
Exploration of Urban Mining role in the recovery of post-consumption construction materials and components

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Abstract

This qualitative research explores the role of Urban Mining, as a circular economy strategy, in facilitating the recovery of post-consumption materials and components generated by the life cycle of buildings. The relevance of this inquiry is founded on the growing need of implementing systems that manage resources consciously, especially in a sector such as construction, which is responsible for over 35% of the waste generated in Europe (European Commission, 2020). Through thirteen exploratory and two in-depth case studies, the project identifies the diverse circular strategies, such as reuse, repurpose, upcycle, etc., that companies employ to avoid these materials ending up in disposal. By looking at the integration of circular strategies and Urban Mining in case studies, it emerges that Urban Mining can have an important role in supporting the recovery of discarded materials and components, by shifting the view on these materials from valueless materials to precious resources. This project suggests that transitioning to a circular construction sector should include companies that enact diverse circular strategies in their business and initiatives that support the recovery of post-consumption materials and components from the urban environment.

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1 Introduction

1.1 The problem area

The traditional linear economic approach to resource utilisation typically begins with the extraction of raw materials from the natural environment to produce marketable goods, which, at the end of their life cycle, are often discarded as waste, primarily in landfills (Aldebei & Dombi, 2021). It is frightening to think that, since the Industrial Revolution, over 80% of the world's natural resources have been mined and accumulated as anthropogenic resources (Ghisellini et al., 2022). The circular economy model emerged as a response to the need to reduce the demand for finite natural resources and for better understanding how to use them efficiently (Ghisellini et al., 2022). It is progressively gaining importance as an alternative to the linear economy (Orenga Panizza & Nik-Bakht, 2024). The European Union (EU) has made development of 'a circular and resilient economy' one of its priorities for the years 2024 to 2029 to support Europe's industries while developing a cleaner and more competitive Europe (European Union, 2024).

Furthermore, the EU has identified 'construction and buildings' as one of the key value chains, which requires urgent coordinated action due to the sustainability challenges it poses (European Commission, 2020). The construction industry consumes vast quantities of raw materials (Orenga Panizza & Nik-Bakht, 2024), and these resources become waste throughout the lifecycle of buildings (Koutamanis et al., 2018; Orenga Panizza & Nik-Bakht, 2024). In Europe, the construction sector accounts for about 50% of all extracted materials and over 35% of the total waste generated (European Commission, 2020). Because of this, the Construction and Demolition Waste is considered to be one of the main waste streams in Europe (Bockreis & Ragossnig, 2022; Koutamanis et al., 2018). Thus, the construction industry should strive to replace primary materials with high-quality recycled alternatives (Bockreis & Ragossnig, 2022; Orenga Panizza & Nik-Bakht, 2024), driven by the primary aim of prolonging the service life of goods in use and making resources available for reuse at the end of their life cycle, thereby meeting future demands (Bockreis & Ragossnig, 2022). This is particularly important considering that a significant portion of waste materials has the great potential to be redirected from landfills and reused as new components or materials (Orenga Panizza & Nik-Bakht, 2024). Therefore, approaches aligned with circular economy have gained relevance in the construction sector, as they improve resource efficiency (Orenga Panizza & Nik-Bakht, 2024). In Denmark, the construction sector accounts for 40% of the total waste generated (Cocinto, n.d.), and in response to this, the government introduced 'The National Strategy for Sustainable Construction'. The strategy defines the development of construction in a sustainable direction, to follow Denmark's goal of reducing greenhouse gas emissions by 70% by 2030, compared to 1990 (indenrigs- og boligministeriet, 2021). Since cities hold a large part of the population and economic activities, they are characterised by high consumption of energy and materials (Ghisellini et al., 2022). In fact, most of the vast quantity of resources extracted for the construction sector ultimately accumulates in urban areas (Aldebei & Dombi, 2021; Ghisellini et al., 2022). The concept of Urban Mining, recognised by researchers as an important approach of the circular economy, views the materials accumulated in cities as a valuable stock, and it refers to the process of reclaiming these resources at the end of their life cycle and reintegrating them into new production systems. (Bockreis & Ragossnig, 2022; Brunner, 2011; Cossu & Williams, 2015; Ghisellini et al., 2022; Gutberlet, 2015). Urban Mining refers to the activities of mining for raw materials in the urban environment instead of nature (Aldebei & Dombi, 2021).

1.2 The scope of the thesis

This project explores the potential of Urban Mining by researching the circular strategies that are being used to recover post-consumption materials and components that come from the lifecycle of buildings. This

research is driven by the wish to have a more livable future where both the planet and humans thrive together, connected with the fascination of the potential of unwanted buildings and spaces to be preserved and transformed to meet and improve the needs of the communities and biodiversity that are around them. The thesis aims to contribute to the research that recognises the value of used resources and the catastrophic impacts of their inefficient management, both on humans and on the planet. Thus, this project focuses on the idea of locally recovering used materials and components from the construction sector to avoid their end in landfill as waste and the need to deplete natural resources for new raw materials. This research is targeted at architects, interior designers, contractors, furniture design companies, and other actors of the construction sector, who aim to have circular practices in their work by sourcing secondary materials locally, instead of depleting natural resources, which usually need to be transported from further away (Koutamanis et al., 2018).

1.3 The Research Question

In order to explore the potential of recovering construction waste, this research asks the following main research question:

What is the role of Urban Mining in supporting the recovery of post-consumption construction materials and components?

Urban Mining refers to the concept of mining the anthropogenic stock of materials that is held in the urban environment, when it becomes available at the end of its primary use. It is strongly connected to the term 'recover', explained hereafter, as both have the same goal, however, urban mining concerns the idea and metaphor of mining the urban sphere, which is used to highlight the value of used goods in cities (Aldebei & Dombi, 2021).

The term recovery is used as a general term that groups all the different activities and strategies that save used materials and components at the end of their use from disposal, for example, reuse, preserve, disassemble, repurpose, upcycle, recycle, and so on.

Post-consumption materials and components are all the objects, components and materials that are part of the buildings' structure, either exterior or interiors, like bricks, flooring, furniture, fixtures, windows, etc.

The value chain of buildings refers to the succession of phases that a building, or one of its individual components, goes through in its life cycle, starting at its planning and design to its demolition at the end life. Each phase sees the involvement of various actors, each with a unique role.

To guide the research, the main research question can be divided into two sub-research questions, which are as follow:

RQ1: What circular strategies are used to recover buildings' post-consumption materials and components?

RQ2: What barriers and benefits are encountered when recovering these materials?

The first research question focuses on analysing the existing landscape of companies that apply one or more circular strategies in their business to recover post-consumption waste that comes from buildings. The second research question delves into the possible barriers and benefits that could be encountered when dealing with the recovery of discarded material.

2 Methodology

This research is a qualitative study that uses case studies as the main method, both exploratory and in-depth. This type of research is appropriate for this thesis, as it focuses on the uniqueness and subjectivity of the data in its particular context (Lim, 2025). Thus, this project can be defined as a qualitative study because it engages in human behaviours and social phenomena that are experienced by the companies that decide to recover used materials as part of their business (Lim, 2025). To explore the complexity of these phenomena, the relevant data was collected using different methods: desk research, literature review, observations, exploratory case study, in-depth case study, and semi-structured interviews. Throughout the research, the method of desk research was used to gather information and data about the state of the art on the key topics and about the exploratory case studies, as well as to identify the two in-depth case studies. The resources were selected depending on the relevance of the research topics. As shown in the Research Design, illustrated in figure 1, the research is composed of three parts: the exploratory phase, the in-depth phase and the conclusion phase.

During the exploratory phase of this research, the data gathered by desk research is used to define the problem area and explore the main topics. First, the literature review was conducted by analysing documents in the form of reports, books, documents and scientific articles, in order to explore the state of the art and to get reliable data about construction waste, its recovery, Urban Mining, and other relevant topics for the thesis. Additionally, the exploratory case study method is selected to explore which strategies the companies are currently applying when recovering waste materials from buildings, as this method allows flexible exploration of unfamiliar phenomena (J.Mills et al., 2010). This way it is possible to have a general overview of the industry landscape, whose aim is to answer the RQ1: ‘What circular strategies are used to recover buildings’ post-consumption materials and components?’.

Then, in order to delve deeper and connect literature to practice, the renovation of Thoravej 29 by Pihlmann’s architects and the furniture company Underflod are treated as in-depth case studies. The case study is a suitable method to use because it produces context-dependent knowledge, allowing this research to go in-depth into the problem dynamics and explore the phenomenon firsthand (Flyvbjerg, 2006). During this in-depth phase, the circular practices that they use to recover used materials and components were explored, as well as the barriers and opportunities that they encounter in their work, answering the RQ2: ‘What barriers and benefits are encountered when recovering these materials?’. The two companies were first approached by email, and they agreed to an interview. Semi-structured interviews were conducted by preparing guiding questions and topics to discuss, and by letting the conversation flow naturally. The semi-structured interview method does not produce objective data that has to be quantified, but rather on description and interpretation of meaningful relations (Brinkmann & Tangaard, 2015). This type of interview enables an in-depth understanding of their contexts, the challenges they encountered and which solutions they adopted to recover the post-consumption materials. In the interview with Pihlmann, which took place in their office, the interviewee was Isabella Priddle, who worked for two years on the renovation project of Thoravej 29. The interview with Underflod was online and the interviewee was Emil Maegaard Jorgensen, the co-founder and head of design of the company. The interviews were recorded and transcribed with the consent of the interviewees. The interview guides and transcripts can be found in the Appendix B. A second round of questions was prepared for the two in-depth case studies in the form of an open-question survey. Unfortunately, it was not possible to collect the necessary data due to time constraint and scheduling conflict. The surveys can be found in Appendix C.

The conclusion phase is structured in two parts: the discussion and the conclusion of the research. In the discussion, the overall results of the collected data from the exploratory and in-depth phase are analysed and reflected upon. Then, the conclusion summarises the key finding of the research.

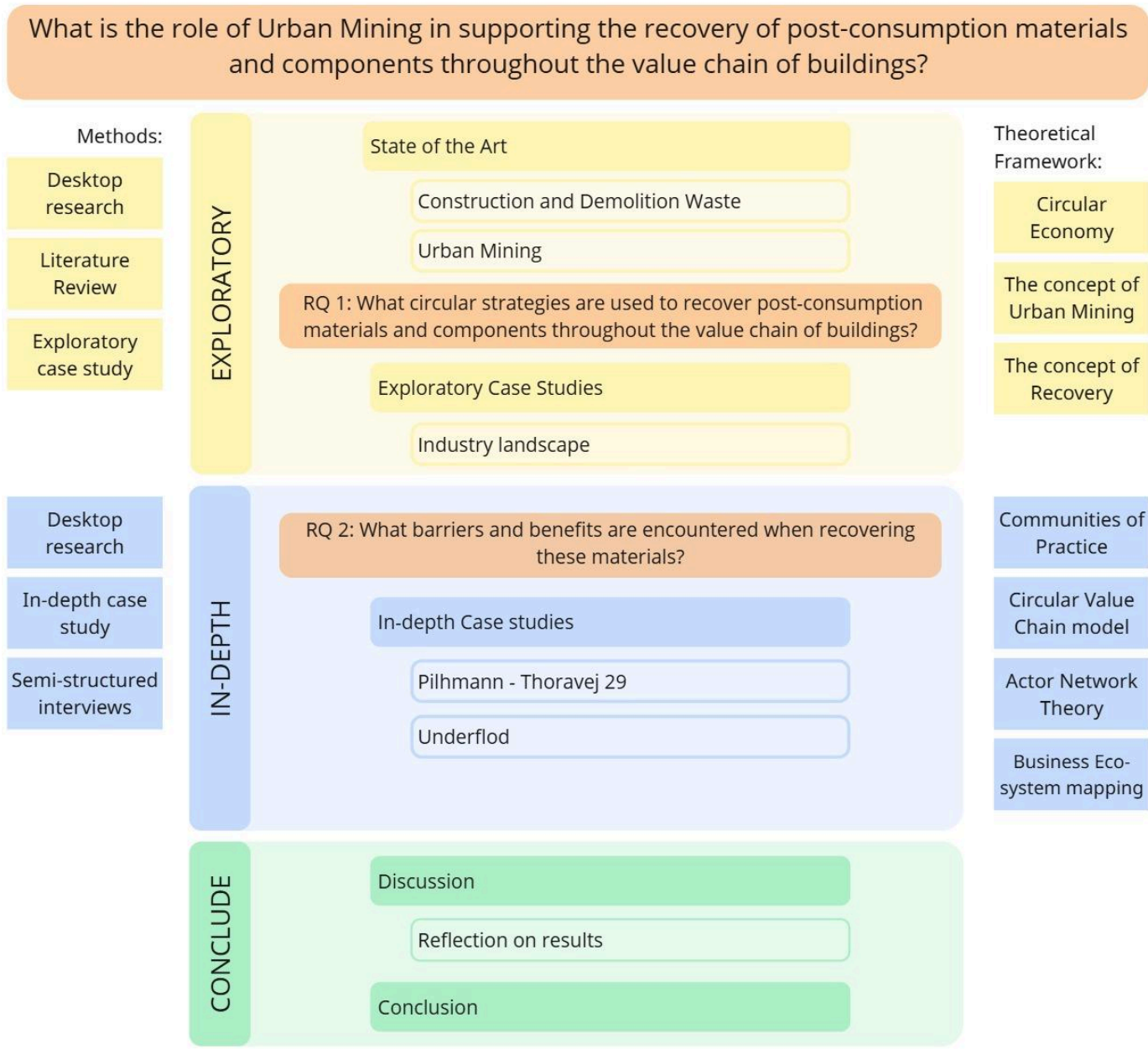


Figure 1. The Research Design.

3 Theoretical Framework

The chapter introduces the theoretical framework and analytical tools that support the analysis of this research. It introduces the key concepts, such as circular economy and Urban Mining, which provide the foundation for understanding the case studies and interpreting the research findings.

3.1 Circular Economy

The circular economy (CE) model aims to replace the linear economy "take, use, waste" system, as a response to the pressing need for reducing the demand of finite natural resources and for better managing them (Ellen MacArthur Foundation, 2025; Ghisellini et al., 2022; Orenge Panizza & Nik-Bakht, 2024). Furthermore, this framework aims to tackle global challenges like climate change, biodiversity loss, resource scarcity, waste and pollution, while also addressing important social needs (Ellen MacArthur Foundation, 2025). It does so by acknowledging the constraints of our planet's resources and perceives the world as an interconnected system where waste and pollution represent dangerous shortcomings (Bocken, de Pauw, Bakker, et al., 2016). Therefore, it strives to find methods to: eliminate these shortcomings, ensure materials remain in circulation rather than becoming waste, and restore the natural environment (Bocken, de Pauw, Bakker, et al., 2016; Ellen MacArthur Foundation, 2025).

The waste hierarchy (EUR-Lex, 2025; European Commission, 2024), shown in figure 2, highlights the priority order in waste management, aiming at improving resource efficiency and minimising waste. It puts prevention as the preferable solution, followed by preparing for reuse, recycling, other recovery, and disposal as a last resort. Prevention includes measures taken to avoid that the material becomes waste. Preparing for reuse consists of operations, such as cleaning or repairing, that ensure that the materials that have become waste are going to be reused. Recycle entails any recovery operation by which the waste materials are reprocessed. Other recovery included the operations that result in waste being used to replace other materials to fulfil a particular function or in waste being prepared to fulfil said function. Disposal encompasses "any operation that is not recovery, even where the operation has as a secondary consequence the reclamation of substances or energy (e.g. landfilling, incineration)."



Figure 2. Waste Hierarchy pyramid.

3.1.1 CE Key Strategies

In their paper, Bocken et al. (2016) defines the fundamental strategies towards a circular economy as the slowing, closing and narrowing of resource loops. Then, the fourth strategy, regenerating, was added by Konietzko et al. (2020).

1. 'Narrowing resource loops' aims at reducing the quantity of resources used per product.
2. 'Slowing resource loops' includes the prolonged use of the resource over time, and it does so through the design of long life and design for product-life extension.
3. 'Closing resource loops' results in a circular flow of resources as it aims at closing the loop between waste and production.
4. 'Regenerating resources loops' accounts for the need to increase renewable energy consumption and the need to minimise toxic substances utilisation.

The four strategies can be used together, which can be mutually reinforcing, in contrasting the traditional linear approach (Bocken, de Pauw, Bakker, et al., 2016; Konietzko et al., 2020). Konietzko et al. (2020) also include 'inform' as a support strategy because transparency and exchange of information is of high importance in enabling a CE.

3.1.2 Urban Mining as concept

In this thesis, Urban Mining will be considered an CE strategy that envelopes the implementations of various practices aimed at locally recovering waste, thereby contributing to a more circular urban environment. The concept of Urban Mining positions cities as holders of valuable resources, often in literature referred to as anthropogenic stock, giving them an intrinsic value (Aldebei & Dombi, 2021). This approach serves as a strategy within the framework of CE, focusing on efficient waste management in the urban environment by recirculating them, thus extending and closing the resources loops (Ghisellini et al., 2022; Konietzko et al., 2020; Koutamanis et al., 2018). Urban Mining perceives materials and components that have reached the end of their life cycle as important assets to be 'mined' (Aldebei & Dombi, 2021). This concept encourages practices such as deconstruction and local sourcing, emphasising the importance of recognising and reclaiming the value inherent in disposed materials, which often possess significant potential for reuse or recycling (Ghisellini et al., 2022).

