, the level of detail, type and timing of information that is required vary depending on the actor. The specific needs of each actor in the sourcing processes must align the provided information to have effective information flows.

Contractors require information that allows for procurement and efficient logistics to be able to successfully integrate the reused products in the new project according to respondent B1. The information demand often includes dimensions, fire/acoustic ratings, quantity, availability, condition, delivery times, storage needs, packaging, installation requirements and compatibility with existing systems. Therefore, depending on the procurement, contractors need the information early to be able to design with the reused products.

Reuse suppliers work as an intermediary role, receiving information from the inventory and deconstruction stage, and from contractors and designers. The reuse suppliers at times need photographic documentation and basic product identification such as type, model and dimensions in order to plan their measures to sell. Reuse suppliers also need specific requirements that includes functionality, dimensions, and design constraints to match the available products with the project requirements if they are helping with matchmaking. Clients, according to D2 demands environmental data and risk-related information such as warranties. It was further stated by respondent C1, that most contractors and clients need information and traceability. This is amplified by respondent D2 stating that the information of reused components is important for their digital model in Pythagoras. Respondent D2 states traceability is requested to enable improved management over building components in the operational phase.

4.4 Inventory

The first processes to implement reuse in a project, is to assess and identify the products from a demolition project. This is done by conducting an inventory often done with tools like CCBuild, Palats, Excel or by hand. Interviewee A6 explained that a hazardous material survey is the only inventory requirement before a demolition project. However, the introduction of reuse has increased the amount of labour before a demolition or deconstruction. Respondent A6 and D2 explained that a general screening of the available material and products in a building is needed to provide project managers with a general quantity overview of the products used in the building, as most constructions does not have detailed information of the used material. After the assessments has been made will a reuse inventory be conducted to establish which products will be reused, followed by a more detailed inventory of individual components after disassembly. The inventory process contains various independent actors, producing project specific inventories that are difficult to apply in future projects.

4.4.1 Factors affecting Information Flows

The quality and completeness of available product information is influenced by who conducted the inventory, the applied methods, the level of thoroughness, and tools used to capture and structure the data. Interviews show no standardized approach for conducting inventories currently exists, further resulting in the same product can be documented very differently across disassembly projects. As noted earlier, there is no industry-wide standard inventory tool used in the Swedish construction sector. Excel-protocols or hand-written notes with scanned PDF:s are common, but specialized inventory tools built into platforms such as Palats or CCBuild are also widely used. In the specialized inventory tools, there are templates for each product type with information input sections. Interviewees acquainted with these tools explain the available input is not an issue, rather the process being too time consuming. However, as explained by respondent D1, research is currently being conducted to develop a standardized inventory template that could be widely used. Also, the person responsible for the information input has great effect on what data is documented as there is no demands on input resulting in every individual using personal methods, explained by respondent C1.

For inventories to be conducted effectively, interviewee C1 stated that the individual responsible needs to understand the full reuse process chain and the broader purpose of working towards reuse, rather than treating the inventory as an isolated task. Incorrectly documented components were described as leading to additional work downstream, and in some cases, products had to be discarded due to incorrect assumptions made about their condition during the inventory. Underlying this is the need for the individual conducting the inventory to recognize that the documented products is ultimately intended to find its way into a new project. These processes are currently highly individual, and the level of detail documented from inventories varies considerably from project to project.

Interviewee A6 argued that conducting a detailed inventory in early stages was also described as potentially counterproductive, as some of the components initially inventoried could later prove not viable for reuse, rendering the detailed documentation unnecessary. Instead, the previously mentioned approach of progressively increasing the level of detail in the inventory was described as providing greater accuracy in the assessment of reusable products. This reduces the need for assumptions and increases the likelihood of identifying hidden defects that may not be detected in earlier stages. It was also noted that if available information is insufficient, products risk being disregarded by potential buyers prior to initial contact, regardless of their actual condition or suitability. Interviewee C1 noted that it is beneficial to clearly distinguish and document which products are suitable for recycling and which can be reused, as this reduces the need for additional work later in the process.

4.4.2 Deconstruction

Deconstruction practices also affect the flow of information in the reuse process. When procuring a demolition contractor, it is important to clearly specify which products are intended for reuse to ensure they are carefully and appropriately deconstructed. It is also preferable for reused products to have a predefined destination in a new building to avoid prolonged storage, although this is difficult to achieve in practice according to respondent D2.

Interviewee C1 notes that reuse specialists provide manuals detailing how products should be deconstructed, packaged, and transported when bound for a reuse hub. However, it is noted that these manuals are not always followed by demolition contractors, meaning that the guidance provided by reuse specialists does not consistently translate into practice. Failure to comply with the manuals may result in materials that are either not reusable or improperly packaged, leading to additional costs such as landfill fees and extra labor. The interviewee provides an example where improperly packaged glass sheets collapsed during transport and were destroyed.

4.5 Condition Assessments and Refinements

The approach to grade the product properties and condition vary immensely. The extent of the grading depends on the product complexity, and which organization is conducting the refinements and grading. C1 explained that their type of organization offers functionality assurance on certain products, as they sell various reused products that have varying functions and aspects. This is done by filling out information in CCBuild or Palats, the template to fill information regarding the product varies depending on the product properties. However, some contractors and clients also sell or offer products without any inspection according to interviewee A3, which then leaves the client/contractors from the new project with the responsibility to grade and make refinements of the products. The refinements are then made to fit project requirements, often by using internal resources. An example of a project-based solution, referred by respondent A5 and C1, is an Excel file with parameters for each component type, specifically intended for one project. Respondent C2 explained that their organization, which is specialized in a single product, has many internal and external technical structural engineers, as well as a lab that is used for testing the reused bricks reducing product uncertainty.