3.1.3 Recovery of resources

Another main concept employed in this research is the 'recovery' of resources. This term refers to the circular strategies and practices aimed at salvaging discarded materials before they end as waste in landfills. Recovery is tightly connected to Urban Mining as it represents its main goal. In other words, Urban Mining can be considered as the mindset towards used resources, while recovery as the practical application of this mindset, which wants to reclaim these resources back in the system. Therefore, recovery is meant as a comprehensive term that includes circular practices like reuse, repurpose, upcycle, return, recycle, refurbishment, and other practices whose purpose is to recover the value in waste and extend their life cycle.

3.1.4 Construction circular value chain

The circular value chain model has the aim to help companies shift to circular businesses and, the model used in this thesis, was tailored to the construction sector by Nordic Innovation (2021). The model consists of five business models that can be implemented to support CE into practice, and have various sub-models each. The usual construction value chain, shown in figure 3 below, consists of six processes, engaged throughout the building's lifecycle, which are:

1. The Planning and Design of the systems, components and the complete building, including materials and technical decisions. It is a phase not to be undermined, as most of the decisions taken in this phase either lock or unlock the potential of the resources to be reused (Baker-Brown, 2017).
2. Material and Component Manufacturing, which produces materials (cement, steel, bricks), and

assembled components (ventilation systems, floor panels, fixtures, elevators).

3. Logistic, meaning the transportation of the materials and components to the construction site and of the packaging or surplus material from it.
4. Construction, during which the building is constructed, including the assembling of individual components.
5. Operation encompasses the use phase of the building, which includes all the processes and activities that accommodate the needs of the tenants, such as energy, heat and water, maintenance, refurbishment and renovation.
6. Demolition of the building happens at its end of use. It includes the separation of components and materials if possible, which are either recycled or sent to landfill.



Figure 3. The construction value chain (Nordic Innovation, 2021).

The five circular business models are: Circular Inputs, Sharing Platform, Product as a Service, Product Use Extension and Resource Recovery, described below. These models also aid the enactment into practice of resource flow efficiency, by tackling the narrowing, slowing, closing and regenerating resource loops (Bocken, de Pauw, & Bakker, 2016; Konietzko et al., 2020). Different circular business models affect different parts of the construction value chain, as shown in figure 4.

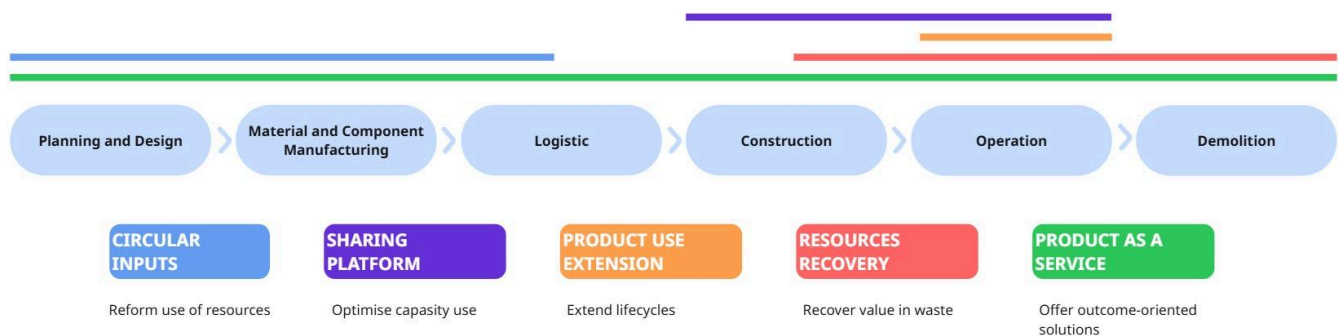


Figure 4. Construction Circular Value Chain Model (Nordic Innovation, 2021).

1. Circular Inputs refer to the use of circular supplies and design strategies to make durable, long lasting products, and it is applied in Planning and Design, Materials and Components Manufacturing and Logistic.
2. Sharing Platform enables the optimisation of the use of buildings by sharing solutions. It affects mostly the Construction and Operation phases. In Construction surplus materials and specific machinery can be shared between multiple contractors, and, in Operation, it includes having multiple activities that use the same space.
3. Product Use Extension aims to extend life cycles of materials and components, through strategies like repair, maintain, resell, refurbish, etc. This phase is applicable to the Operation phase.
4. Resource Recovery pursues collecting and recovering discarded materials and components by giving back value to them at their end-of-life, and it concerns the Construction, the Operation and the Demolition phases of buildings.

5. Product as a Service offers outcome-oriented solutions, which allows customers to use products or services without having to own them, and it is applied in all the phases of the construction value chain.

Figure 5 below shows the sub-models that can be enacted depending on the circular business model. The sub-models will be expressed in this thesis as circular strategies.

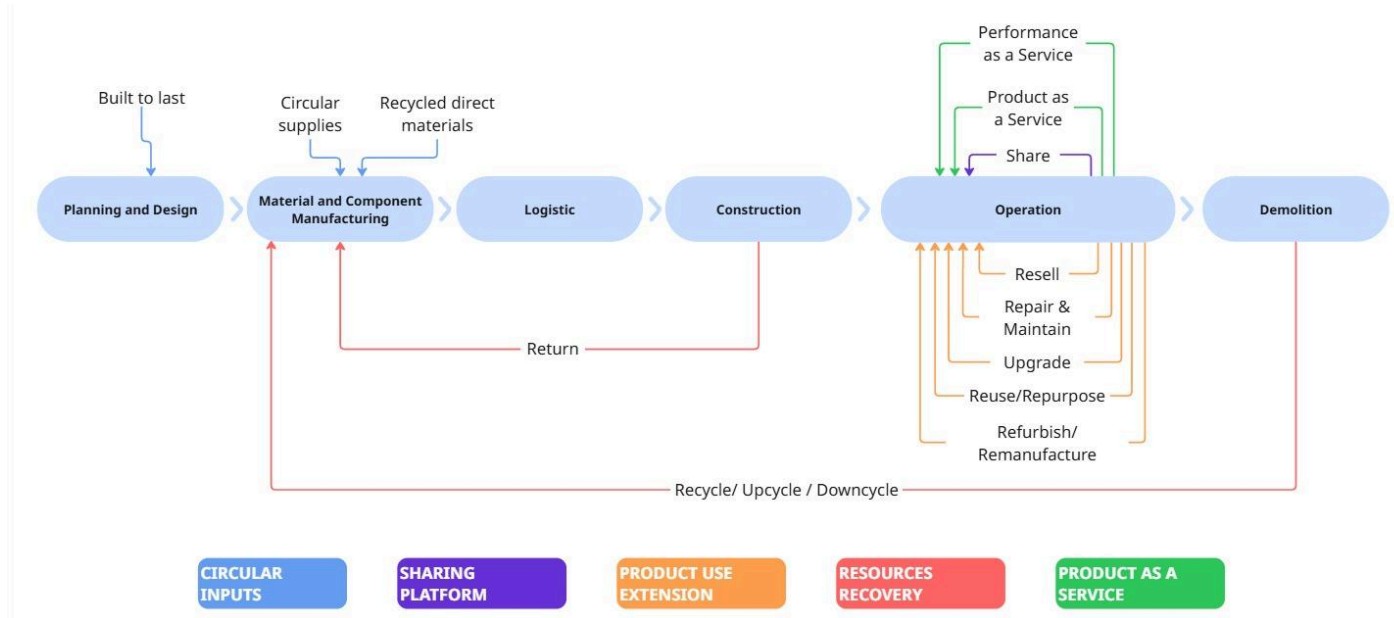


Figure 5. Circular sub-models, aka circular strategies (Nordic Innovation, 2021).

The circular business models will be applied to the in-depth case studies analysis to understand and visualise what circular strategies they enact in their business in relation to the construction value chain. The Circular Inputs, Product Use Extension and Resources Recovery business models have been observed in the exploratory case studies and in-depth case studies at different levels. Shared Platform is only applicable to Pihlmann in-depth case study and Product as a Service is not present, so it will not be mentioned hereafter.

3.2 Communities of Practice

During the research, the interactions with the in-depth case studies have highlighted the fact that each company has the ability to self-organise the way it intends to recover discarded materials from buildings. To create distinction to these different approaches, it is relevant to use the term ‘Communities of Practice’ (Wenger, 1998). A Community of Practice (CoP) informally emerges around what people find important and it exists by creating a shared practice as members partake “in a collective process of learning”, which, in this research case, is about how to manage post-consumption materials to be able reuse them. Wenger (1998) states that CoP are determined by three dimensions (figure 6), which are:

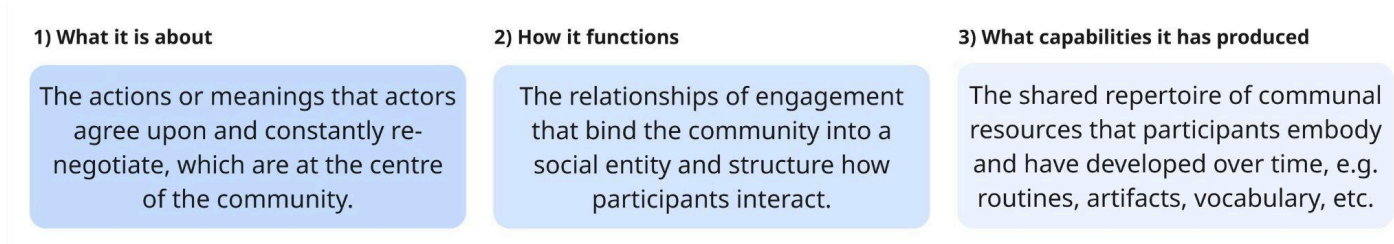


Figure 6. The three dimensions of a CoP (Wenger, 1998).

In this thesis, CoP is utilised to gain a better understanding of the in-depth case studies and their diverse way of recovering post-consumption materials that come from buildings' lifecycle. Therefore, CoP is used to analyse which practices the case studies self-organise around in order to recover discarded materials by finding membership in diverse communities.

3.3 Actor Network Theory

Actor Network Theory's (ANT) (Callon, 2001) purpose is to examine how networks of actors and actants are constructed, and it provides analytical tools for understanding the ongoing process of societal reconfiguration. The members of the network can be human (actors) or nonhuman (actants, e.g. materials, components, legislations) and they exert varying degrees of agency in their networks. In this report, ANT (figure 7) is used to understand how the in-depth case studies constructed their network around their practice, thus it supports the visualisation of the CoPs' second dimension (how it functions).

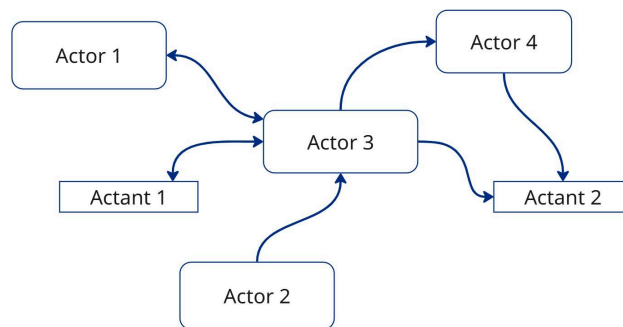


Figure 7. Actor Network example (Callon, 2001).

3.3.1 Business Ecosystem Mapping

The Business Ecosystem Mapping tool (figure 8) can be used to map and get insights about the connections between stakeholders. It requires to draw the different flows between the stakeholder by also indicating the direction and importance of the flow. The flows are the service and resource flow, the information flow, and the finance flow. (CIRCit Nord, 2025). In this research, this tool is used by implementing it to the ANT mapping of the in-depth case studies to visualise how they are organised. The finance flow is not included due to lack of data.

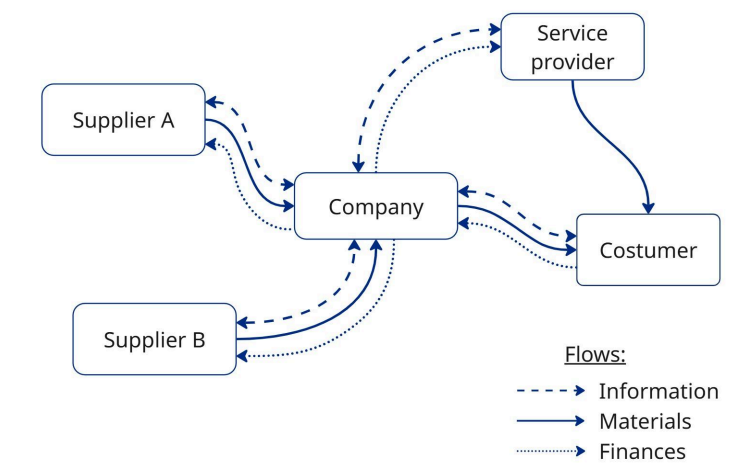


Figure 8. Business Ecosystem Map (CIRCit Nord, 2025).

4 State of the Art

The objective of this chapter is to provide the state of the art of the relevant literature that is about construction and demolition waste and urban mining.

4.1 Construction and Demolition Waste

The traditional linear economic approach to resource utilisation begins with the extraction of raw materials from the natural environment to produce marketable goods, and, at the end of their primary life cycle, these products are often discarded as waste, primarily in landfills (Aldebei & Dombi, 2021). This linear model is considered unsustainable, as it results, among other things, in vast depletion of natural resources (Aldebei & Dombi, 2021; Orenge Panizza & Nik-Bakht, 2024), a reduction in nature's generative ability (Aldebei & Dombi, 2021), and social inequities (Booth & DAC, 2025; Ghisellini et al., 2022). The linear model is also used by the construction sector, which is responsible for about 50% of all extracted materials and over 35% of the total waste generated in the European Union (European Commission, 2020). Because of this, the Construction and Demolition Waste (C&DW) is considered to be one of the main waste streams in Europe (Bockreis & Ragossnig, 2022; Koutamanis et al., 2018). This waste consists of significant volumes, which ultimately diminishes landfills capacity and exacerbates the harmful effects associated with landfills on the planet and human health, such as water and soil pollution, and methane emissions (Orenge Panizza & Nik-Bakht, 2024). Moreover, the greenhouse gas emissions that come from material extraction, manufacturing of construction products, construction and renovation of buildings are estimated to be 5-12% of Europe's total greenhouse gas emissions (European Commission, 2020). However, just by having greater material efficiency, it would be possible to reduce 80% of these greenhouse gas emissions (European Commission, 2020). One of the issues with today's construction materials and components is that they are not designed to be easily undone, a stark contrast to past practices where materials were viewed as valuable resources to be reused as much as possible. In fact, the concept of circular economy was always a part of human development, but in modern society it shifted from being a tool to overcome poverty to one that is needed to overcome saturated markets driven by overconsumption tendencies (Baker-Brown, 2017). As illustrated in figure 9 below, the conventional construction materials flow starts when the raw materials are extracted and used to manufacture components and materials, which are then utilised as inputs during the construction or renovation of buildings. Unfortunately, some of these materials are likely to become C&DW already during construction, usually due to surplus resulting from poor planning or due to carelessness in the application. In the operation phase, the C&DW is generated due to needed repairs, renovation, and breaking or discarding of components, such as windows, furniture, fixtures, external or internal construction materials (concrete, bricks, plaster), etc. The C&DW generated in the demolition is the most vast in quantity, and it is created when it is decided that the building has reached the end of its life. In today's linear approach, the C&DW normally ends up in recycling or in landfills (Orenge Panizza & Nik-Bakht, 2024).

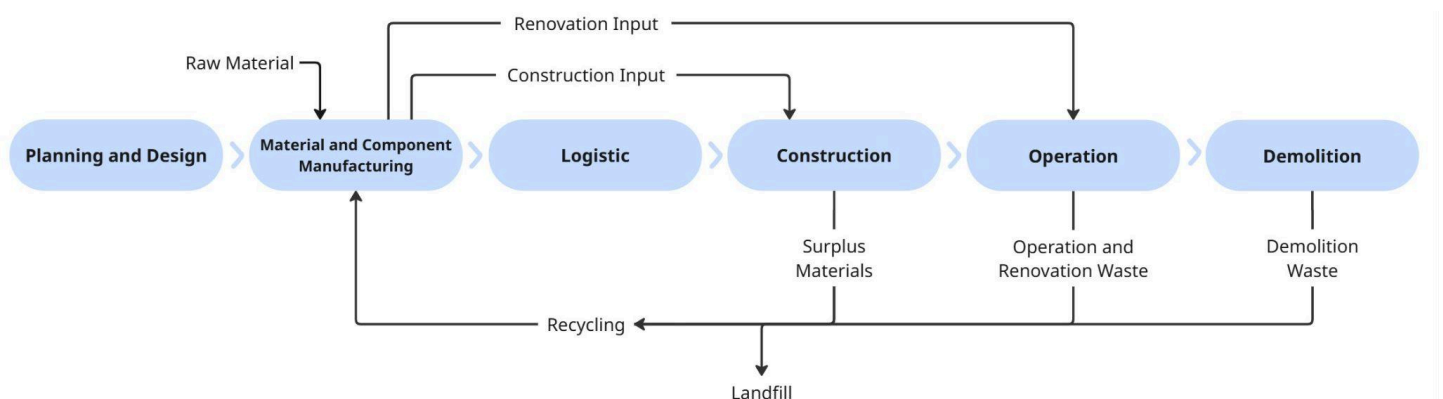


Figure 9. Material flow in the construction value chain (Nordic Innovation, 2021; Orenge Panizza & Nik-Bakht, 2024).

Society is starting to catch up with the fact that ‘resources which are contained in wastes should be recovered and utilised as much as possible’ (Cossu & Williams, 2015) and approaches aligned with circular economy have gained relevance in the construction sector, as they improve resource efficiency by reutilising waste materials generated from construction, renovation, and demolition (Orenga Panizza & Nik-Bakht, 2024). And to mitigate negative impacts, the building industry needs to invest in developing waste free construction methods for buildings that consume minimum resources during operation and are deconstructable at end of life (Baker-Brown, 2017).

4.1.1 The potential of Renovation

When renovating in the conventional way a lot of unnecessary waste is created, making renovation a big source of construction waste even if smaller than demolition (Koutamanis et al., 2018). This is because, during renovation, the unwanted components and materials are usually destroyed or handled with little care as their perceived value is low. The causes for building renovation are often due to one or more of the following factors: safety, improving energy efficiency, changes in aesthetic preferences—when the building is considered old or unappealing—, and new needs and use (Building Radar, 2025). However, renovation has a great potential for the implementation of circularity as it could promote the prevention and recovery of big quantities of C&DW created otherwise by demolitions (Koutamanis et al., 2018). Renovation projects are increasingly more relevant in the construction sector, as there is a growing tendency of reducing building construction in combination with preserving existing ones, to mitigate the waste of demolition and the extracted resources for new constructions (Koutamanis et al., 2018). The more promising area of impact is renovating the buildings that no one likes as, by giving them a new life, the buildings are preserved, instead of being demolished to build new ones in their place, with the added benefit of improving the local economy (Booth & DAC, 2025).

4.2 Urban Mining

The concept of Urban Mining refers to the process of systemic reclaiming and reusing the significant amounts of resources, such as materials and components that come from production to utilization of products, infrastructures, buildings, machineries, and discarded waste, from the urban environment after their use has ended (Bockreis & Ragossnig, 2022; Brunner, 2011; Cossu & Williams, 2015; Ghisellini et al., 2022; Gutberlet, 2015), in other words it generally refers to what happens after the materials are recovered from anthropogenic stocks (Aldebei & Dombi, 2021; Koutamanis et al., 2018). Urban mining also encompasses on-site preprocessing, collection and separation techniques (Ghisellini et al., 2022; Koutamanis et al., 2018), along with deconstruction, offering a viable alternative to conventional demolition methods (Koutamanis et al., 2018). This approach broadens the scope of Urban Mining beyond mere recycling to incorporate diverse forms of circularity, including reuse and remanufacturing (Koutamanis et al., 2018). Because of this, it is considered a strategy for transitioning to a circular economy and sustainable cities (Aldebei & Dombi, 2021; Koutamanis et al., 2018).

Urban Mining serves as a metaphor drawing parallels between the range of activities that process anthropogenic resources within cities and traditional mining, which involves the extraction of resources from the Earth’s crust (Aldebei & Dombi, 2021). It initially focused on electronic waste because it holds a high concentration of rare earth minerals desirable for their reuse in new electronics. Then the concept extended to hibernating stocks, “abandoned material stocks that have yet to be collected for waste management” that, however, make less than 10% of the anthropogenic stocks, so it extended again to in-use stocks, in other words, to buildings and infrastructure as they are “the largest anthropogenic stock and the most prominent product of the urban environment” (Aldebei & Dombi, 2021). In summary, even though it originally focused on electronic waste, with time, it shifted to all types of waste that are produced from

different aspects of urban life (Koutamanis et al., 2018).

Sometimes buildings are wrongly considered static invariable stocks (Cossu and Williams, 2015), on contrary, they are characterised by regular resources flow (Aldebei & Dombi, 2021). In fact, C&DW as anthropogenic stock offers a huge variety of materials to reclaim (Cossu & Williams, 2015), making the materials found in buildings attractive alternatives to depleting raw materials (Ghisellini et al., 2022; Koutamanis et al., 2018), which involve significant expenses for extraction and transportation from primary sources (Koutamanis et al., 2018). On top of that, it is important to remember that traditional mining activities to extract raw materials have both environmental and social impacts, such as forest loss, conflicts events, expropriation, water pollution, etc. (Ghisellini et al., 2022). Another viable reason for the attractiveness of anthropogenic stock over raw materials is the significant concentration of the resources available, which is often comparable or even exceeding natural stocks (Cossu & Williams, 2015). Although, it is relevant to mention that Urban Mining can also have negative social impacts if badly managed. The exploitation of workers is still a possibility and it could even lead to child labour, especially in the case of electronic waste recycling as it can *“be performed very far from the point of collection and generation”* (Ghisellini et al., 2022). Regulations that protect workers and support businesses that want to recover waste without outsourcing it to developing countries are very important.

4.2.1 Barriers and benefits of Urban Mining

Implementing Urban Mining and of recovering waste materials involves both barriers and benefits. For the success of the recovering materials, it is significant knowing various factors like their precise content, how they were assembled and to what they were exposed. These factors ease the extraction and the possibility for the material to be reused, repurposed or remanufactured (Aldebei & Dombi, 2021; Koutamanis et al., 2018). Table 1 lists the barriers that companies may find when recovering discarded materials and components. The barriers mostly highlight the issue of not knowing which, how much and in what condition the materials will be, as well as the negative perception they usually have.

Barriers:	Source:
Complexity of recovering resources in densely populated cities	(Aldebei & Dombi, 2021), (Koutamanis et al., 2018)
Lack of data and consequent unpredictable quality of the materials	(Aldebei & Dombi, 2021), (Koutamanis et al., 2018), (van Hees et al., 2025), (Ghisellini et al., 2022)
Higher labour costs	(Ghisellini et al., 2022), (Baker-Brown, 2017)
Limited and volatile availability of resources	(van Hees et al., 2025)
Negative end user perception. Reused products are perceived as more environmentally friendly but of lower quality.	(Ghisellini et al., 2022), (van Hees et al., 2025)
Not being able to exactly show stakeholders the final result	(Baker-Brown, 2017)

Table 1. Barriers of recovering materials from the urban environment.

Working with strategies that recover materials also entails benefits, which are both environmental and social. Table 2 lists the benefits found in literature. The benefits include the reduction of environmental impacts, creation of local employment and of strong partnerships, and the engagement in activities to improve the social environment.

Benefits:	Source:
Avoided extraction of raw materials	(Ghisellini et al., 2022), (Aldebei & Dombi, 2021)
Reduction of unprocessed waste and avoided landfilling	(Ghisellini et al., 2022), (Koutamanis et al., 2018)
Avoided production and transportation of raw materials	(Ghisellini et al., 2022)
Creation of local employment benefits	(Ghisellini et al., 2022)
Supporting the transition to circular economy and sustainable cities	(Aldebei & Dombi, 2021), (Koutamanis et al., 2018)
Giving value back to existing stocks and flows	(Aldebei & Dombi, 2021), (Koutamanis et al., 2018)
The creation of co-creative and locally driven partnerships	(van Hees et al., 2025)
Creation of new processes, skills and technologies in waste management, product design and production	(van Hees et al., 2025)
A growing business demand for circularity	(van Hees et al., 2025)
Engaging with social labour institutions, social initiatives and citizen communities	(van Hees et al., 2025)

Table 2. Benefits of recovering materials from the urban environment.

5 Analyses 1

This chapter presents an analysis of explorative case studies with the goal to identify the circular strategies used by companies to recover discarded materials in the construction sector. The chapter addresses the RQ1: ‘What circular strategies are used to recover buildings’ post-consumption materials and components?’

5.1 Explorative Case Studies

To understand what circular practices are being used in the recovery of discarded materials and components, thirteen organisations were examined to provide an overview of the industry landscape. The selected companies enact different circular strategies to recover resources, allowing to have diverse perspectives on effective recovery strategies. Based on the characteristics of waste handling the companies are divided into three different groups:

1. Case studies that resell materials and components;
2. Case studies that reuse/repurpose existing buildings;
3. Case studies that upcycle waste to make products.

5.1.1 Resell materials and components

This category includes companies that acquire discarded materials and components, either by buying them or having them donated to them, and then reselling or giving them away. The main circular practices presented are the reselling or exchange of material and in some cases the added service of dismantling the resources from the buildings. They contribute to slowing and closing the resource loops by saving these materials and making them available for reuse. The case studies are:

- Copenhagen recycling centres offer Reuse Points, where citizens can exchange for free still perfectly usable everyday items and in some cases even building materials and other bulky interior items. The recycling centres also offer activities to educate citizens on how to better use our resources (Affald KBH, 2025; Circular Copenhagen, 2025).
- Genbyg, located in Kastrup, specialises in purchasing and reselling used building materials. They also offer the dismantle and transport to their centre for all the items (door, windows, furniture, flooring, etc.) and launch various upcycling projects aimed at B2B market and retail (Genbyg, 2025).
- Rotor DC, based in Brussels, collaborates with various companies to dismantle, process and resell used construction materials and components, including furniture. Rotor DC’s specialisations include: repair and rewire of light fixtures, reprocessing of wood, cleaning and preparing for reuse furniture and building hardware, removing mortar from ceramic tiles, planning and organising salvaging operations in large and complicated buildings. They also manage the cooperative Rotor where reclaiming materials is investigated through research and design and the generated knowledge is available to all (Rotor Deconstruction, 2025).

This group includes digital platforms that involve mapping available resources for businesses or consumers, such as the following harvest maps:

- Opalis, founded by Rotor, is a platform that maps the area of Belgium, France and the Netherlands, by providing an overview of retailers that resell used building materials and other operators that offer dismantling, tailor-made elements or specialised advice, etc. (Opalis, 2025).

- In the Netherlands, the platform Oogskaart was founded in 2012 by Superuse to support its 'harvesting' strategy when salvaging discarded building materials (Baker-Brown, 2017; Superuse, 2025). The harvest map helps to identify surplus and waste materials, and to facilitate their repurposing and reuse (Baker-Brown, 2017).
- The Material Reuse Portal, managed by ReLondon, "brings together construction materials from multiple marketplaces to create a single place where reusable materials can be found". It is designed for the UK territory, however it has the goal to be scalable worldwide (ReLondon, 2025).

5.1.2 Reuse/Repurpose existing buildings

In this category are included companies, usually architects, that preserve existing buildings and/or reuse the materials and components in construction and renovation projects, by dismantling the unwanted materials and components and their repurposing or reusing. They contribute to slowing and closing the resource loops by extending the life cycle of buildings and avoiding that the dismantled materials go to disposal. The case studies are:

- The architects at Landager, located in Denmark and Iceland, specialise in the transformation of existing buildings and the reuse of their materials, guided by the goal of *"preserving what holds value and giving it a new life in a way that is both aesthetic, functional, and respectful of our planet"*. In their projects they explore the added cultural value of connecting the past of buildings to the present (Landager, 2025).
- Schmidt Hammer Lassen (SHL) (Copenhagen, Aarhus and Shanghai) include, in their approach, the integration of ecological restoration and circularity. They adopted the strategy of transforming existing old buildings to meet modern needs rather than to build new, for example an historic warehouse into a modern office or a silo industrial structure into a new neighbourhood (SHL, 2025).
- Superuse Studios (Rotterdam, Amsterdam, Beijing, Atlanta) harvest resources by dismantling building materials as locally as possible, reuse as much of the materials as possible and preserve the parts of the buildings that can remain as they are. Another strategy they implement is ensuring that what they build is disassemblable to facilitate maintenance and end-of-life recovery (Baker-Brown, 2017; Superuse, 2025). The name 'Superuse' derives from the concept of extending the usefulness of materials and objects from what was originally intended with the goal of adding value to them (Baker-Brown, 2017).
- In Paris, Jacob+MacFarlane's transformation of the Docks de Paris (figure 10) into the City of Fashion and Design is an example of reusing existing, sometimes unliked, buildings and adapting them to new needs. The architects recognised the value of an old building and gave it new life through retrofitting. They added to the simple concrete building an external steel and glass skin. Retrofit is a complex process that has the potential of enhancing the energetical performance of buildings, adapting existing buildings for climate resilience (Baker-Brown, 2017).

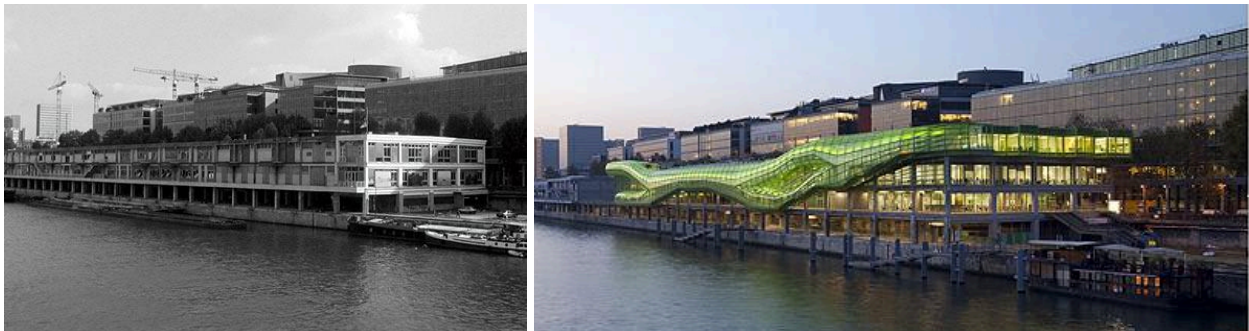


Figure 10. The transformation of the Docks de Paris building (Jakob+MacFarlane, 2025).

- Lacaton and Vassal saved a lot of materials from going to landfill when they were contacted about the creation of a new building that would have replaced the Tour Bois-le-Petre (figure 11). Instead, they proposed retrofitting it by leaving unmodified the interiors, and replacing the precast cladding of the facades with glazed winter gardens that extended the apartment and gave a new modern look to the building. This new layer wraps around the building and provides more natural light and ventilation, better quality of air and reduced overheating (Baker-Brown, 2017).



Figure 11. The transformation of Tour Bois-le-Petre (Lacaton & Vassal, 2025).

5.1.3 Upcycle waste to make products

In this category, companies source waste materials to make their products. The main circular practices observed are the upcycle of discarded materials into products, designing for disassembly and durability, and return systems. They contribute to slowing and closing the resource loops by recovering value in wasted resources. The case studies are:

- A:gain, Copenhagen, sources secondary raw materials from post-consumer and demolition waste, industrial production scrap, and discarded new production. And then upcycle them into building components and interior products. They focus on the waste streams of wood, plastic, glass and textile. Other circular strategies they use in their business are designing for disassembly and designing durable products that have full digital traceability, and having a take-back system (a:gain, 2025).
- Front-materials, Amsterdam, develops new types of planet-friendly building materials by upcycling waste and dry-stack systems that can be disassembled when required. Their waste based products are: WasteBasedBricks, from at least 60% upcycled industrial and demolition waste, Skip Tiles, from industrial by-products, Pretty Plastic Panels, made from 100% PVC plastic waste turned into facade cladding, and Paper Waste Panels, decorative wall panels made from industrial paper waste and post-consumer cardboards (FRONT®, 2025).

5.2 Summary

Table 3 below summaries the main circular strategies used by the exploratory case studies just discussed. The exploratory case studies were helpful for identifying two companies that are examined as in-depth case studies in the following chapter. Pihlmann represents the group of case studies that preserve existing buildings, and Underflod is part of the case studies upcycle waste to make products.

	Case Studies	Circular Strategies
1. Resell materials and components	Copenhagen's Reuse points (DK)	Exchange/Swap
	Genbyg (DK)	Resell Dismantle/Deconstruct Upcycle
	Rotor DC	Resell Dismantle/Deconstruct
	Harvest maps	Resell
2. Reuse/repurpose existing buildings	Landager	Preserve Dismantle/Deconstruct Reuse/Repurpose
	SHL	
	Superuse Studios	
	Docks de Paris	Preserve Retrofit
	Tour Bois-le-Petre	
3. Upcycle waste to make products	A:gain	Upcycle Design for disassembly Design for durability
	Front-materials	Upcycle Design for disassembly

Table 3. Exploratory case studies' circular strategies.

6 Analyses 2: In-depth Case Studies

In this chapter the in-depth case studies, Pihlmann and Underflod, will be discussed. The objective of this chapter is to go more in depth on how organisations are recovering post-consumption materials and which barriers and benefits they encounter. Thus it will answer the RQ1: ‘What circular strategies are used to recover buildings’ post-consumption materials and components?’ and the RQ2: ‘What barriers and benefits are encountered when recovering these materials?’.

6.1 Pihlmann and the renovation of Thoravej 29

The architect studio Pihlmann, based in Copenhagen, was founded by Søren Thirup Pihlmann in 2021. The studio’s project showcases the interest in repurposing existing buildings for new uses while preserving their cultural and historical heritage. This interest is also found in the renovation project for the Thoravej 29 building, which originally used to be a factory in the 1960s. It was clear from the start that this renovation was going to be different from conventional linear approach, where the unwanted materials and objects are mostly demolished brutally and thrown out. Instead, the transformation of this building was centered around the concept of ‘self-recycling within the building’, meaning that all dismantle materials and components were viewed as useful resources, “even those traditionally deemed insignificant”, so they were deconstructed and stored carefully to be later reused and repurposed according to their inherent qualities to meet the needs of the new use. After buying the building, Bikubenfonden, the current owner of the building, wanted to renovate the old building in order to accommodate the shift in use and give it a new life as an open community hub.