4.5.1 Factors Affecting Information Flows

The varying approaches and product properties results in hindering of structured and systematic information flows. The contractors that offer their reused products without any inspections, results in additional work for the buyers, as they will be responsible for the assessments and refinements according to respondent A3. This could be problematic if the contractors or clients are not experienced and must contact other organizations to help grade and make the assessment later, therefore, resulting in more ad-hoc and project-based solutions. If the product condition is poor, the reused products could become unused with resources and time being wasted by acquiring unnecessary material and added storage costs. This also applies to reused products that are used internally in the organization. An example given by interviewee D3, was how a client neglected the importance of the right quality assurance, even if it is the same company that possesses the product, led to extensive rework as a result of simpler assumptions. The therefore highlighted, by various interviewees, importance of acquiring the right experts or to have a standardized quality framework if needed to enable efficient information flows within the same organizations.

Interviewee C1 explained that their organization, reuse supplier with a reuse hub, offers product functionality assurance, however, the assessments are often done by different people. This results in varying documentation of the products aspects and dimensions, inevitably increasing the complexity and matching of elements if not all the information is structured alike. Respondent B1 elaborated that the possibility for reuse supplier and virgin material suppliers to collaborate could improve the structure of information when grading reused products. This is critical for products that are complex and will require experts to perform the analysis. Interviewee D2 agreed that quality assurance would be difficult for reuse hubs as they handle many different products with varying properties. For the reuse hubs it is particularly important to present the information of the graded products thoroughly to not surprise contractors if their expectations do not match what has been described according to respondent C1. Bricks, carpets and ceiling tiles are considered simpler elements, and currently, there are some organizations that provide quality assured elements of this stature.

Respondent C2, as earlier explained, have both internal and external structural engineers that help with the analysis and labs that is used for examining the bricks. This allows for a standardized approach, as their organization is specialized on bricks, meaning that their experience results in improved testing standards, objective assessments, and systematic documentation of the products, reducing the quality uncertainty. A critical factor for their organization is to test bricks from the existing project before deconstruction to prevent companies from sending unusable waste as potential reused products. The process according to interviewee C2 allows for similar warranties and aspects as new bricks. Their processes also allow for bricks fulfills CE (Conformité Européenne) mark which invevitably encourages more companies to invest in reused bricks.

"I can confidently say that if you buy a product from us, you know it has the right quality. The quality is ensured through our approval process, which specifies how we test the bricks, what procedures we follow before they reach us during the cleaning process, and how we deliver them onward." - Quote by C2

4.6 Reuse Material Communication

There are currently different ways in which products are advertised for sale. These include general reuse platforms such as Palats and CCBuild, as well as more specialized business models where suppliers take back and resell reused products. Respondent C1 describes the degree of accessibility as varying among reuse platforms, with some open targeted more towards the public and others operating under restricted access facilitating construction professionals. Contractors often assign the help of reuse suppliers to handle and post reused products on these types of websites. As mentioned by interviewee D2, reused products can be communicated internally through different organizational resources or by simple contacts.

4.6.1 Factors Affecting Information Flows

As previously stated, reused material platforms present information in different ways. The interview study shows similar results to the literature review regarding information not being presented in a standardized way, Respondent B1 states searching for products on reused material platforms takes too much time.

> ***"I do not want to depend on repeatedly searching a portal in the hope of identifying a product precisely when it becomes available. This creates a need for continuous monitoring, which is inefficient, time-consuming, and inevitably increases the overall cost."*** **- Quote by B1**

Respondent also mentions there is no system which notifies the buyer of products that are available on the platform. This way, the buyer would not need to constantly sit and monitor the various platforms and instead be informed directly when a product is on the market.

A recurring theme from the interviews is in an ideal scenario, the same level of information when purchasing virgin material is included when enquiring about reused products. If reused products were to have equivalent information to virgin materials, uncertainty about material quality and usefulness would be reduced significantly. There are currently business models for some simpler components established which offer sale of reused products with quality reassurance. Respondent D3 state that contractors are used to purchasing products from suppliers with established relationships and systems they are used to. The same interviewee also mentions that reuse specialists alongside not being experts on specific products often also lack sales experience. If reuse specialists collaborate with virgin material suppliers and their sales teams, they could inform contractors about similar products available on the reused market and present them in a more informative way, drawing on product-specific expertise. This could help streamline and simplify the process of finding and sourcing reused products.

***"I do not know how to sell products, I am not a sales manager but if we collaborate with a virgin material supplier who already have established networks and sales skills could an idea be to offer 5 reused doors out of 10 new ones"* -**
Quote by C1

From the site visit to a reuse supplier, it was stated that they do not want to sell to the public because private customers often have less experience with construction materials, which increases the risk of returns. An example given was that private customers may not understand that doors can be either right- or left-hinged. On the other hand, multiple respondents generally question current reused material platforms long term relevance for organizational use. Due to limited amounts of available products, fragmented market structure, quality assurances and limited expertise on specific complex products, these platforms in their current state might be better suited towards private clients. According to respondent D1, current reuse hubs could function more effectively as reuse coordinators and logistics centres, a "spider in the web", collaborating with suppliers rather than being fully responsible for the sale of more complex products.

Respondent C3 notes that more detailed requirements on product information for products that are uploaded to reuse material platforms could lead to more products being sold. A lack of sufficient product information creates uncertainty for buyers, who may then need to reach out to the seller directly, adding unnecessary steps to the procurement process. Current reuse platforms impose few requirements on the information that must be provided, placing considerable responsibility on individual companies and actors to determine what is documented and shared. Also mentioned, when companies are required to list materials on a reuse platform but face no requirement to complete the transaction, the motivation to provide comprehensive product information is reduced. This, ultimately limiting the quality and usefulness of what is available to potential buyers.