“It used to be the sort of building with these low ceilings, a lot of interior partition walls, that made you feel really disoriented. And what we’ve done is opened up the building in accordance with the clients’ requirements for the program.” Isabella, architect.

The renovation aimed to create a welcoming and uplifting atmosphere, addressing the former factory’s narrow spaces, and embracing, instead, a more open design that would facilitate social interactions and events. Today, the people interested in making a change and transforming society can have access to various events, resources, and workshops held at the community hub, which is named ‘Thoravej 29’ to honor its location (Booth & DAC, n.d.-b; Pihlmann, 2025). Some pictures taken during a visit of the building are available in Appendix A.

Moved by their approach of ‘self-recycling within the building’, Pihlmann collaborated with contractors and manufacturers to identify the best effective methods for enacting this approach while creating at the same time a space that would accommodate the building’s new function. As a result, a Community of Practice (CoP), as defined by Wenger (1998), emerged during the renovation process, centred around the practice of recovering and reutilising every possible element of the materials extracted from the building within the building itself. This shared practice defined what the community of practice was about, which functioned thanks to the various collaborations that Pihlmann established with the stakeholders to manage these materials. From this collaborative experience, the CoP produced a collective process of learning that strengthened partnerships and generated insights valuable for future projects. In summary, the three dimensions (figure 12), that determined this CoP, are:

1) What it is about

Recovering and reusing as much of the dismantled materials of the building within the building itself.

2) How it functions

Collaborations with different stakeholders, like the contractors and manufacturer, to manage the recovering of these materials.

3) What capabilities it has produced

New knowledge, skills, and a network of actors familiar with the process, which are all resources for future renovation projects.

Figure 12. The three dimensions of Pihlmann's CoP (Wenger, 1998).

6.1.1 What is it about

Pihlmann utilised different strategies to be able to enact their shared practice. Figure 13 shows these practices in relation to the Construction Value Chain Model, which was adapted to the renovation's context. The renovation project happened during the main Operation phase, aka the use phase, of Thoravej 29 and it extended its life by adapting the spaces from the Original Operation to the New Operation, and pushed the Demolition further on. To make this shift, the Planning and Design of the project and Selective Demolition of the materials and components were undertaken.

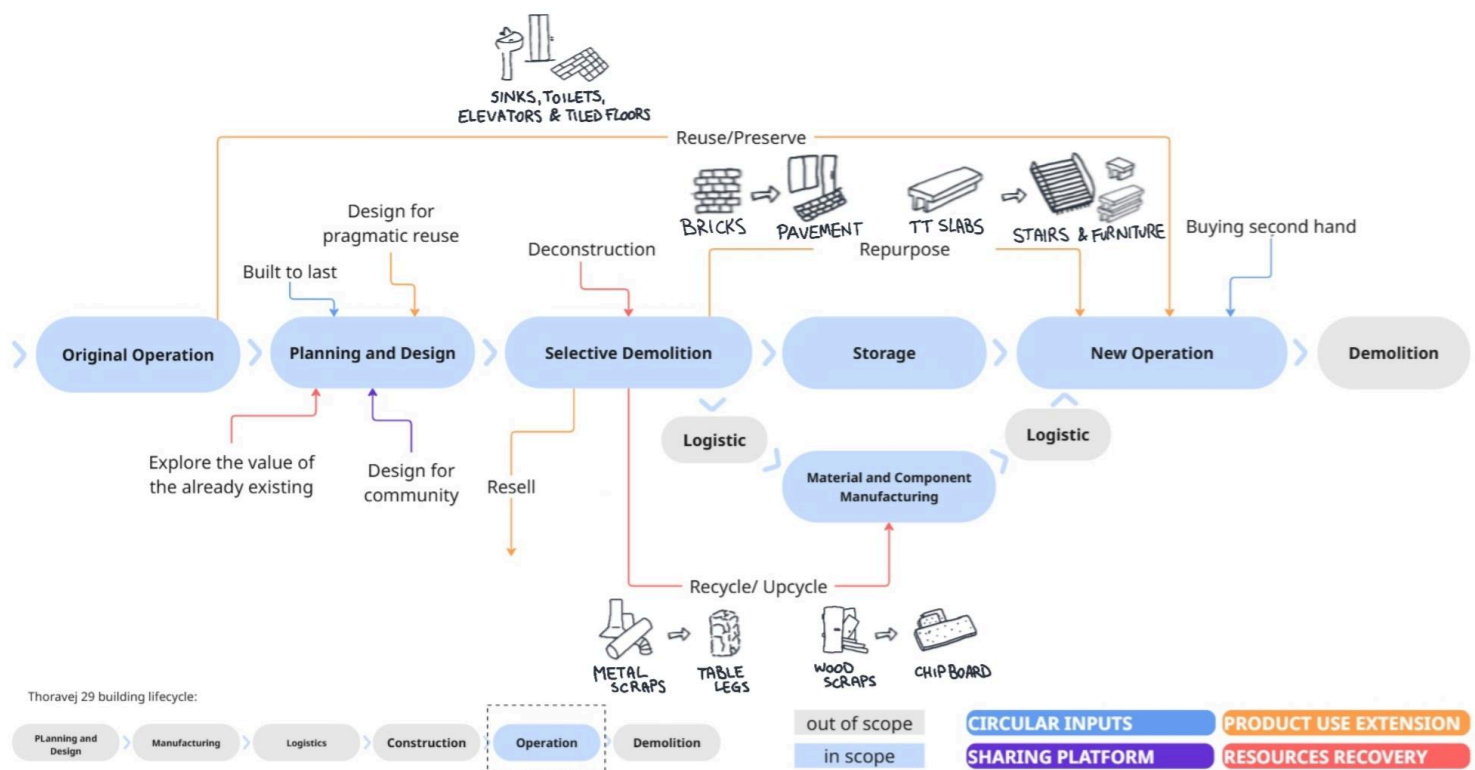


Figure 13. Thoravej's renovation circular practices (Nordic Innovation, 2021).

As shown in figure 13, during the Planning and Design of the renovation, Pihlmann architects were guided by the strategies of designing for pragmatic reuse of the materials and components, building solution that would last many years more, exploring the value of the already existing and designing for the Thoravej 29 community and its social requirements, such as shared functional spaces that are going to experience extensive use. What could be left untouched from the Old Operation was directly reused in the New Operation, such as the bathroom sinks and toilets or the elevators, which remained in the same place in the final building. The tiled floors were also preserved as they were, resulting in an intriguing collage of old floorings that reveals, in the now open spaces, part of the building of history (figure XC below). Then, during the Selective Demolition, the unwanted components were carefully deconstructed and stored. The cement TT slabs and facade's brick were repurposed within the building, and the wood and metals scraps were sent to manufacturers to be recycled into new elements, which were incorporated again in the building's New

Operation. The furniture that was needed for the New Operation was bought second-hand. And the things that they did not find a use for are going to be resold, for example, they rewired the old lamps and stored them carefully so that the client can sell them as vintage objects.

As for this thesis' focus, only the circular strategies of Repurpose and of Recycle Upcycle are going to be described more in depth in the following text, as these are the strategies that Pihlmann used to directly recover the materials and avoid waste

6.1.1.1 Repurpose

Pihlmann created double and triple height ceilings to create larger spaces and have a more immersive layout for the people entering the building. To do so, they cut the ceilings of different floors, which gave them a surplus of concrete they could creatively reuse. These concrete components were TT slabs, named like this because their profile is shaped like a double “T”, and designed to support significant weights, making them ideal for floors, ceilings, and roof structures. The TT slabs were repurposed for two different uses, some of the slabs were tilted at an angle to create the structure of the wide stairs (figure 14).



Figure 14. The TT slabs repurpose as stairs.

The rest of these TT slabs were used to make benches or tables (figure 15) around the building. These slabs can be seen stacked on each other or cut into more and more thin portions depending on which floor they are at. This is because they need to get lighter as you go up. On the ground floor, the cafe counter was made by stacking two 6.8 meters long TT slabs, weighing around 6 tons.

“On the ground floor, we have the heaviest TT furniture, and as you go up in height, we have to reduce the volume of the TT slabs for the weight. [...] They get lighter as you go up, whether just a single T slab or we cut them into smaller pieces and use them as table legs.” Isabella, architect.



Figure 15. TT slabs repurposed as benches.

On the ground floor, they also have made alterations to the facade. Instead of the previous standard row of smaller windows, they cut out the bricks from beneath them to create larger openings, suitable for either a glass garage door or an expansive window wall. In this process, they flipped the bricks and they laid them down onto the ground. In other words, the removed bricks from the facade were repurposed to create the pavement (figure 16). This created a subtle design element, allowing passersby to notice the bricks on the ground and understand their origin in a didactic manner.



Figure 16. The bricks were repurposed as pavement in front of the openings.

6.1.1.2 Recycle/Upcycle

During the renovation, there was a significant amount of surplus material retrieved from the selective demolition, including the old doors that could not be reused due to fire regulations, forgotten furniture left behind in the building and old wooden floors. These materials were sent to a manufacturer, where they were ground into small granules to transform them into a custom-made chipboard (figure 17) intended for the new furniture. The new boards showcase vibrant pops of colour, including remnants from the blue and red

doors, creating a unique visual effect.



Figure 17. Bench made new chipboard.

Then, the metal scraps removed from the old building during the selective demolition were brought to a recycling plant. Here they were crushed into parallelepipeds, sandblasted and finally finished with a clear lacquer. Then they were turned into furniture, for example by using them as the legs of conference tables (figure 18).



Figure 18. The crushed metal scraps.

6.1.2 How it functions

Pihlmann had to foster collaborations with various stakeholders to achieve their goal of recovering as much as possible from the renovation. The social interaction of the actors shaped the CoP, by negotiating their responsibility around the shared practice. The main actors of the network (figure 19) that formed around the Thoravej 29's renovation were: Pihlmann, the contractors, the chipboard manufacturer, the metal recycling plant and Pihlmann's client and owner of the building Thoravej 29, the Bikubenfonden.

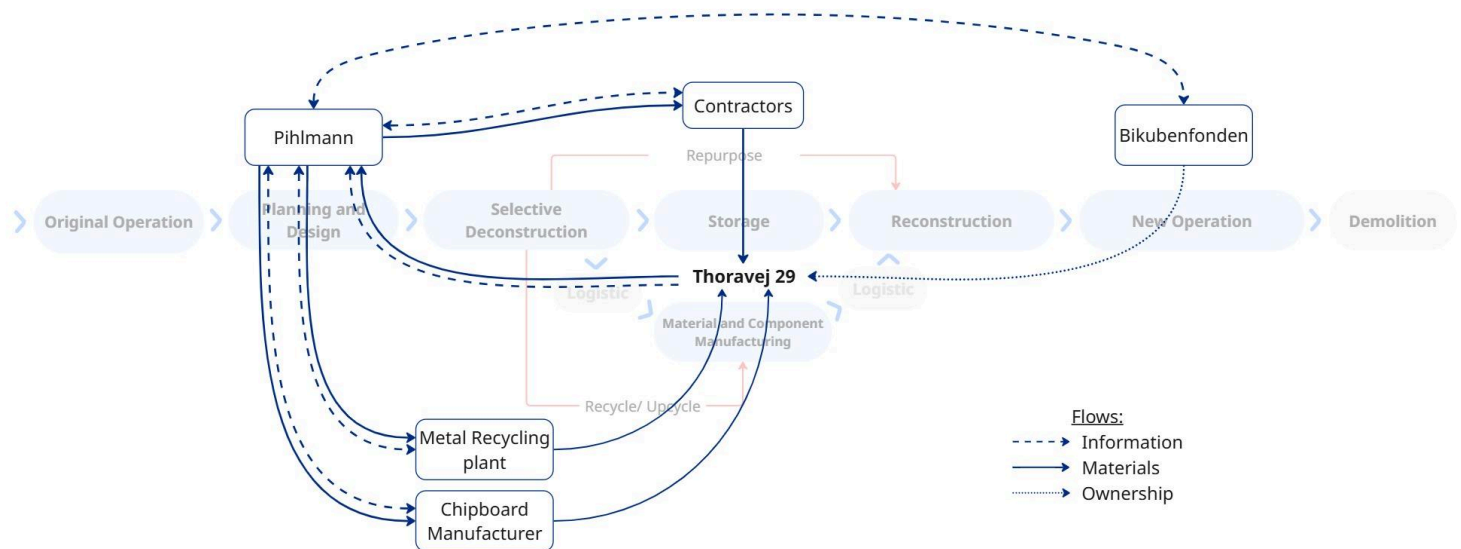


Figure 19. Actor Network of Thoravej 29 renovation (Callon, 2001; CIRCit Nord, 2025).

Pihlmann was in charge of the Planning and Design of the renovation and mediator for all the other actors. The architect studio received materials and insights, e.g. limitation and characteristics of the spaces, from the Thoravej 29 building itself. There was an exchange of information between Pihlmann and all the actors: Bikubenfonden expressed their needs and wishes for the New Operation, the contractors negotiated on the jobs that needed be done during the phases of the renovation, and the metal recycling plant and the chipboard manufacturer got instructions about what they needed to know with the metal and wood scraps. The materials that were removed from the building were distributed by Pihlmann to the other actors, depending on what needed to be done, and then put back into the building as new elements, as described earlier on.

The complexity of the process was logically characterised by some challenges that Pihlmann had to face, such as the renovation being a time consuming process, contractors and manufacturers not used to this way of working, and not being able to show stakeholders the final outcome (interview with Priddle). It is interesting to observe that all the barriers are relevant to the management and engagement of the stakeholders throughout a new approach of renovating.

6.1.2.1 Barrier 1: a time-consuming process

Thoravej 29 renovation's goal to recycle within the building meant the project and its every step took a long time. Mindfully deconstructing the material from the building is slower than breaking everything that is not needed anymore, and the materials need to be stored properly not to get damaged. Then, the various stakeholders need to figure out how to reuse them to accommodate the new needs of the building.

6.1.2.2 Barrier 2: stakeholders not used to the way of working

Another challenge was navigating with contractors that are not used to saving the old materials to reuse them, the new way of working needed to be negotiated together. The team also faced the challenge of finding a manufacturer willing to take on the unconventional process of making a new chipboard from the old doors, furniture and wood floor, as it was something they had never done before.

6.1.2.3 Barrier 3: stakeholder engagement and commitment

The case study showed an issue of having to convince the stakeholders of being onboard with decisions when they show them exactly the end result. What was very helpful for Pihlmann in this matter was that the client,

Bikubenfonden, believed in them and was supportive in experimenting new ways of working. And now that the project is complete it will be easier for Pihlmann to show future clients how waste can be managed circularly within renovations.

6.1.3 What capabilities it has produces

Throughout the renovation, the CoP built new knowledge, skills and a network of actors now familiar with the process, and can use these valuable resources for future projects, which made overcoming the various challenges worthwhile (interview with Priddle). The case study highlighted various benefits, which are presented below.

6.1.3.1 Benefit 1: less environmental impacts

Having this approach of recovering all the possible materials and components (even the unusual ones) was Pihlmann's aim to minimise its environmental impacts. The renovation, compared to building a new construction, had 3 to 9 times lower greenhouse gas emissions, and reduced waste production by 90% (DAC, 2025). Additionally, the architect studio extended the building's use life preserving it by adapting it to the new use needs and to the modern taste. This was done without erasing the history of the building, instead they left visible signs of where stuff once was and where the modifications were applied, showcasing the process.

6.1.3.2 Benefit 2: new strong and valuable partnerships

The renovation enabled Pihlmann to build a new network of stakeholders that are now familiar with their approach of working, believes in what Pihlmann is doing, and that can take pride in their work. In fact, they showcased the changes conducted on the building. Works, such as the electrical wiring, that are usually hidden in today's construction, are there for everyone to see. This meant that the contractors could creatively express the skills of their trade. This network of valuable partnerships could be very useful for Pihlmann's future projects.

“It was nice to see that excitement coming from different trades people throughout the process, as they were doing something that would be visible to everybody, which I think, nowadays, everything in typical construction projects is hidden away. It was so nice to see that they could take some pride in what they were doing and execute things really well. I think they did a really good job. It was nice to work alongside them.” Isabella, architect.

6.1.3.3 Benefit 3: example for future projects

Another benefit, now that the project is completed, is that it will be easier for Pihlmann to show future clients what they would be able to do. Pihlmann can use the success of Thoravej 29 renovation as an example and inspiration for what the clients could do with their own project. Additionally, the renovation project can also be an inspiration for other architects, designers and contractors on what can be done with materials that are considered as 'waste'.

6.2 Underflod

The two brothers, Mads and Emil Maegaard Jorgensen, founded Underflod, a furniture design company that makes its products from discarded materials, in 2021. They are based in Odense and want to help and encourage the interior and furniture industry to become circular. The purpose of their business is to show the importance and feasibility of creating circular products that are better for the environment without giving up elegantly timeless designs. They want to demonstrate that the circular economy and interior design can go hand in hand. Underflod's selection of products is crafted by social workers in Danish prisons and at Odense Værkstedet, a facility that provides work opportunities to disabled citizens. They source post-consumption woods from recycling centers and thrift shops, and industrial waste from various companies around Funen, the island where Odense is located. Then, another side of their revenue comes from collaboration with other firms, which contact Underflod about a new product line or about some waste materials that they would like to figure out what could be used for (Underflod, 2025a). As this thesis focus is on the discarded materials coming from post-consumption, the analyses of Underflod will focus just on the recovery of the wood side of the business.

“We put it as a mission to make the furniture industry more circular, and that's what we are trying to accomplish. And then at the same time, we're trying to work very hard in the local environments to create job opportunities for people that are not fitting into the norms of a workplace, no matter if it's criminals or people with disabilities.” Emil, co-founder and head of design.

Underflod's Community of Practice (CoP), as delineated by Wenger (1998), emerged when the two brothers rented an old workshop to start the business in 2021 and then flourished thanks to the various collaboration they created throughout the years. Their CoP's aim is to create beautiful interior products by upcycling discarded wood from recycling centres and thrift shops, which is the shared practice. Then, how the CoP functions is determined by the joint effort of all the stakeholders. Thanks to this collaborative environment, they constantly produce new knowledge and experience on turning discarded materials into products. In summary, the three dimensions (figure 20) that determined this CoP are:

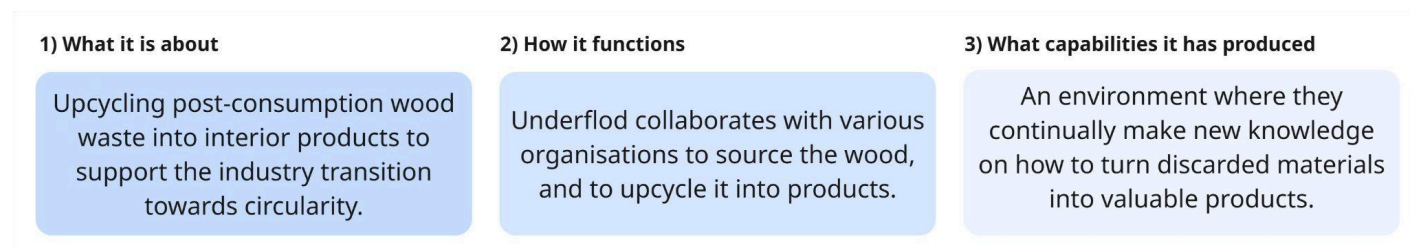


Figure 20. The three dimensions of Underflod's CoP (Wenger, 1998).

6.2.1 What is it about

By analysing Underflod's in relation to the value chain of buildings (figure 21), it is clear that the company applies various circular strategies to guarantee the success of the process, such as the circular strategies applied to the design e.g. design for disassembly, attachment and to maintain the integrity of the material), and having circular supplies by upcycling discarded materials.

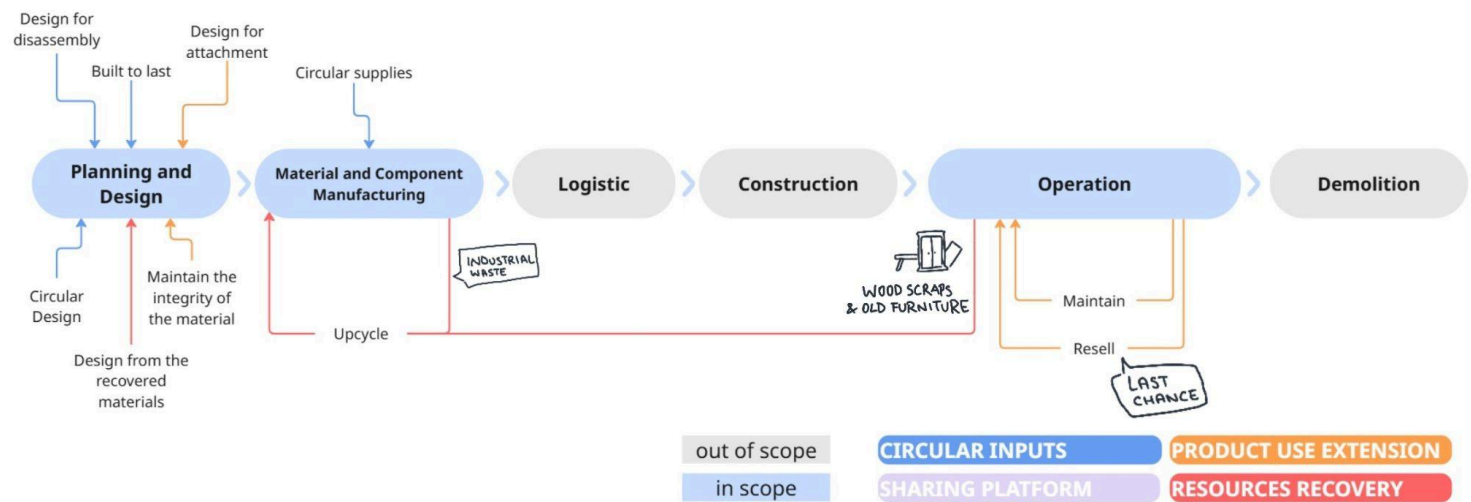


Figure 21. Underflod's circular practices in relation to the Construction Value Chain Model (Nordic Innovation, 2021)

Planning and Design is crucial for the process of creatively designing circular products. In this phase, Underflod makes decisions on how they can design from the recovered materials by making products that are built to last, disassemblable and are designed for attachment, so that they can last entire life times. Additionally, Underflod designs to maintain the integrity of the sourced material, so that during production as few processes as possible are needed and waste is minimised. The wood they recover and upcycle originates from the Operation phase of buildings, as it is old broken furniture or pieces of wood usually donated by citizens, who were going to discard them. The circular supply of wood waste is upcycled in the Material and Component Manufacturing. Then, the wood reenters the Operation phase to start a new use life as interior products. Another source of material for Underflod is industrial waste that are usually production leftovers they recover from various danish companies, like this the materials get recirculated and upcycled within the Material and Component Manufacturing. Underflod offers tips on how to maintain their products. Additionally, Underflod also has a service on their website, called 'Last Chance' (Underflod, 2025b), where they resell used or discontinued designer furniture or their returned products to extend their life by recirculating them within the Operation phase.

It is relevant to illustrate all the different overlapping circular strategies of Underflod business to show the diversity of possible circular strategies. However, as this thesis focuses on post-consumption waste and industrial waste is instead considered post-production, the analysis is going to focus only on the circular strategies that Underflod uses to recover the wood waste. The circular strategies are circular supplies and upcycle, and design from recovered materials.

6.2.1.1 Circular supplies

The post-consumption wood waste that Underflod recovers comes from recycling centres and thrift shops. The wood that comes from the recycling centres is donated by the citizens who were going to discard it. As it was bureaucratically complex to grab the materials directly from the wood waste's container, Underflod placed a wagon next to it, so those who are interested can place their wood in it. Interestingly, people can even grab from the wagon the pieces of wood they need for their own project, as Underflod's interest is primarily in the wood getting reused, even if it is not by them. Then, from the thrift shops, Underflod gets furniture that is not going to be resold because it is either too worn out or beyond repair. This way, Underflod can get the wood one step earlier than the recycling centre by going directly to the thrift shops and picking up the furniture they were going to throw out. This is an advantage also for the thrift shops' volunteers, who are often elderly people, as they do not have to make the trip to the recycling centre.

“For us it was also important that, if Mr and Mrs Jensen spotted something in that cage that they could use, then they were just as entitled to use it as us. Because the whole mission was recycling, it wasn't necessarily just for us to get more products through.” Emil, co-founder and head of design.

6.2.1.2 Design from recovered materials

Underflood designs a product starting from the waste material with the intention to have as few modifications to it as possible to minimise waste. This is in contrast with the conventional way of designing, in which the product's concept is thought first, then the needed materials are sourced, and finally the materials go through various processes before the product is ready.

“Then you give the waste new value by deciding to do nothing. And that's also an interesting way of designing. Sometimes it's actually about figuring out how little you need to do.” Emil, co-founder and head of design.

6.2.1.3 Upcycle

When upcycling waste into products, the company assures that the wood goes through as few steps as possible, as every time it undergoes a process more waste gets generated. Additionally, if there is an offcut material from production, they critically figure out how it can go back into the system instead of getting thrown out. For example, they have some offcuts from the cutting boards production. So, what they do is to make a magnet-free knife holder out of these thin pieces of wood by only drilling a slit into them, where the knife can be lowered into place. Hence, they have a new product by upcycling their own waste and they did not even need to invest in new tools for making it.

6.2.2 How it functions

Underflood's communities of practice thrives thanks to the relationships of engagement that the company has created with various local organisations. The actors engaged in the upcycling of the wood waste are: the thrift shops and recycling centres for sourcing, Underflood for design, and the Danish prisons and Odense Værkstederne for production. The actor network in figure 22 depicts the materials and information flows between stakeholders.

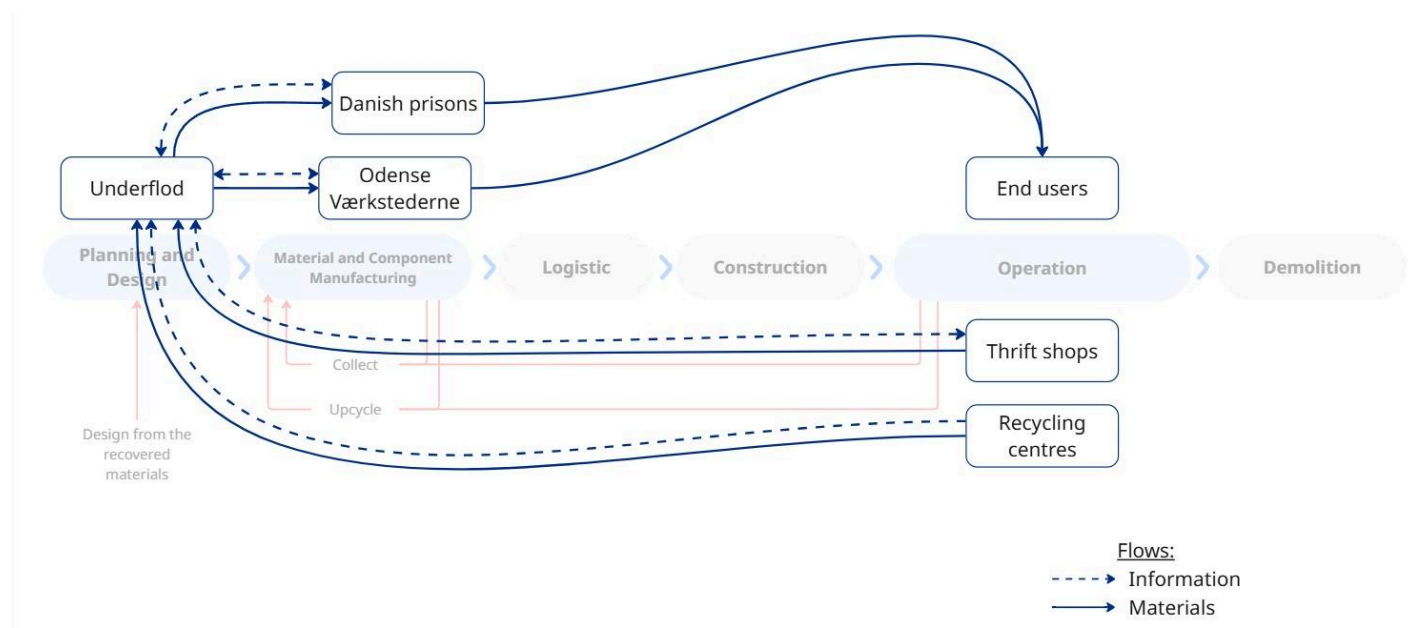


Figure 22. Actor Network of Underflood (Callon, 2001; CIRCit Nord, 2025).

Underflod logically is the mediator of the network and has to exchange information with the rest of the actors to manage the logistics, the products' design and other relevant information. Then, the material flow begins as wood waste at the recycling centres and thrift shops, Underflod designs the product to upcycle from it, then it is given to the Danish prisons and Odense Værkstederne for production, and finally the material return in the Operation by being sold as product to the End users.

Having a business that upcycle wood waste into timeless interior products comes with some obstacles to overcome. During the interview three main barriers were discussed.

6.2.2.1 Barrier 1: bureaucracy

The first challenge of recovering wood from recycling centres is the extreme difficulty of getting to the material once it is inside the container. And this is due to a large amount of bureaucracy. Dealing with a large scale of recycling from the public means, consequently, dealing with a lot of documentation. Underflod needed to get to the source of the material before it entered the container and became 'forbidden material' as Emil put it during the interview. Their solution, which was also mentioned previously, is to put the wagon close to the containers so that the citizens can donate their wood to Underflod by placing it in the wagon, allowing Underflod to get to the wood easily and to make it accessible to everyone.

6.2.2.2 Barrier 2: the unpredictability of the wood

The unknown quality of the material is another challenge, especially the one of the wood from the recycling centres. Not always the wood that gets donated is good enough to reuse, and this is mainly because of three factors. The first is the fact that not everybody that donates it knows the difference between solid wood and vineyard, which Underflod cannot reuse. Secondly, the wood at the recycling centre stays outside not covered, so it has a high probability of getting damaged by the weather, especially in a rainy place such as Denmark. This is one of the reasons they also started to source from thrift shops. Thirdly, the dimensions of the materials are always different and inconsistent.

"It's a lot easier to work with industrial waste when it comes to putting stuff in in systems and categories because you know, that they will have a standard thickness on the wood of 30 or 40 millimeters for example. And there will always be the case. (...) it will be consistent." Emil, co-founder and head of design.

6.2.2.3 Barrier 3: how the wood was treated

Underflod also found that not knowing how the wood was treated during its use is an issue. If it was used as a dining table or as a worktop in a workshop affects how it can be reused. Not knowing if the wood has been exposed to chemicals limits the possible products that the wood can be used for, as it could easily become a health risk. So, for products that come in contact with food, like their cutting boards, they source wood from industrial waste, as they know exactly how the wood has been treated from the manufacturer.

6.2.3 What capabilities it has produces

The CoP of Underflod continuously expands their knowledge of how waste materials can be upcycled into products and how to do so by creating as little waste as possible. The company has created a nice environment for this growth and strong partnerships with a multitude of actors. Furthermore, the case study indicated several benefits that are explained below.

6.2.3.1 Benefit 1: less environmental impacts

Thanks to Underflod's efforts, the materials that were going to be wasted in landfills or incinerated gets, instead, a new use life as valuable pieces of furniture that hopefully will last generations to come. Waste is

also avoided in their production as Underflod creates systems in which the materials have to go through as little processes as possible, and, if there is an offcut, it gets back into the system to be reused. Additionally, Underflod sources the material locally, which leads to reduced need of transportation.

6.2.3.2 Benefit 2: materials cost

Sourcing waste materials as input for their products is beneficial for Underflod as the materials cost is lower, usually even free. On the other side of business in which they source industrial waste, it is also beneficial for the companies that get to sell their leftover materials to Underflod and save the value of the resources at the same time.

6.2.3.3 Benefit 3: strong network

Underflod can rely on a strong network of collaboration with different organisations around Danmark. Organisations that are engaged in saving these materials. And the network grows as companies that are interested in saving or doing something with their waste contact Underflod to help them. Worthwhile to mention is that their production also supports a just work environment for more vulnerable citizens, underlining the importance of social intervention in circular transition.

6.2.3.4 Benefit 4: a liked narrative

The narratives that the products hold, of being crafted locally by vulnerable workers from waste, is admired by the customers. They can be proud of the circular product they have bought and by knowing the story that is behind it, thanks to the transparency of the company, they are more likely to value the product and make it last longer.

7 Discussion

In this chapter, the results of the exploratory and the in-depth phases will be reflected and compared between each other. The following chapter will be divided into the key findings that answer the RQ1 and RQ2, the implications of the research, its limitations and future research.

7.1 Key Findings

7.1.1 RQ1's findings

RQ1: What circular strategies are used to recover buildings' post-consumption materials and components?

To answer RQ1, data was collected on the state of the art and exploratory case studies. The exploratory phase, then, led to the selection of two companies as in-depth case studies, with the goal to further explore the recovery of discarded materials.

This research found that there are many circular strategies employed by organisations to recover materials and components in the construction sector, and that a single case study can use more than one strategy in their business, which aligns with the observations from both the exploratory case studies and the in-depth case studies. For example, Genbyg, while it employs the main circular strategy of Resell, also offers services that belong in the Dismantle/Deconstruction and Upcycle strategies.