4.7 Integration of Reused Components

The integration of reused components includes purchasing and designing with reused products. With key roles being the contractors, designer and depending on the procurement the clients. In Kaj 16 the information of the reused products needs to be included in the BIM model since the project excludes storing information on paper. To separate reused components from virgin material components, the building elements are described with an "R" at the end of the type ID in StreamBIM according to interviewee A5. This allows for easier filtering if one is to search for reused components in the BIM model. The link for the QR-code that includes the information of the reused component is also added in the digital element, done by designers.

The interviews indicate that greater digitalization of the reuse process is needed to reduce the manual workload currently associated with sourcing, documenting, and communicating reused products. Interviewee C3 exemplifies this by describing an AI tool currently in development that scans images of products to assist with product identification and documentation. Technology enabling the direct transfer of product information from the reuse platform CCBuild into a BIM model through a script already exists and is functional, yet remains unused in practice across the industry.

Since the reused components require additional storage, there must also be logistics platforms that are used to coordinate the products after the purchase has been made. Palats offer in their logistics platform, a map of the storage facility to help with logistics in the hubs for both reuse hubs and internal hubs for contractors which was explained by respondent C1. This improves the material handling in the hubs and enhances the coordination for the logistics between the hub and the project. A challenge in the integration of reused products is not having coordinated or planned logistics prior to purchase. Respondent D2 states that transportation and storage of reused products should be established beforehand to minimize the risk of searching for such services on short notice. Identifying the destination of the products, whether internal or external, prior to disassembly helps reduce logistical risks, such as prolonged storage times that increase costs. The availability of reliable information across the process affects both logistical planning and confidence about the products from buyers. If transport and storage are not identified prior, actors may need to use ad-hoc solutions leading to higher risks, or that the reuse process is abandoned entirely.

4.8 Sourcing

Reused product need to match project requirements and currently, the process to find suitable elements is time-consuming. Contractors and clients must continuously search for reused elements in the product banks from Palats and CCBuild, and often must rely on coincidence to find reused products. In bigger construction projects there is also the issue of quantities, which is a common problem highlighted in the interviews. Product banks often lack sufficient quantities of the same product to create a sense of cohesion within larger construction projects. Interviewee B1, strengthened this statement by referring to the Kaj 16 project, which needed larger quantities. To meet the product demand, requirements were broadened when sourcing carpets to find a large supply. As a result, the project actors had to find suitable solutions to combine different carpets and still maintain uniform aesthetics. Another important aspect for larger construction projects to incorporate reuse is to request products from reuse suppliers months in advance, preferably 8-12 months in advance according to interviewee C2. This is important to secure the needed demand and help plan the reuse integration. For these types of projects, having a different building that is to be demolished as a material bank becomes effectively necessary for large scale reuse to counter the issue with quantities, described by interviewee A3. This idea is executed in different ways in practice. Interviewees describe the complexity of reuse from buildings within the same organization or concern is reduced. However, caution is required, as respondent D3 means there remains a risk of overestimating one's knowledge of the material which could lead to required design changes in later stages of project.

Interview results show the complexity of applying reused materials in construction projects is increased when going beyond organizational boundaries. As highlighted previously in 2.7, Reuse Material Flows in Construction, there are several scenarios of where reused products end up after a building is disassembled. The most complex scenario described by respondent D3 is when material leaves the organization. The current sourcing of reused products beyond organizational boundaries is highly dependent on contacts within the construction sector. When sourcing reused products for new construction, contractors typically rely on their professional networks to identify buildings scheduled for demolition within a time frame that aligns with their project. At times, this process can even be characterized as haphazard. Respondent D2 also identifies LinkedIn as a platform where project managers can signal their intent to buy or sell products. The current system facilitates access to reused products for actors within the Swedish construction sector who possess more extensive contact networks, compared to those with more limited connections. The sourcing process according to many interviewees needs more incentives and stricter requirements to make reuse viable for more firms. Interviewee C2 explained how current actors are mainly motivated by reducing the environmental impact, however, many remain profit driven excluding themselves from finding future solutions.

Architects play a key role in determining which products are reused by aligning product selection with design requirements. It is important to incorporate reused products prior to the submission of construction documents to make the process of finding products easier. This enables a more proactive approach to identifying reused products, while also providing flexibility in the search process and reducing the need to adhere strictly to specifications defined in the construction documents. For example, a reuse supplier such as respondent C1 prefers to be involved and informed of intended products at an early stage in the design process to maximize the potential for sourcing reused products. Furthermore, interviewee D3 states that when the integration of reused products is addressed too late in the design process, it may be necessary to negotiate with the building committee to permit their implementation.

5

Discussion

Based on results, the information flow is confirmed as a central aspect of the function of reuse. The results showcased various perspectives of key actors and their involvement of reuse and how it varies. The interviewees explicitly mention that there is a need for specific information structuring regarding the product and that reaching this structure is accompanied with barriers. By discussing the case Kaj 16, empirical data and literature could future research be presented. The findings from this study showcase that solely identifying what information is required is not sufficient to enable efficient reuse. It is also important to include how information is structured and communicated between actors across the supply chain. The actors involved are recipients of similar information but the information delivery and utilization is what separates the actors necessities. Interviewees mentioned similar barriers and enablers that is included in the literature review. However, from the empirical findings, it is evident that information flows are critical to analyze, if reuse will experience stronger and established processes in the future.