The circular construction value chain model (Nordic Innovation, 2021) was used to identify the strategies used by the case studies. It was found that the case studies presented different strategies which, since their similarity to the ones of the model, can be categorized as sub-strategies, as they overlap in meaning. As it can be seen in table 4, the circular construction value chain model (Nordic Innovation, 2021) and Urban Mining share most of the strategies. Urban Mining adds the strategy of Dismantle/Deconstruct as a vital strategy to recover the materials from the anthropogenic stock (Koutamanis et al., 2018), which is also used by Pihlmann and some exploratory case studies, like Rotor DC and aforementioned architecture studios. Furthermore, Urban Mining encompasses strategies like Recycle/Upcycle/Downcycle, Reuse/Repurpose, Refurbish/Remanufacture (Koutamanis et al., 2018), and Resell, as the recovered materials have the potential of being Circular Inputs as alternatives to raw materials (Ghisellini et al., 2022; Gutberlet, 2015; Koutamanis et al., 2018). The case studies also represent the same circular strategies of Urban Mining, excluding Refurbishing. However, the presence of some sub-strategies was observed:

- The sub-strategy Exchange/Swap is used by Copenhagen's Reuse Points, which differs from Resell as there is no payment but has the same goals of extending the material's life cycle.
- Some of the exploratory case studies and Pihlmann presented the sub-strategies of Preserve and Retrofit as a way to reuse and adapt buildings to new needs.
- The in-depth case studies mentioned Built to Last as one of the circular strategies. Strategy not included in Urban Mining, which focuses more on waste management.

	State of the Art		Exploratory case studies	In-depth case studies	
	Circular Construction Value Chain (Nordic Innovation, 2021)	Urban Mining		Pihlmann - Thoravej 29	Underflod
Circular Inputs	Circular Supplies	✓	✓	-	✓
	Built to Last	-	✓	✓	✓
Product Use Extension	Resell	✓	✓ + Exchange / Swap	✓	✓
	Repair & Mantain	-	-	-	✓ only Mantain
	Reuse / Repurpose	✓	✓ + Preserve; Retrofit	✓ + Preserve	✓
	Refurbish / Remanufacture	✓	-	-	-
Resources Recovery	Recycle / Upcycle / Downcycle	✓	✓ Upcycle	✓ Recycle/ Upcycle	✓ Upcycle
		Dismantle / Deconstruct	✓	✓	-

Table 4. Overview of the circular strategies and sub-strategies employed.

This research also found that dividing the circular strategies into clear categories is difficult in real life as their meaning and use overlap across various activities of the organisation. This is also due to how the execution of circular strategies is deeply affected by the social interactions and collaborations that are part of the specific local context of the company. While simplification can be useful to explain how things are done, it compromises the in-depth understanding that comes from extensive data. In this case simplification was necessary since the lack of said data.

Another key finding is the fact that Urban Mining highlights the idea of sourcing materials from the surrounding urban area, remaining local. This is also observed in how the in-depth case studies source the waste materials. Pihlmann recovered the materials extracted from the building within the building itself, and Underflod sources materials and manages production alongside local organisations. By looking at the integration of circular strategies and Urban Mining in real life scenarios, it emerges that Urban Mining can have an important role in supporting the recovery of discarded materials and components, by shifting the view on these materials from valueless to precious materials.

7.1.2 RQ2's findings

RQ2: What barriers and benefits are encountered when recovering these materials?

To answer RQ2, data was collected from the two in-depth case studies with the scope of having a deeper understanding of what could be the limiting and driving factors to recover used materials.

7.1.2.1 Barriers

Both Pihlmann and Underflod encounter difficulty in recovering materials, which was also stated as a Urban Mining barrier by Aldebei & Dombi (2021) and Koutamanis et al. (2018). Pihlmann stated that the challenge of the renovation project lied in the time that each step took, which would sometimes discourage the stakeholders. This was probably due to the fact that many of the processes were done for the first time, so they needed to figure out how to do them and engage the stakeholders in the execution. Underflod highlighted the challenging fact that when the waste gets discarded at the recycling centre, it becomes very difficult to retrieve it with the main reason being bureaucracy. This is problematic because, according to the

waste hierarchy, disposal should be the last resort. Therefore, regulation should facilitate, not hinder, the recovery of these materials to promote their reuse and prevent unnecessary waste, as per the Waste Hierarchy (EUR-Lex, 2025; European Commission, 2024).

Pihlmann mentioned other barriers that involved maintaining the stakeholder's engagement and commitment. One of the challenges was not being able to show the stakeholder how the finished project would look exactly. Another barrier was the fact that contractors were not used to the approach of carefully dismantling the materials to reuse or repurposing. These challenges are most likely aggravated by the negative cultural perception that today's society has towards used materials (Baker-Brown, 2017; Ghisellini et al., 2022; van Hees et al., 2025).

Underflood, instead, primarily discussed challenges related to the materials. They found that the unpredictability of the wood waste characteristics and quality made dealing with these materials more difficult, as they never knew what materials they would get, if they were treated with dangerous chemicals during their use, or if they would arrive rain-damaged. These barriers could be addressed with systems within the waste management that facilitate the recovery of discarded materials and make them available to interested parties, who are currently forced to find clever workarounds, like Underflood wagon, to source them. However, these informal solutions compromise quality as the materials are not safely stored nor sorted.

7.1.2.2 Benefits

Both of the two in-depth case studies stated that having less environmental impacts are important goals for them. In Pihlmann's case, the old building of Thoravej 29 was preserved and the materials and components within it were recovered in different ways. Underflood sources waste to make its product and minimises the waste of the upcycling process. These are in line with the environmental benefits found in Urban Mining literature, which include the avoided extraction and transportation of raw material and reduction of waste in landfills by giving value back to existing stock materials, and supporting the transition to circular economy and sustainable cities (Aldebei & Dombi, 2021; Ghisellini et al., 2022; Koutamanis et al., 2018). Another benefit Pihlmann and Underflood share is the creation of strong partnerships which are, as van Hees et al. (2025) states, locally driven and cover actors across different disciplines. The growth of these networks makes them valuable resources that increase the demand and awareness of circular strategies in the construction sector.

Then, Pihlmann mentioned as a benefit the possibility that Thoravej 29 success can become an inspiration, not only for their future clients, but also for other architects and designers. Projects like Pihlmann's can persuade other actors in the sector to also apply circularity in their works, which supports the transition to a circular construction sector. Somewhat similar is Underflood's benefit of building a well liked narrative that encourages the end users in purchasing circular high-quality products, as they admire the fact that they are locally crafted in a socially just environment, even if they do not really care about sustainability. This admiration affects the attachment the clients have to the products, which are more likely to be well kept for longer.

7.2 Implications

In the construction sector, there is a growth of organisations that recover materials generated throughout the lifecycle of buildings, by enacting circular strategies aimed at slowing, closing and regenerating the resource loops (Konietzko et al., 2020). To transition to a circular economy, more and more companies need to recover waste rather than depleting natural resources. Companies such as the ones of the exploratory case studies, Pihlmann and Underflood, demonstrate that it is possible to create beautiful buildings or products with discarded materials. However, as seen in this project, recovering materials comes with both barriers

and benefits. Companies that work to recover these materials should keep in mind the importance, as stressed by literature and in-depth case studies, of collaborating with multiple actors that are engaged and believe in recovering the value of waste. Furthermore, concepts that facilitate the implementation of circular strategies, like Urban Mining, should be shared by all stakeholders to guarantee a successful transition to a circular economy (Ghisellini et al., 2022).

In order to address the barriers previously discussed, especially the ones referring to the complexity of recovering waste materials due to regulations and the unpredictability of their quality, there is a need for top-down solutions that help companies recover said materials. Discarded material should be carefully dismantled, properly stored, and they should be made available for whomever interested, for example with the use of harvest maps, seen in the exploratory case studies. Additionally, governments should promote the preservation of existing buildings through renovation projects to avoid their demolition and consequent creation of waste (Booth & DAC, 2025).

7.3 Limitations and future research

This research presents few limitations that could be addressed in future research. Firstly, the complexity of social interactions and circular strategies' overlapping in meaning requires analysing more data to have an in-depth understanding. For example, regarding the RQ2, barriers and benefits of recovering discarded materials should be explored more by having more interviews with the in-depth case studies to see if other barriers and benefits arise. This was attempted in the present research in the form of an open-questions survey (Appendix C). However it was ultimately unsuccessful due to time constraints and conflicting schedules. Furthermore, future research should aim at engaging more with the companies to acquire more detailed data, and it should also involve a company or initiative that resells the discarded construction materials, for example like Genbyg. This would expand the understanding of different perspectives that this research tries to achieve. Future research could observe the process of a company that is considering recovering materials in its business to analyse what barriers and opportunities it finds while doing so.

Another interesting aspect that future research could explore is the use of assessments and monitoring tools, such as Life Cycle Assessment and Materials Flow Analysis. Such tools are key in addressing the lack and unpredictability of data noted by literature and the in-depth case studies. Additionally, these tools also facilitate the evaluation of social and environmental impacts, and the understanding of the broader implications of Urban Mining practices, while also improving the traceability of materials and components (Ghisellini et al., 2022). Finally, future work could explore the development of practical tools that would facilitate the recovery of construction waste. For example, it could build a collaboration with a municipality or a private firm to create a digital platform where the companies can put their surplus materials or waste, and connect with other companies that might be interested in using those resources.

8 Conclusion

This project answers the main research question:

What is the role of Urban Mining in supporting the recovery of post-consumption construction materials and components generated by the life cycle of buildings?

The relevance of working on this inquiry is founded on the growing need of implementing systems that manage resources consciously, especially in a sector such as construction, which is responsible for the 50% of extracted materials and over 35% of the waste generated in Europe (European Commission, 2020). The research explores the role of Urban Mining, as a circular economy strategy for managing urban anthropogenic resources at their end of use life (Bockreis & Ragossnig, 2022; Brunner, 2011; Cossu & Williams, 2015; Ghisellini et al., 2022; Gutberlet, 2015), in the context of recovering post-consumption materials and components coming from different phases of the lifecycle of building, which include construction, operation (including renovation), and demolition (Koutamanis et al., 2018; Orenga Panizza & Nik-Bakht, 2024). The Circular Construction Value Chain (Nordic Innovation, 2021) was employed as it is a tool created to support companies in the industry with the implementation of circular business models.

To answer the main research question thoroughly, it was relevant to understand which circular strategies are currently being used by companies in real life to avoid materials ending up in disposal, and explore which barriers and opportunities these communities encounter. So, the following research questions were asked:

RQ1: What circular strategies are used to recover buildings' post-consumption materials and components?

RQ2: What barriers and benefits are encountered when recovering these materials?

A literature review of the topics of construction and demolition waste and Urban Mining was done to have an overview of the state of the art, which is relevant in answering the RQ1. Then, to acquire the perspective of the reality of companies, the current industry landscape was analysed during the project's exploratory phase. Thirteen companies were selected as exploratory case studies, ensuring variety in circular strategies for waste management and gathering different perspectives. The industry landscape was helpful to identify two companies, Pihlmann and Underflod, as in-depth case studies, which are discussed in the in-depth phase of the research. The data of this section was acquired by having semi-structured interviews with the companies. The main scope was to delve deeper on which circular practices are used in real life and to understand what are the possible barriers and opportunities that companies may encounter when recovering waste, thus answering RQ2. The in-depth case studies were analysed as Communities of Practice (Wenger, 1998) as this theory recognises that communities have diverse ways to self-organise depending on their specific social, cultural and environmental context. The circular construction value chain (Nordic Innovation, 2021) was used to visualise the circular strategies used by the in-depth case studies in relation to the value chain of buildings. The Actor Network Theory (Callon, 2001) and the Business Ecosystem Mapping (CIRCit Nord, 2025) was employed to visualise how the in-depth case studies self-organised around recovering discarded materials and components, including material and information flows.

By looking at the integration of circular strategies and Urban Mining in case studies, it emerges that Urban Mining can have an important role in supporting the recovery of discarded materials and components, by shifting the view on these materials from valueless to precious materials. Furthermore, Urban Mining facilitates the improvement of resource efficiency in cities, by considering all the stock materials as valuable resources that should be recovered at their end of life. This research found that exploratory and in-depth case studies presented diverse strategies which, since their similarity to the ones of the circular construction value chain, were categorized as sub-strategies, as they overlap in meaning. This is also due to how the

execution of circular strategies is deeply affected by the social interactions and collaborations that are part of the specific local context of the company, which makes it difficult to strictly categorise the circular strategies in defined boxes.

While answering RQ2, the in-depth case studies revealed a number of barriers and benefits that occur when recovering materials. The barriers included regulatory constraints, unpredictable materials quality, and keeping stakeholder engaged and committed to the project. These challenges point to the need for systemic change in how these resources are treated and perceived when they reach the end of their life cycle. Despite the encountered barriers, Pihlmann and Underflood highlighted some key benefits, such as environmental gains, building strong local partnership and improving the end user and stakeholder perspectives on these types of resources. Relevant to mention is that both in-depth case studies presented efforts of working and finding collaboration locally, which is also a key factor of Urban Mining.

The implications of this project suggest that transitioning to a circular construction sector should include companies that enact diverse circular strategies in their business and top-down initiatives that support the recovery of post-consumption materials and components from the urban environment. These initiatives should assist the action of carefully dismantling resources from the anthropogenic stock, storing them properly and placing them available for whomever interested in using them. Additionally, governments should promote the preservation of existing buildings through renovation projects to avoid their demolition and consequent creation of waste (Booth & DAC, 2025).

Future research should tackle the limitations of this research by engaging more with the companies to acquire more detailed data on the barriers and benefits these companies find when recovering discarded materials. Additionally, it should also involve a company or initiative that resells or offers the discarded construction materials available for free. This would expand the understanding of different perspectives that this research tries to achieve. Future research could also consider the following topics to delve into: looking at the perspective of a company that is still considering recovering materials in its business, exploring the use of assessments and monitoring tools in addressing the lack and unpredictability of data, and developing a practical tool that would facilitate the recovery of construction waste.

To sum up, this thesis aims to contribute to the research that recognises the value of solutions which aim at recovering resources and avoid the catastrophic impacts of their inefficient management, both on humans and on the planet. The case studies demonstrate that, despite the barriers, circular strategies and Urban Mining could play a crucial role in affecting the resources efficiency in the construction sector. However, it is important to recognise that recovering waste should not be an excuse for continuing the current overconsumption tendency. Even if post-consumption materials were recovered, a system would still be unsustainable if it did not address the need to slow down production and consumption habits.

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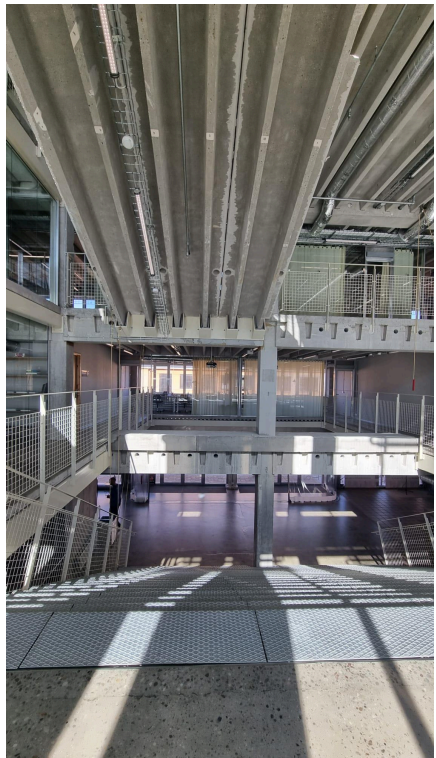
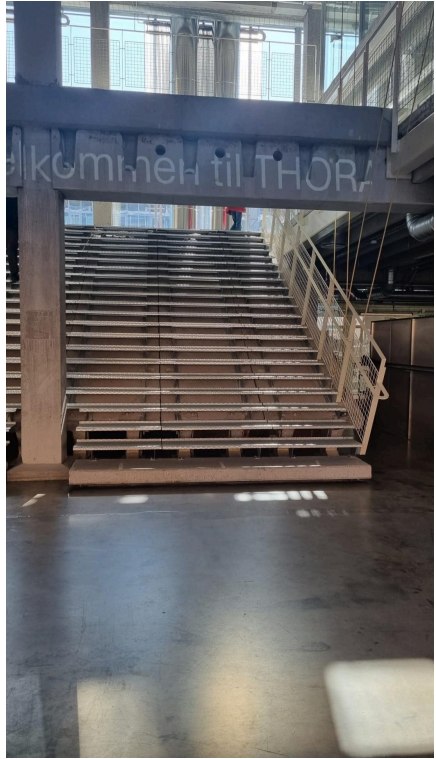
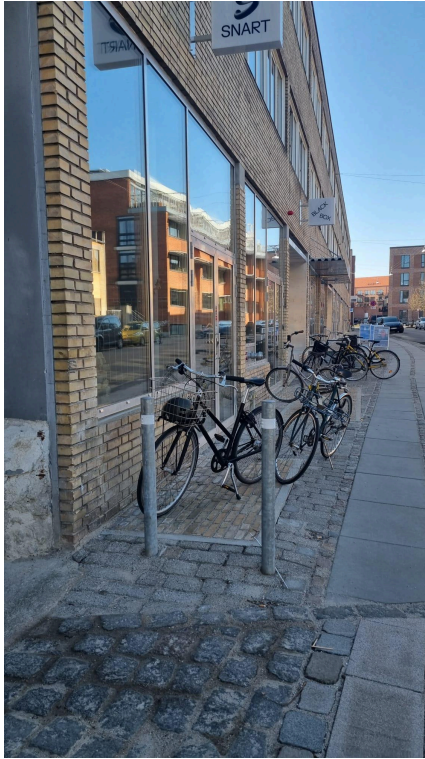
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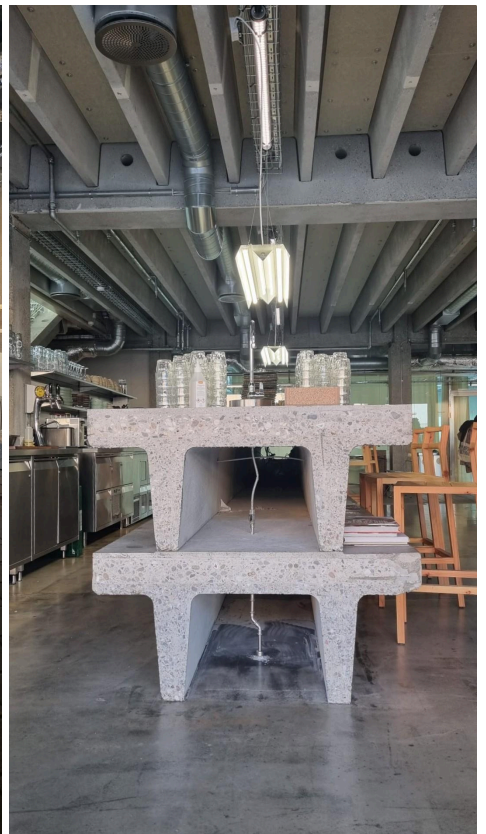
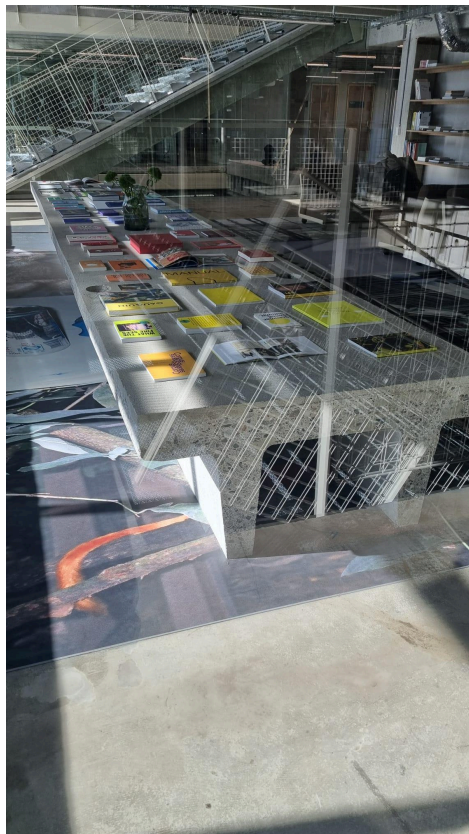
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Appendix A: Pihlmann & Thoravej 29 pictures

The pictures presented here were taken during the visit to the Thoravej building and during the interview at Pihlmann studio.



From the top left: (1) exterior of the building; (2) detail of the facade's bricks repurposed as pavement; (3-6) TT slabs repurposed as stairs seen from different angles.



From the top left: TT slabs repurposed as (1-2) bench; (3-4) table; (5) seating (6) 6.8m bar counter seen from the sides, showing the two TT slabs stacked on top of each other.



From the top left: (1) visible pipes; (2) bench in chipboard made from wood scraps; (3) bricks repurposed as pavement; (4) metal parallelepiped made from crushed metal scraps; (5) original tiled floors (6) TT slabs sections at Philmann's studio (picture took during the interview).

Appendix B: interview guides and transcripts

B.1 Pihlmann interview

B.1.1 Interview guide

Date: 17th March 2025

Interviewee: Isabella Priddle, architect

Objective: understand how Pihlmann handled waste material streams as a resource during the renovation projects and what are the processes that go into sourcing these materials.

Questions and topics prepared for the interview:

- Greet and thanks for helping and ask if can record and if I can use the company and his name in the report
- small intro and agenda if necessary
- What is the approach/mindset necessary when dealing with the recovery of materials while renovating?
- Do they have a process with steps and considerations?
- What are the main barriers and challenges?
- What about the materials that do not end up being used, how do they manage them?
- What about when they need something that is not available in the building? Do they source secondary materials from somewhere else?
- Do they have a network?

B.1.2 Interview transcript

00:00:05 Isabella Priddle

Yeah. So it's an old building from the 1960s that's this concrete. So we have columns and beams throughout the building, and then it's all joined together by these TT profiles, concrete slabs, that are made of reinforced concrete.

So it used to be quite a sort of a building with these low ceilings, a lot of interior partition walls that made you feel really disoriented. And what we've done is opened up the building in accordance with the clients requirements for the program. And in doing so, we cut open the floor slab, cutting open all of these TT slabs to create double and triple height spaces. Which really emphasizes this idea of compression and release.

So you have areas that are like large spaces for gathering that have really high ceilings and then that's contrasted with more intimate areas. The program of the building very much starts with the public space on the ground floor, and you'll see that when you visit it, with an auditorium space, a large gathering area by stairs, a public cafe, and a couple of exhibitions. One of the exhibitions just opened on Friday and then the other one is called Room Room and it's like an art gallery.

And then at the back of the ground floor, we have a lot of workshops. And then if you work your way up to the first floor, there's a canteen that's for the people that are working in the building, a library and a nice open terrace. And then second and third floor programmatically, they're very similar with glass meeting rooms and then also open office areas. So they're the least public, you won't be able to visit those when you go.

But by cutting open these TT slabs, it both enabled us to have these high ceilings and create large gathering spaces, but then it also gave us a surplus of concrete that we could play with. In a lot of areas that took the

form of these stairs, so it's almost like you're cutting open the slab and then tilting it on an angle and then putting stair treads on top of that. And then, because we actually had more openings, you know, for example here where we have one staircase, but then there's actually sort of four bays that have been cut open. We had a lot of extra concrete, so we played around with it. Made some TT slab furniture. What you see in this visual is a little bit updated. It's not what was made in the end. But here you can see sort. This view is very true to what it is now that you walk in and you're met with this large staircase that's made of these TT slabs, and you can see exactly where it got cut out from.

00:03:00 Giulia Sollenni

That is very interesting.

00:03:00 Isabella Priddle

Yeah. Let's see here.

This one also is very true to what you see in the final building, sort of this grand staircase and one of the main moves that we did was this sort of snaking staircase. So. You start on the ground floor. You come up to the 1st and then you have to walk back here on the 1st floor to get to the second and then come back around up to the third. And in doing that, we had to create a larger, like an extension off the back of the building for circulation. We built this technique for sawda glass curtain that's 1 1/2 meters away from the existing facade. So that when you walk up the stairs, you have somewhere to go and to circulate around the building. It also enabled us to have a circulation of a lot of installations.

So we have a lot of ventilation pipes that are running through that technique facade. And it's also interesting because you can see the previous facade that's now sort of inside this glass curtain wall, so that's quite interesting, which is very different from the north facade. This is also, like I said, a little bit outdated.

But what we did in the final building is the first, second and third floors, they're actually untouched on the north facade. It's just the ground floor that we've altered. And all we've done is created larger openings. So where there used to be just like a regular row of windows, we cut out the bricks from underneath the windows and created a large opening for either a glass garage door or a large. Window wall area with glazing and doing that we flipped the bricks so we cut them out from the facade and then put them down into the ground. Yeah. So it's sort of a subtle move that as you're walking down the street You'll notice these bricks sitting in the ground and be able to sort of didactically understand where they came from.

So that's quite interesting. But like I said, the north is almost untouched, just with these subtle changes on the ground floor and then the South facade is sort of this stark contrast with...

See, there might be a self facade view in here.

With all these this render of... There you can sort of see what it looks like. Yeah, like this. Let's see if there's a zoomed out version or not. Yeah, you can sort of see it here. It's like a facade built in front of the previous facade, so that's quite cool.

And then in terms of the interior, of course, we use these TT slabs as furniture and it sort of ranges when you're on the ground floor. We have the heaviest TT furniture and as you go up in height, we have to reduce the volume of the Tt slabs for the weight.

So it's sort of fun. You can see that they get lighter as you go up, whether it be just a single tee, T slab or we cut them into smaller pieces and use it as legs, we actually have one portion of the TT there. And the little sliver right there, which is quite fun.

00:06:10 Giulia Sollenni

So to make them like this was just like cutting..

00:06:13 Isabella Priddle

Yeah, we'll cut them in sections and then like stacked, let me see. Probably. A good photo on my phone somewhere. Stacked them on top of each other... Let's see...

Yeah. So, on the ground floor, we have like a, you know, double TT. That's 6.8 meters long, so it weighs like 6 tons or something like that. And then in some places this is also on the ground floor we just have a single one that's used as a bench. But then if you go upstairs. Then we have some that are used. That is, you know, like this where it's just a small portion and then something on top made of a wooden material, yeah. And then something on top made of wooden material.

Another sort of way that we sort of drew reference to the building's past was through the floor finishes on the ground. So wherever there used to be existing tile, we left that in place. So it's sort of this collage on the ground of old tiles and old floor finishes and so you can see indications of where walls used to be, even though it's an open space. So you'll be able to see that quite clearly on the ground floor. Something like this, you know where you can see.

And then. We also had this heavy furniture that was made of the TT slabs. There you can also see a nice image of that taken in the exact same place in the previous building, and then once those slots were cut out and. So it's quite a contrast of these like low ceilings of these floors that used to be for an office building and then the height that you're able to get.

And then. Yeah, we had a lot of surplus material that was taken out during the light demolition, like old doors that we couldn't Reuse as doors because of fire regulations and some other furniture that was just left behind at the building. Some wooden floors that we took out and what we did was we sent them to a factory in Newland and we ground them up into small granules and then we were able to turn that into our own type of chip board. So I can actually show you here we did some experiments.

Yeah, changing the size of the granules. So they used to be covered with paint. That was like in this sort of purplish color. So we ground it up And then added it to a binder and then it sort of was able to become this board like this that we used to make.

00:09:06 Giulia Sollenni

And it has pops of color.s

00:09:07 Isabella Priddle

Yeah.

00:09:08 Giulia Sollenni

Interesting, yeah.

00:09:08 Isabella Priddle

Some of the old blue doors and red doors and stuff. And then you'll see that the furniture there is made out of this Chipboard material. So that was quite interesting.

And then we did a similar thing with metal, where all of the you'll also see that when you go to the building. The metal that was taken out in the demolition. We had it brought to like a recycling plant where it was crushed. Yeah, into cubes.

00:09:38 Giulia Sollenni

Yes, I think I saw them on the website.

00:09:40 Isabella Priddle

Yeah, you did? They were crushed into cubes and then it was sandblasted and then finished with a clear locker and then turned into furniture. So those were a few of the interesting sorts of furniture projects that came out. Came out of trying to use sustainable materials that were found within the building.

00:10:00 Giulia Sollenni

And this process of like reusing materials, was it already like asked in the project itself or is it something you work with?

00:10:08 Isabella Priddle

Yeah, that's a good question. Yeah, I think WE were very lucky as the clients really wanted to do something innovative and sustainable. So this was sort of our approach to that and I think some things evolved over time, like in the initial competition like you can see here. Reusing the TT slabs and reusing like creating tables out of them and then also creating those stair treads out of them. Was part of the initial competition. As it evolved and we realized we had a lot of materials that had been put into storage. So we had a surplus of metal and of wood. Then we had to figure out a way to reuse those, so those came later. But always it was a part of the project to try to do something in a sustainable way.

And I mean otherwise in the building, a lot of the regular furniture like chairs and Other tables that sort of these special pieces of furniture, I mean you can't see it here, but then we bought a lot of it second hand. You'll see that in, for example, if you walk up the stairs at the building and you peek into the library there. It's old second hand furniture.

00:11:22 Giulia Sollenni

And like also other materials, I would imagine like a material that you didn't have from the like the material from the buildings. Did you find it? Try to find it. Also that second hand or more difficult.

00:11:36 Isabella Priddle

Yeah. So. For example, like I said, with the soft furniture and stuff, then we sourced a second hand from a a looper Mark and I think there was somebody working there that can collect, you know like 50 of the But then most of the other things that we were focused on were found within the building itself. Yeah. And also like another big element to the project was keeping things in the existing place that they already were.

So for example, here you can see on the ground floor there always were toilets back here in the building on the ground floor, we left those in place. Then we just demolished it. It's slightly different in the final project, but we demolished these small walls to sort of create a large front room in front of the toilets with sinks. So there you can see a collage of the existing toilet tiles on the floor and on the wall. But yeah, that saved a lot. And we reuse like old sinks and. Stuff that we found within the building as much as we could. Same thing here. Maybe this is a good one to look at.

Slightly different in the final project, but let's say this is the second floor and there's two circulation cores that were existing with staircases and elevators, so those remain in the same place, and then also. These groups of toilets, they also remain in the same place in the final building.

00:13:13 Giulia Sollenni

And what about like the leftover materials? Were you able to find somebody else that wanted another project or?

00:13:20 Isabella Priddle

Yeah, I mean, we tried to use as much of it as possible. But then some of it, yeah, some of it got reused in other ways, like. I think you know, for example, we had these lamps that were existing in the building. Had them retrofitted so they could be reused as lamps. Some of them are used in the building, but then otherwise actually Bikubenfonden is the client. They have sort of a storage Area that they're housing all of these lamps and I think that they'll sell them. So they're sort of interesting ways that you can even if they don't have a place in the building right now, they can have a new life later on. That's quite interesting.

00:14:03 Giulia Sollenni

It's totally admiring all the different things you can do and.

00:14:06 Isabella Priddle

Yeah, yeah. Here you can see some diagrams that sort of show what we were talking about of the TT slaps sitting in between these beams. Then it gets tilted at an angle. Or gets taken out entirely and used as furniture and same thing with the floor finishes that. Now you used to have these existing walls here separating rooms with three different rooms. Floors and then those were taken away. And then you're just left with this sort of carpet collage of floor finishes.

00:14:34 Giulia Sollenni

Can you take a picture?

00:14:35 Isabella Priddle

Yeah.

00:14:38 Giulia Sollenni

***, especially because it took time, I imagine. Uh.

00:14:40 Isabella Priddle

Yeah. I mean, I think we were very lucky that the client Bikuben was really interested in supporting up and coming architects and designers and artists. They were very generous with us in terms of. You know, even if some people at the foundation couldn't see the final vision, there was always somebody who did believe in us. So I think you couldn't get a better client for a project like this. And I think now that this project is completed, it'll be easier in the future to have clients that are willing to,

00:15:17 Giulia Sollenni

It's easier to show, yeah.

00:15:20 Isabella Priddle

yeah to follow through because they can see that there was a success and it is possible. Yeah. So.

00:15:25 Giulia Sollenni

Do you think you will get more clients interested in something like that?

00:15:28 Isabella Priddle

Yeah, I think. And I think that that was the objective with the building as well, like with these different stories that we can tell about different ways of building furniture. And having an architectural intervention in an existing building. Not only for our clients, but just for other people as well. Other architects and designers use it as a case study of what is possible that you can use a building that isn't typically deemed as beautiful, but create a beautiful project. By exposing its past and sort of showcasing the process of how the building came to be.

00:16:13 Giulia Sollenni

Yeah and i imagine that also like the narrative behind, it needs to be shown to everybody.

00:16:16 Isabella Priddle

Yes. Yeah. Yeah, exactly.

00:16:17 Giulia Sollenni

The whole point. Well, that's amazing.

00:16:20 Isabella Priddle

It is funny to look back at these now because it is slightly different, but I think it really the vision that was part of the competition project, it really has come to fruition, so that's exciting.

00:16:33 Giulia Sollenni

In the creativity part behind it's amazing.

00:16:36 Giulia SollenniIsabella Priddle

Yeah, yeah, yeah, it is.

00:16:39 Giulia Sollenni

Like all the way thinking. Yeah, that material that was like holding up a floor could be used in some different ways.

00:16:47 Isabella Priddle

Yeah, yeah. And it is great because because of the rebar that was in these concrete TT slabs, it really gave us so many more possibilities of how to reuse it that with another material. That wouldn't be possible. But I think probably the best thing for you to do now would be. Go to Thoravej and have a look.

00:17:22 Giulia Sollenni

To see with my own eyes and see all the different, especially in now that I had this talk I can understand way better.

00:17:29 Isabella Priddle

And have a look to see, I think on Thoravej website you can find something about the schedule of events for this 29 days of Thoravej because. Of course you can just walk in and see, but maybe it's fun to experience a performance there and see how the buildings are being used, or see if there's a day that they have a guided tour that you can go on so that you can access parts of the. You wouldn't be able to just every day, but otherwise you should just go. And enter because you can see the ground floor and then walk up this main staircase and have a look on the first floor. You can't get past that, unfortunately, but. But I think you can still really get a sense of the building by seeing that, yeah.

00:18:14 Giulia Sollenni

Did you think you created a network now with this project for like contractors and people that work in?

00:18:20 Isabella Priddle

Yeah, I think. Yeah. Yeah. I think that wasn't one thing that was nice. You know, working with, for example electricians, I think they really took pride in what they were doing because everything is exposed. So it was nice to see that excitement coming from different trades people. Throughout the process they were doing something that would be visible to everybody, which I think nowadays everything in typical construction projects is hidden away. So nice to see that they could take some pride in what they were doing.

00:18:45 Giulia Sollenni

It's hidden away.

00:18:53 Isabella Priddle

And execute things really well. And I think they did a really good job. It was nice to work alongside them.

00:18:58 Giulia Sollenni

I imagine it's more engaging when you, you know, people will see it, so you can be creative in your own art.