5.1 Information Demand in the Reuse Market

As mentioned in the empirical findings, contractors require detailed information from reliable sources to determine if the products can be integrated in a project. Depending on the contractor's versatility in a project, their demand is to have accessible product information to correctly design and plan their logistical procedure at the correct time. This includes, fire and acoustic ratings, dimensions, condition, quantity & availability. In the case study Kaj 16, the minimal requirements are product dimensions, article ID and classification. Information demand and requirements are also highly dependent on the complexity of the product. Simpler elements, such as cable ladders and roof tiles, require less information compared to a door which involves a broader range of parameters that includes functional and regulatory properties such as fire and acoustic ratings. These aspects are critical to verify if the product is aligned with project requirements, enhancing planning and easier integration into the BIM model. Reuse suppliers on the other hand, receives inventory based information from the deconstruction processes. Acting as intermediary roles in the supply chain, receiving information from the inventory & deconstruction stage and delivering the reused components information based on contractor, designers and clients requirements. Depending on the complexity, must reuse suppliers receive photographic documentation, basic product identification such as type, model and dimensions, as well as function requirements which aims to enable planning and preparation for resale to effectively match products to projects. Interviewee C1, stated that finding the year, model and brand of a component shortens the information gathering process of products with insufficient information, as it gives the opportunity to find product data online.

Clients show the need for distinct information as their role goes beyond the construction phase into the operational stage. Interviewee D2 stated that clients demand environmental data, warranties and traceability of the reused products. This was confirmed by D2, further stating that the information of the reused products must be arranged to allow for implementation in their digital systems, in this case Pythagoras. This shows that information requirement extends beyond the installation and also into the management of the operational stage. As mentioned in the literature, life cycle documentation and digital product passports are heavily requested when sourcing reused components (Hamidkhaniha et al., 2025; De Wolf et al., 2024). Despite the alignment between the empirical data and the literature, it must be noted that this insight is gathered from one public client, VG Regionen, with the potential of not representing the private clients. Future research could benefit from examining how public and private client prioritize information on reuse in the operational stage.

From interviewee B1, it is evident that designers would prefer if the reused products had greater availability to enable easier integration. In Kaj 16, the vision was to work in a 3D-model throughout the project which requires BIM-compatible information. This includes product type, aesthetics, dimensions and functional aspects to align with other designed components. This information must be accessible in early stages, before construction documents are submitted if the goal is to design with reused components and not after.

5.1.1 Key Actors in Reuse Material Flow Scenarios

The needed information of reused products vary depending on the stage, actor and the product properties. It was therefore important to discuss which actors are involved in which stages to better understand the demand of information in the supply chain of reuse as mentioned by Lambert & Cooper (2000) in section 2.5. After analyzing the results, the key roles involved are often based on which scenario the reused components follow. The inventories are commonly conducted by consultants or reuse specialists, and are finalized at times in collaboration with the client. In Scenario 1, most of the processes are handled within the project, however, in scenario 2 the products could be documented and stored with other internal resources. In scenario 3 and 4 are external specialist more common such as reuse suppliers or consultants allowing for external usage by preparing the information to fit other organizations.

The condition assessment and refinement stage include reuse suppliers, technical specialists and contractors that are responsible for the condition assessments and determining its reuse potential. In the simpler scenarios (1 and 2), the inventory is often conducted internally while the more complex scenarios (3 and 4) often require external specialists such as engineers or reuse suppliers to minimize the uncertainty. For the material communication stage, Scenario 1 is excluded due to its limitation within the project. Scenario 2 could require external resources within the same organization, whereas scenario 3 is information exchange informal between actors and organization by relying on networks and contacts. Scenario 4 involves platforms such as CCBuild and Palats and reuse hubs which allow for publication and structuring of the information of reused components to encourage matchmaking between organizations. This stage is particularly important for information flows, as it enables a market between organizations and is shown in table 5.1. The final stage, integration, require contractors in all scenarios to coordinate logistics and installation of the reused elements. The more complex scenarios, however, could involve coordination between reuse suppliers, logistics suppliers and contractors as just-in-time and other logistical coordination could become difficult to achieve. Explicitly discussing the key roles has enabled the study to better frame the complex supply chain of reuse and identify what information is needed from which actors.

Scenario	**Material Communication**	**Characteristic**
1 Internal Reuse	Not Needed	Products stays on site
2 Within Organization	Limited	Same Organization
3 Network Based	Informal	Relies on Contacts
4 Platform/hub-based	CCBuild/Palats & Similar	Open Market

Table 5.1: Material Communication in Different Material Flow Scenarios.

The process model mentioned in the literature study, more specifically figure 2.4, includes the logistical activities, but does adress the importance on the actual process in which information is distributed if the scenario replicates products going outside of the organization's boundaries. It was therefore important for this study to include Reuse Communication for reuse as a separate stage which is shown in figure 4.2. This was particularly important for Rose et al. (2018) as the development of a marketplace could enhance reuse sourcing. This could also be seen in figure 2.3 in section 2.7 *Reuse Material Flows in Construction*, as the off-site logistics section could be elaborated or replaced with the process model for reused products.

5.2 Factors Hindering Structured Information Flows

The reuse processes consists of various barriers throughout the supply chain that hinders structure information flows. The inventory, as identified in the empirical study and literature, varies in level of detail due to actors having varying templates with varying demands and requirements resulting in inconsistent information. This has an collateral effect on contractors and reuse suppliers, as contractors often must make own assessments as a result, increasing time consumption, making the products more expensive. Contractors and clients that provide reused products, therefore, transfer the responsibility of the products to the reuse suppliers, leaving them to structure information and resell them to new projects while at times having to refine them and find suitable buyers. The variation hinders efficient information management and emphasizes the need for standardized classification of reused products based on product type.

Similarly, products on CCBuild and Palats vary in information consistency. The empirical data show, templates are filled in differently, as there are few information criteria that are mandatory resulting in inconsistent information. This causes some products that are usable to never reach the right targets as they are not correctly published. This explicitly speaks for stronger and higher demands of required information to be filled in to minimize assumptions and uncertainty regarding the reuse platforms. Insufficient information could result in clients or contractors not engaging in buying reused components due to uncertainty in liability and alignment of the project requirements. In contrast, too much information result in added labor, gradually increasing the costs making the components more expensive. Some products are also published directly from a project without reaching a reuse supplier meaning actors with less experience might fill information incorrectly,

The variation in information requirements for publishing in CCBuild and Palats is determined by the product complexity as previously mentioned. Respondent C1 explained that knowing year, model and producer could help identify the product information quicker if available online. However, this depends on the type of reused product, as information on project specific components might not be available online. The fragmentation and project-based nature of the construction industry is partly the reason for the difficulty in applying certain components in various projects.

In the empirical study, late involvement of designers and reuse suppliers was identified as a barrier. Reused components that are integrated late into a final design make the implementation of reuse complex. However, it is currently a common approach in the Swedish construction industry. Respondents C1 & C2 stated that early involvement is preferred to increase the time scope to source reused products. Despite these statements, the relationship between designers and reuse suppliers is weak at earlier stages. This results in the scale of integration to become reduced and stressed as there is no access to find suitable products in the provided time.

5.2.1 Structural and Market Barriers

A challenge identified in the results is the common sourcing of reused products through informal contacts and networks, which makes the process inconsistent. This results in reused products being unevenly distributed across the industry. Actors who have broader networks have higher potential of finding demolition projects and thereby reused products. This inevitably reduces the reuse potential for actors with smaller networks, as products passing through informal systems bypasses reuse platforms entirely. This reduces the volume of accessible products for actors who depend on platforms or other channels to source reused components. The reuse activity therefore risks concentrating among a limited group of actors. The utilization of reuse platforms could reduce this dependency by presenting available products in equal terms.

Obtaining reliable information for reuse generates a need for trust between the different organizations. Having structured business processes for reused products enables greater trustworthiness, as unclear or unverified information is subdued. This inevitably helps contractors and clients engage in the open reuse market more as they perceive the sourcing to be reliable and easier to integrate in their project.

The supply chain for reuse has previously been mentioned as complex, however, this is partly due to companies having to rely on external sources for efficient application. Guerra et al. (2021) mention that businesses often have to partner with smaller companies or consultancies to adopt circular strategies, which is confirmed by the empirical data. However, it is also the reason for the fragmented nature of the construction company, which results in countless actors engaging in reuse adoption with varying measures. This inevitably affects the aforementioned actors, trying to find profitability when applying reuse. While many interviewees highlight the need for stricter regulations and incentives for reuse, this must not affect the companies ambition towards transitioning to applying reused products. Small solutions that are project-based could still be important to help enable a broader knowledge spectrum of reuse. Similarly have other industry wide adoptions, such as BIM, led to many actors actively trying to transition before any regulations.

5.3 Improving Information Structures in the Reuse Market

The reuse market experience a lack of standardized information structures for reused products. Unlike virgin materials, where established systems and product declarations provide consistent and comparable data, reused products lack an equivalent standardized framework. This section of the study will therefore explore and discuss what type of framework could benefit actors involved in reuse. Section 5.4 proposes a thesis framework that contains key processes for efficient implementation of reuse.

5.3.1 Reuse Supplier Roles and Market Development

A recurring observation from the results is that the current form of reuse hubs is limited in the range of products they handle. Unlike specialist suppliers, which operate within a specific product category and can develop deep expertise in their field, reuse hubs are expected to handle and assess a wide variety of products, with varying complexity. Quality assurance is particularly challenging for reuse hubs, largely due to the wide variety of products they handle. With the limited resources of these hubs, it is unreasonable to expect any single organization to have the technical knowledge, testing capacity, and expertise to handle all product types consistently. As a result, products risk being inadequately assessed and poorly presented, which may reduce buyer confidence and limit reuse potential. This discussion is not intended to address organizational shortcomings, but rather to examine the current role of reuse hubs and what they can realistically be expected to contribute within the reuse process.

Reuse suppliers must engage in finding reasonable solutions and engage in discussion with the reuse product recipients to have a continuous flow of feed-back as this topic is actively changing. Despite having reuse suppliers as the main focus for improvement must contractors and clients also be open to support and collaborate with the reuse suppliers to help integrate reused products effectively into their project. Contractors and clients are also involved in providing reuse suppliers with the material after conducting the inventory. It could also be beneficial if reuse actors engage in continuous discussion with reuse platforms, such as CCbuild and Palats, providing feedback on practical limitations and contributing with input to develop fitting features. Enabling all actors to understand the entire supply chain of reused material could benefit the advancements and help towards standardizing the reuse market.

A proposed solution is for products to find their way back to the original suppliers instead of being handled by reuse hubs. Suppliers of virgin materials within specific product categories naturally possess deeper product knowledge, which could facilitate quality assurance of reused equivalents, while their established customer relationships could provide an effective channel for introducing reused products to the market. Furthermore, the logistic systems and workflows already established for the distribution of virgin material could serve as a foundation for developing equivalent processes for reused products. This type of arrangement already exists for certain products, such as bricks and ceiling tiles. Introducing this model to a wider range of products could allow actors that are best equipped to handle them, improving the quality of information available to customers and the probability that products find a new application. The future of current reuse hubs, therefore, might have a different role within the reuse process and instead act as an intermediary between contractors and suppliers through collaborations with these actors. This role could include sourcing, storage, and coordination of products between deconstruction and reaching supplier. Drawing on the structure of virgin material supply chains, where specialized third-party logistics providers have proven more efficient than self-managed logistics, a similar approach could be adopted for the handling and coordination of reused products.

Furthermore, the aforementioned structural challenge where products are dispersed across multiple platforms, must also be addressed. This requires buyers to continuously monitor several websites to identify available products, possibly resulting in informal networks for sourcing. A platform compiling listings from multiple hubs and suppliers, along with a notification system which alerts buyers when desired products are available could enable a more proactive approach to reuse sourcing. Broadening this idea is the concept of a platform connecting deconstruction projects with new construction projects. Such a platform could enable deconstruction projects to publish inventory data on available products, allowing new construction projects to coordinate reuse opportunities in early stages. Providing greater visibility of available products, could improve the possibilities of incorporating reused products into design and procurement processes. Additionally, this solution could help address the issue of insufficient quantities for larger construction projects identified in the empirical findings. Contractors could identify demolition projects earlier in the reuse process enabling actors to prepare effectively rather than relying on platforms and reuse hubs that often lack the volumes for larger projects.

The current supply of reused products in the Swedish market may be better matched to smaller or premises adaption projects (ROT). These types of projects are generally more flexible in their product specifications, reducing the demand for large quantities that can be difficult to obtain from the current reuse market. It is therefore important to question if larger projects are fit for reused products, which serves as valuable showcasing for reuse ambition. The reuse industry however, might be more effectively driven through smaller projects where supply and demand are better suited with the offers from the current reuse market.

5.3.2 Digitalization of the Swedish Reuse Process

A recurring observation from the interviews is the extensive manual labor required to perform building inventories. This includes documentation of products, conduct quality assessments, and transfer data across digital platforms. This workflow increases the time and cost of implementing reuse compared to virgin materials. Although, this points towards advancing digitalization, the main challenge is not the availability of digital solutions, but rather using the tools that exist. This is largely due to the reliance on traditional workflows and the conservative mindset of the construction sector to adopt new tools and practices.

An example of the gap between technology availability and practical integration is a plug-in that enables a direct connection between the CCBuild reuse platform and the widely used Revit BIM software. This plug-in allows product information published on CCBuild to be converted into a Revit-family and integrated directly into the BIM model. This could eliminate unnecessary steps by reducing the need to enter the same information multiple times, while also improving the consistency and accuracy of product data compared to manual transfer, where human error may occur. However, this plug-in is not widely used across the industry, seemingly due either to resistance to adoption or a lack of awareness of its existence. CCbuild is currently also developing an AI-based tool to help with manual effort associated with inventory and product documentation.

Linking reuse platforms to BIM environments is also reflected in the broader literature. Hamidkhaniha et al. (2025) discuss the integration of Digital Product Passports (DPP) with BIM to improve product traceability and support early decision-making during the design stage, both of which were identified in the empirical study as aspects requested by actors in the construction industry. Furthermore, De Wolf et al. (2024) identify linking BIM with reuse platforms and integrating DPPs as ways to facilitate communication and collaboration between actors in the supply chain. De Wolf et al. discuss scan-to-BIM, in which existing buildings are scanned and reconstructed into BIM models, demonstrating strong potential for cataloging products in digital databases. This could, in theory, represent a step toward large-scale inventories of existing building stock. However, although 3D scanning technology has been available for more than a decade, its application to reuse in the construction industry remains limited. One possible explanation is the lack of demand for reused products, which may make the time and cost required to create detailed digital inventories difficult to justify. However, the digital developments discussed in this section, together with the general consensus of the interview study, collectively indicate that manual and pragmatic information management approaches are not compatible with a future scalable and systematic reuse process. This reinforces the need for the construction sector to transition from traditional working methods to more structured processes to manage information related to reuse.

5.3.3 Methods and templates

A recurring theme from the results is the lack of standardized methods and templates throughout the reuse process in construction. Inventory methods, quality grading frameworks, and information requirements on reuse platforms reflect the absence of structured and consistent information documentation. As a result, the reuse process varies considerably between actors and projects in Swedish construction and points towards a need for greater standardization across the industry, also reflected in the broader literature on information management and circular material flows. However, since construction projects are inherently project-specific, products differ in condition and type, while procurement structures, involved actors, and the scale and ambition of reuse also vary between projects. This raises the question of what level of standardization is optimal or even realistic for a more efficient flow of information in the reuse process. Establishing a minimum baseline of information requirements to be documented across all projects and products may be more realistic than implementing a single universal system while still allowing for some flexibility.

An initial baseline could be to request, at a minimum, year, model, and producer of a product. As the empirical data suggested, this will accelerate the locating of product specification, data sheets, and technical information by reviewing online sources, replacing detailed manual documentation. In an ideal scenario, a product-specific identifier such as a GTIN (Global Trade Item Number) would enable even more reliable product identification, although this information is not always available. Identifying GTIN or a minimum requirement could help construction reuse establish consistent information structures.

5.4 Reuse Information Framework

Based on the discussion, the following recommendations are intended for actors in the Swedish construction industry seeking to adopt reuse practices or improve information flows in their existing reuse processes. This section does not suggest that there is a single solution to the challenges of reuse. Rather, it highlights current inefficiencies in reuse processes and presents recommendations aimed at improving information flows and enabling reuse to be implemented on a broader scale.

After discussing empirical data and literature, a proposed framework is presented. The framework is based around the six most important aspects to consider when applying reuse. Aspects were chosen based on the discussion of the empirical study and the literature review. The framework is finalized and presented in Tables 5.2, 5.3, 5.4 and 5.5. The framework can be applied early in the project to maintain equal knowledge regarding reuse in the project. However, considering the project-based organizations of the construction sector, the content might be different depending on the project. It is therefore important to adapt the framework for projects with specific requirements.

1. Minimum information requirements per product type

Creating a project specific standard for what parameters are mandatory for each product type could reduce ad-hoc methods to document reused products. This should include which products are going to be reused in the design and should at least be year, model and producer or ideal, product specific identification such as GTIN.

2. Role clarity

Stating role and role objectives could minimize uncertainty in product documentation, who produces and who receives each information type. Clarifying key role activities might help structure reuse processes.

3. Timing - when information must exist

The framework specifies the importance of early involvement as sourcing products after fixed construction documents are finalized could result in reducing the reuse potential of a project. If the product is to be incorporated into the design, it is essential that sufficient information is available early in the process to enable informed decision-making before the construction documents are finalized.

4. Logistical Coordination

Establish transport, storage, and a clear product destination, ideally, before deconstruction begins. Where applicable, engage a reuse specialist to assist with sourcing and logistical coordination. To maximize the potential for reuse, the reuse specialist should be involved early in the project phases, prior to design decisions being finalized.

5. Condition Grading

Adopt a shared vocabulary across reuse platforms to facilitate a consistent and comparable presentation of reused products. Aim to extend professional grading practices to a broader range of products than is currently covered.

6. Digitalization

Develop awareness of relevant digital tools for reuse processes and actively work towards integrating them into organizational workflows. This requires a broader shift within organizations across the industry, away from manual and fragmented practices.

Table 5.2: Framework Stage 01 — Inventory

01 — Inventory *Identify and document existing products before demolition*		
Category	**Baseline Information**	**Additional Information**
Requested Information	• Product type, producer, model, year • Product dimensions where applicable (height, width, depth, often not required for area based products such as carpets, ceiling tiles) • Quantity available • Condition grade • Visual documentation	• Material composition • GTIN or equivalent identification where available • Original installation year (Traceability for repeated reuse) • Known defects or limitations
Responsible actor	• Primary responsibility: Consultant or reuse specialist • Supporting role: Client (approves scope of inventory) **Note:** *The individual conducting the inventory and demolition contractor must understand the full reuse chain, incorrectly documented components lead to additional work or products being discarded downstream*	
Format & tools	• Utilize digital inventory templates (e.g. CCBuild or Palats), avoid manual methods such as scanned PDF:s • Consider progressive level of inventory detail. General screening first, detailed component inventory after disassembly	
Timing	• General screening: before demolition decision • Detailed inventory: before deconstruction begins • Component-level documentation: after careful disassembly	
Key risks with insufficient information	• Reuse potential of products is unknown or underestimated • Demolition contractors may damage reusable products without clear instructions • Downstream actors receive insufficient information, increasing manual workload and cost	

Table 5.3: Framework Stage 02 — Condition Assessment & Refinements

02 — Condition Assessment & Refinements *Grade quality & refine*		
Category	**Baseline Information**	**Additional Information**
Requested Information	• Dimensional verification • Clear description of product condition • Warranty statement (if possible) • Reuse potential confirmed • Refinement needs identified • Updated visual documentation	• Fire rating and acoustic class verified • Formal test report • Structural assessment • Safety and liability documentation **Note**:*Additional information is dependent on the product type and complexity.*
Responsible actor	• Simple elements: Reuse supplier or contractor • Complex elements: Technical specialist or original virgin material supplier **Note:** *Reuse hubs cannot realistically be expected to assess all product types consistently, specialist actors per product category produce more reliable and standardized assessments*	
Format & tools	• Standardize parameter request from contractor per product category • CCBuild/Palats or similar condition fields • Year, model and producer as minimum identifiers to retrieve product datasheets online • Test reports from accredited labs where required (e.g. quality assessed components)	
Timing	• After careful deconstruction • Products should be listed or communicated to potential buyers • Re-assessment may be needed after storage if significant time has passed	
Key risks if not fulfilled	• Buyers receive unreliable information leading to uncertainty and reluctance to purchase • Products may be inadequately assessed and poorly presented, reducing buyer confidence • Liability uncertainty increases if condition is not formally documented • Products risks being discarded due to incorrect assumptions made in earlier stages	

Table 5.4: Framework Stage 03 — Reuse Communication

03 — Reuse Communication *Publish & match products to new projects*		
Category	**Baseline Information**	**Additional Information**
Requested Information	• Product listing with photos • Product dimensions • Year, product model, producer or specific product identification if available (GTIN) • Quantity available • Original project • Price indication • Contact information	• Installation documents • Compatibility notes • Environmental data (EPD) • Availability date and lead time • Fire and acoustic documentation • Warranty details • Storage and transport information
Responsible actor	• Primary: Reuse suppliers focusing on a single product type or reuse supplier via CCBuild/Palats/similar • Where no reuse supplier is involved: publishing actor takes full documentation responsibility **Note**: *Reuse hubs might be better positioned as coordinators and logistics intermediaries, complex product categories are better handled by specialist or original virgin material suppliers who possess deeper product knowledge* *Foster collaboration with virgin material supplier to channel sales for complex products*	
Format & tools	• CCBuild/Palats or similar product listing • Mandatory minimum information fields must be completed before publishing	
Timing	• Reused products should be sourced from a reuse supplier 8–12 months prior to the construction stage **Note**: *Early listing enables designers and contractors to incorporate reused components before construction documents are finalized*	
Key risks if not fulfilled	• Products that are usable never reaches the right buyers due to poor or incomplete listings • Unequal access to reused products - actors with broader networks have structural advantage • Insufficient quantities for larger projects if sourcing begins too late • Late request severely limits design integration potential	

Table 5.5: Framework Stage 04 — Integration

04 — Integration *Design and coordinate logistics for reused products*		
Category	**Baseline Information**	**Additional Information**
Requested Information	• Article ID • Confirmed delivery time • Storage and packaging requirements • Traceability log • Installation instructions • Quantity confirmation • Dimensions (height, width, depth)	• BIM object or Revit family • QR code or Digital Product Passport link • Operational stage documentation • Environmental and lifecycle data for client systems **Note**: *Common labeling of reused components in BIM model helps with identification*
Responsible actor	• Logistics coordination: Contractor or specialist logistics provider • BIM integration: BIM coordinator or designer • Information delivery: Reuse supplier **Note**: *Client operational requirements: Must be specified at procurement stage to ensure traceability is structured correctly to enable identification and maintenance of reused components throughout the operational stage*	
Format & tools	• StreamBIM or equivalent BIM platform • CCBuild to Revit plugin for direct BIM integration • Dedicated site logistics plan for reused products (Å-APD) • CCC storage mapping for logistics coordination of reused components • Delivery coordination with reuse hub or CCC	
Timing	• Storage destination must be confirmed before disassembly • Continuously update the BIM model to maintain usability throughout the project	
Key risks if not fulfilled	• Ad-hoc logistics solutions and increase costs and risk of product damage • Prolonged storage increases costs and risk of deterioration • Manual BIM entry increases errors and inconsistencies in product data • Client unable to manage reused components in operational stage due to missing traceability • Reuse process abandoned entirely if logistics are not planned	

6 Conclusion

Reuse in the construction industry was described as underdeveloped, with various processes that are yet to be standardized. Information flows are critical to examine the function of reused products and it is important to continue the standardization of reuse construction. Various actors are continuing research on creating structured processes for reused product types. The thesis has explored what information needs exist when implementing reuse in the Swedish construction industry to efficiently handle reused products in digitalized projects. To guide the aim of the thesis, three research questions have been formulated; what information key actors need, what factors hinder efficient information flows, and how a supplier information framework could be structured to enable consistent and comparable information flows across the reuse process.

The thesis research questions are answered based on a qualitative approach by reviewing existing literature, conducting an interview study, and a case study of the Kaj 16 project in Gothenburg. Conclusions and formulations are based on the current, constantly improving, reuse market.

RQ 1: Findings reaffirm that information flows are a central function of construction product reuse and that Sweden currently lacks necessary standardization to support efficient product information exchange between key actors of the reuse market. Contractors require reliable information including product dimensions, condition, amounts and availability, with component complexity influencing the required level of information detail. Reuse suppliers require information from the inventories of buildings to be deconstructed, as well as the functional requirements of receiving projects, to facilitate effective matchmaking. Designers require product information before finalizing construction documents to facilitate more effective integration of reused products into the design. Client information requirements should promote the structuring and traceability of information beyond the construction phase to support more effective building management during operational stages.

RQ 2: Various barriers were identified as hindering efficient information flows. The results show inconsistent inventory procedures, the absence of mandatory information criteria on the reuse platforms and inconsistent practices when assessing reused products were key information flow barriers. Interviewees also stated that late involvement of designer and reuse supplier reduces the reuse potential in a project by limiting the sourcing time. At the broader level, the fragmented nature of the construction industry, which relies on informal networks for locating and sourcing reused products hinders a structured reuse market. The conservative organizational structure and mindset of key actors could also collectively limit the adoption of new digital tools prevents the development of a systematic reuse market.

RQ 3: The identified barriers and requested information were addressed to help structure a information framework based on the information standards and procedures in reuse processes. The framework is categorized according to the processes stages in Figure 4.2, Inventory, Condition Assessments & Refinements, Reuse Communication and Integration. The framework showcases key roles, requested information based on product type and how procedures should be structured and conducted to enable efficient information flows when implementing reuse. The final aim of the proposed framework is to prevent ad-hoc solutions towards more structured and predictable information procedures enabling all actors to have a shared understanding of what information is needed, who is responsible for it, and when the information must be delivered.

The case study demonstrates both possibilities and challenges with large-scale reuse in construction. Early planning, dedicated logistics solutions, and structured information management facilitate the integration of reused products into large construction projects. However, such projects currently face challenges in sourcing sufficient quantities of reused materials from the market due to limited supply and inconsistent availability. The findings of the case study contributed to a better understanding of the information needs and barriers within the Swedish construction industry and provided a foundation for analyzing more efficient and structured information management practices for reuse.

6.1 Sustainable Development

The study and findings of this thesis can be connected to the Sustainable Development Goals (SDG) of the UN (United Nations, n.d.). It is directly related to SDG goal 12, Responsible Consumption and Production, which aims to ensure sustainable consumption and production patterns. By examining reuse in construction, this thesis contributes to enable a more circular practice in urban development. This also connects with SDG 11, Sustainable Cities and Communities. Furthermore, the thesis connects to the more general topic of SDG 13, Climate Action, which aims to take urgent action to combat climate change. The construction sector is a major contributor to greenhouse gas emissions and promoting circular material flows could help reduce said impact.

6.2 Future Research

The thesis has identified various limitations of the reuse market and some could be examined further. These topics are not explicitly in the scope of the thesis, but have a role in determining the reuse potential in future projects.

Exploring reuse in ROT and premises adaption
The reuse market could also benefit from exploring the reuse potential of ROT projects and premises adaptation as more suitable for circularity. As identified in this study, the current supply of reused materials in the Swedish market is often insufficient to meet the demands of larger construction projects in terms of quantity and uniformity. Smaller projects such as renovations and premises adaptations require lesser quantities of building components. Future research could investigate whether localized and smaller-scale reuse markets are better suited for reuse implementation.

Reuse Enabling Deconstruction
It could be beneficial for future research to further examine the deconstruction stage and its procurement. The empirical findings indicate that the deconstruction firms have a significant impact on the supply and quality of reused material. The procurement and tools that is utilized is vital to examine as this could help structure the reuse market into supplying more structural elements. It could become important to study if material intended for reuse is handled, packaged and transported correctly. Initiating contractual requirements and incentives at the deconstruction stage can be structured to accelerate the development of structure reuse market.

Collaboration Between Virgin Material Suppliers and Reuse Actors
Based on the findings, collaboration between virgin material suppliers and reuse actors appears to be a promising approach to improving sourcing and quality assessment for reused products. Future studies could examine the division of roles within the reuse supply chain, determining which responsibilities reuse suppliers, specialists, and virgin material suppliers are respectively best suited to fulfill in order to enable a more structured and efficient reuse process. This approach also offers an opportunity to make use of existing sales infrastructures, product expertise, and established relationships in the virgin materials market to broaden the reach of construction reuse.

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