00:19:02 Isabella Priddle

Yeah, yeah, yeah, exactly, exactly.

00:19:09 Giulia Sollenni

It's amazing. I think we covered all the questions.

00:19:14 Isabella Priddle

OK, perfect.

Yeah. And I think you should go visit and.

00:19:20 Giulia Sollenni

I will do this if that is exactly, yeah.

00:19:22 Isabella Priddle2

You can take some pictures then and see these things, and I think it's nice because. Most of what I have said here is visible somewhere on the ground floor or on the 1st floor. If you look up. In these public. So that's nice. And it's also fun and exciting for us as architects to go and see the building being used because there's a lot of people there every day making use of all of the spaces. It's quite an exciting one.

B.2 Underflod interview

B.2.1 Interview guide

Date: 11th March 2025

Interviewee: Emil Maegaard Jorgensen, the co-founder and head of design

Objective: Understand how Underflod handles waste material streams as a resource to develop upcycled circular products and what are the processes that go into sourcing these materials.

Questions and topics prepared for the interview:

- Greet and thanks for helping and ask if can record and if I can use the company and his name in the report
- small intro and agenda if necessary
- I am curious in understanding how Underflod supply chain works and what kind of processes go behind sourcing and managing secondary materials, so how does it all work?
- What kind of materials do you source? Do you personally go to recycling centres to select them?
- What kind of challenges are encountered when acquiring and working with used materials?
- What is the quantity of materials? Do you ever have problems with having enough source materials?

B.2.2 Interview transcript

Giulia Sollenni 0:44

Thank you. So as you may recall from my email, I am interested in my master thesis project in understanding how to facilitate the transition to a sustainable interior design especially. When talking about renovating a space, which means managing a lot of materials that go in and in out of the project, and to find ways of how it could be made more secure. And I found your company because you do exactly that. You take waste materials from recycling centers. And I, as I read also Danish industries, and you recirculate as new

project products. So, I am extremely curious to understand how Underflod supply chain works and what kind of processes go behind in sourcing and managing these materials. So how does it all work?

Emil Underflod 1:52

Well, I mean, obviously there's different ways that it works depending whether it is like public facilities like the recycling stations or whether it's the private companies. I will say we started off from using mostly public waste from the recycling stations, but there's a lot of bureaucracy when it comes to working with recycling in that matter. Often when you, when you work with recycling from the public. Yeah, like publicly accessible recycling stations like we did. Then there's another rules that you need to overcome or to find ways of working around. Because you know, there's a lot of documentation that is needed if you need to work with like a large scale recycling from public waste. But if we wanted to do it the way that we started off, then what we simply did was that we. We needed to get the source of material before it officially entered the containers, because the second that waste gets in the public containers then it's Forbidden material.

Giulia Sollenni 3:18

That's interesting.

Emil Underflod 3:18

That is, yeah, and then it's extremely difficult to get to. Then they have a lot of contracts that you need to win and it gets a lot more complicated once it's been over the edge of the container. So, Our job was to find a way of sourcing the materials from the recycling stations before they entered the containers. So, what we did then was that we put up like these, I don't know if you know like? at a post office you have these wagons for the boxes and letters and everything.

So we put those up next to the containers so that the citizens at the recycling stations had the possibility to donate their waste to us instead of throwing it in the container, so by getting the waste before it would enter the container I just donated directly for reuse. Then we had some options there and in order to be able to do it without breaking any rules we also did it in a way where it was accessible for everyone. You know, For us it was also important that if Mr and Mrs Jensen spotted something in that cage that they could use, then they were just as entitled to use it as us because the whole mission was recycling. It wasn't necessarily just for us to get more products through, so if someone could use the materials as if they were in the container, then they were also able to take it out of the system.

Giulia Sollenni 4:54

Mm hmm. Mm hmm. Yeah.

Emil Underflod 5:15

The challenges that we've met through this kind of work is that. There, there's multiple factors. One thing is when the material is good enough for being reused. And that can sometimes be difficult for the people donating the material to know. It might not be everyone that knows the difference between solid wood and something that is a vineyard, for example, which we cannot reuse or cycle.

That we met. What we would usually do would be that we would have a route with recycling stations like thrift shops. Other different Organs where they would have access to broken furniture and they would have a route where we would then fill up a trailer with all the different woods that we could use and then we could take that back to the social workshop in Odense. And that social workshop is. We can get back to that later and start with the sourcing of the materials maybe. But that's basically how we do it with, with the public waste.

As I said, we've also gotten some furniture from like thrift shops, Red Cross, Charity shops, stuff like that. That would usually be the types of furniture that will be worn out or torn in a way that it would be beyond repair for the personal at the at the church shop. Often you know it will be elderly people, and they will have the challenge.

That there will be a lot of weight or furniture that needs to be then taken away from them to be taken to a recycling station. So that way we could get it one step earlier than at the recycling stations by going directly to the thrift shop and then pick up their waste furniture directly at the source.

And that's been a lot of the it's been a very important process for us to like try and go further and further back, like how far back in the process are we able to get the waste furniture. Or the waste materials because, If we get the wood from a recycling station, then chances are that it's been standing outside in the rain.

Giulia Sollenni 8:03

That makes sense, yeah.

Emil Underflod 8:03

Might have been standing being exploited for other like different things that will ruin the material, so therefore the earlier that we can get the material we can usually get a larger mass of material. The earlier we go back and we can also. What am I going to say?

Giulia Sollenni 8:26

We have a better quality of it because it would not be that damaged.

Emil Underflod 8:27

Yeah. Yeah, exactly. So that was an important step for us to try and see, like how far back can we get recycled furniture in Odense where we are located, there is an organisation called Circle that is like the Organization that works on all the recycling stations in the older to circulate, where they will have a container on each recycling station where citizens can donate. Basically everything you would see in the church shop, you know, glasses, furniture, all kinds of things, they can put that into a container. If it's too good to be thrown out. But people just don't want to spend the effort on reselling it or giving it away. Then they just throw it into the container.

And then there's an organ out in the north of Odensia, where they will then separate all the different fragments of glasses, furniture, whatever. And as well there we would get the broken furniture before it will then be donated to. Usually you'd be donated to like church shops from that big organisation.

And then we could get all the furniture from there before it would. Or say go out to the organisations.

But obviously only the stuff that is too bad to be to be used as it is, because it's also important part of the, you know, the loop of circularity that you wouldn't take something out of where it can be already or where it can be used as it is, so would usually be, yeah, it will usually will be like a dining table where the table top has torn in the middle. It could be a leg that has broken off and it can't be repaired because you know if it's made by an old traditional technique then It will be hella expensive to remake. And nobody would be willing to invest that kind of money into restoring the furniture. Then what we do is that we, like, get them to the social workshops where they will then separate the furniture into like a pure plates of wood that can be used for some products. And the table legs for example, could be used for other products that we have. And then they will put them into system.

Emil Underflod 11:15

The other type of waste material that we use is industrial waste. Virgin waste, so to say so. That will have the benefit that we can use it for, for example, for contact with the food. Because you know it's reused wood from a recycling station, then there is the risk that it's been exploited for chemicals. You know, if it we don't know if it's been a dining table or if it's been a table in a workshop. Where people had like Types of oil or something that has a health risk, so that can't be used for direct contact to food.

But for that source we take the waste directly from the manufacturers around Denmark, so for example. We work a lot with Tabletop manufacturers, especially for kitchens, because every time you make a kitchen table, you know you have the whole kitchen table, but you cut out the room from the sink or for the stove, and that piece of wood will be too small for them to use in manufacturing of table tops. And therefore, it's a

waste material that they would.

In a lot of companies, The norm has been that you would burn the waste internally to generate heat in the factory. But it wouldn't very rarely be the most effective type of heating anyways, but it will be a way of getting rid of their own waste simply by burning it in their own factories. But what we then do is that we have them assemble all these, cut off cut offs on pallets and then these pallets are sent directly to the social workshop. That will then make it into something new. What's then important to do when you start looking at the sourcing of materials like this is often like What you can use the material for. And what's then important is to try and create systems or make systems categories for all the types of waste that you use. What is? Yeah. What am I saying? It's a lot easier to work with industrial waste when it comes to making putting stuff in in systems and categories because you, you know, that they will have a standard thickness on the wood of 30 or 40 millimeters for example. And there will always be the case.

Giulia Sollenni 13:48

That makes sense. Mm hmm yeah.

Emil Underflod 13:59

And you know that the minimum size of a sink will be less than this big, and then yes, it will be consistent. And when you work with circulatory manufacturing then those systems like figuring those systems out, is the key to having success with making something circular. From our point of view now, we do it mostly to show that it's possible to work with like post consumer waste like the wood from the recycling stations and stuff.

But that is very difficult to scale. It's much, much easier to scale by tapping into to industrial waste. For example, we have hooks and hangers like coat hangers that we make from Industrial cut offs from the steel industry. We work with something or a company called industry And they make a lot of manufacturing for the truck industry. And like trailers and truck parts, components and the piece of metal that we use for making our coat hangs they manufacture. Approximately 25,000 pieces A month. Or like they make the same profile, they make 25,000 of those, and for every profile that they do, they need a hole at a specific size. And obviously when it's steel and you chop out a hole then. You will have like a perfectly similar piece of waste every single time. So what we then did was just to manifest or figure out how could we redo this piece of metal into something useful. And it basically looks like the.

Like the witness, dig of a popsicle. And then it was just a matter of, like, where do we bent this in order to make it a hook that is useful for clothing? So by using that kind of material, we already take the shape that it has and figure out how can we buy the least effort or the least remanufacturing, make this into something new because every time a piece of waste or piece of material goes through a process they will generate waste. So for example, the waste that we generate from making a hanger such as this one will be when we drill the holes. For how to hang it? But that will be for a product like this for example, that will be the only waste generated from the process.

Emil Underflod 17:04

Where usually if you would work from a virgin material, you know if you would have a raw steel coil have to roll that out, you have to stamp out holes or stand about the shape. Then you have the whole grid, the whole outer grid would be a waste material, so we actually have less waste manufacturing from the waste than if we would have manufactured it from an emerging material. So therefore, it is really important to look at the waste exactly as it's thrown out and then look at how can we do the least possible with the material in order for it to be used again. Or create a new purpose.

Giulia Sollenni 17:42

That is a fantastic way of working, I'm saying.

Emil Underflod 17:46

If you want to refer to that, you could look at it. It is on our website. It will be called the Heimdall. Like the Nordic mythology. And yeah, they can see the products. We also have a similar product for like. Clothes and towels and stuff like a small hook, and that's made from When you have these huge solar panels. Then you have pieces of metal that you need to put together and you need a bolt that you put through a hole and then it leads to slide into place. So you have like a big hole and then like a slimmer strip. So you can put the bolt in and then slide it into place.

So you get something that looks a bit like a keyhole. And that piece of waste is basically just making one hole to put the screw in where it's bigger, and then the thin piece is then bent up to make a hook as well. So, the process of making that piece of waste into a new product is to drill 1 hole. And to give it 1 bent and then there's a new product.

We then paint it with a power coating so that we also can use a waste material for that part. But it will be a very limited process that that product has to go through.

Another example that we have, we've just taken it out of stock because the waste is no longer generated from the manufacturer, which obviously is a good thing on a greater scale, but Sucks when you are a manufacturing company that wants to sell products as well, but.

We had some placemats made from rubber cork which you used for industrial suction. You know you have these big like metal pipes, kind of where, you know, air will go through or other things like that. And then when you have to put two pieces together, you need a packaging ring to type it. This, and obviously every time you make a circle.

Or like making a ring. Then there will be the whole inner piece. That they can't use. So what we did was basically look at the like what was the use or usability of this material like the cork was very good for restraining heat. So we've made placemats for like Pots and pans. Like that and the only thing we did From the piece of waste till the shelf product was to put a logo on it. So we actually didn't need to do anything with the material in order to optimise it because the way that the piece looked was usable as it was. Some could argue that maybe we would want it to be a little bit smaller or a little bit different in shape or whatever. But every time that you put it through that process then you will generate more waste and therefore it makes much more sense for us to just take it exactly as it is, even though it doesn't have a lot of this sign value.

Then you give the waste new value by deciding to do nothing. And that's also an interesting way of designing. Sometimes it's actually about figuring out how little do you need to do in order to yeah, we have other products where.

Giulia Sollenni 21:38

Yeah. It's very ingenious.

Emil Underflod 21:50

We made something for a soap company. That needed somewhere they could put the soap so that they don't put marks on the table in the bathroom for example. So what we did was to take a lot of similar pieces of cut outs from like marble sinks and that pleases always 70 cent or 70 millimeters like deep And then 49 centimeters long. So what we did in order to use this to hold soaps was basically just to put two feet on it. So we just lifted out the material a little bit. So it wouldn't like with the water and everything that it wouldn't vacuum the table. So all that that took was to lift it up with a little piece of wood and then we had a new product. Because the actual waste piece was functional as it was, we just needed to give it a little tweak in order to take away the potential issue from a vacuum.

But, but it's an interesting way of working, and sometimes we'll then like to combine for example with the hooks and hangers. Then we'll take the wood from the recycling stations because we don't need it, doesn't it won't get the full contact. And then we can put the hangers on there for example. So it's like it's always a

matter of mixing and matching and then every time that we put something, put something through a process where there's an off cut, then we look into what is the potential for the off cut in our own system.

So for example, when we have the off cut of a sink, you know they always will. I think I don't know. There's like 1000 different shapes and you can get a sync in. So even though there might be a minimum size. They very often variate, so we've made a few different products like we have two different sizes of cutting boards and we have two different sizes of tablet tops. That will fit within the room of a sink, but often there will be an off cut that will be a small piece that we cannot use for making narcotic boats. It will have to glue it up. Then we'll have to put it through a new process and that process would be more expensive than buying more Leftover wood. So what we didn't say was to look at, you know, if we have these sizes of cutting boards, then we know that the off cuts will be the exact length of the cutting boards. So what we then did was that we. We made a series of slimmer pieces. We needed something slimmer.

So we made knife holders where it's basically just a thin piece of wood with a drilled line in it where you can lower a knife and then we'll stay in place. So just like a magnet free knife holder where you just put down the knife and then it will stay in place.

Giulia Sollenni 25:04
Fantastic.

Emil Underflod 25:11

But when we did this, we could use the exact same tools that we used from the cutting boards. So we didn't need to invest in new tools, which also meant that we could manufacture it cheaper. We already wrote off the material because, you know, we had a calculated waste from the cutting boards. So we basically had a free product. We only had the time of manufacturing in the workshop and then, to optimise this we put two pieces on the same or like two knife holders on the same process. If I just go a little bit quicker, but also because they use the vacuum to fixate the things when they do the milling in the machines and then there's like a little slim piece of wood. It's approximately 2 centimetres wide, but that will be the one that holds the whole thing together when they do the milling. And that thing has 210 millimetre holes in the bottom. I'm saying a lot of things that you might not be able to follow on with, but, but that's just how it has to be, sadly, but.

Giulia Sollenni 26:27
It is fine. It's very intriguing to hear.

Emil Underflod 26:31

But there's again a thin piece of wood that will then be the same length as the knife holder, so either 30 or 50 centimetres long and there will be two little holes of 10 millimetres that they use for like fixating it when holding it on to the machine. So what we then did was that we looked at this thin piece of two centimetre like slim. A piece of wood that was 30 or 50 centimetres long, and then we looked at what would the possibilities be for this piece of wood and we then figured out that, you know, we had two holes of 10 millimetres, that per fit perfectly with A10 millimetre dowel wooden dowel. So we could like put, we could use it for touching another piece of wood. So what we basically did was that we looked at this piece that was like 50 centimetres tall. And figured out that we could use this for lake for a coffee table. And then we could take the 30 centimetre piece to put out like a touch where the hole was and then we would have like the framework underneath that we'll be able to hold. Like a plate or like what we call it. Like a table top so we could basically use them. You know you have an off cut from a sync. We could use that to make that into a cutting board.

Take off cuts from that, make that into a knife holder and we could take the off cut from that to make into a coffee table. And then we made that coffee table frame work as like 2 triangles like you know, you could just move around so you could use any type of any size of tabletop to put on it.

Giulia Sollenni 28:13

That makes sense.

Emil Underflod 28:19

Or not 100% you would have the dowels that will be in between. Holding it together. We're actually, we made them. Yeah. Yeah, yeah, yeah. I mean, it's. And it's always a matter of, like, how can we make it, like just a little bit more circular. You know, we don't want Anything to be random.

The stuff that annoys me on a personal level is that it's impossible for us to find reused screws for attaching things to the wall, for example. The issue is that nobody wants to talk about how screws are made, because I know from my knowledge of the metal industry that nobody makes anything in 100% work virgin Steel. It simply doesn't make sense from a manufacturer's Perspective it will be way too way too expensive then it needs to be something that is very, very special. But the screws for most of the different types of steel that are being used out there, there will be a very high percentage of waste in the manufacturing. So for screws, it would probably be in between 60 and 70% waste material, but nobody wants to go out publicly and say that. So that means that I also can't go out and say that. The screws that we used are reused in any way. What we did with our screws that is a little bit different is that we cover the heads in reuse paint so that it matches our other products. So that if you have. A piece of Oliga, a hanger and a screw. Then they have the same surface of reuse powder coating.

Giulia Sollenni 31:06

And you said reuse paint because you also get paint from...?

Emil Underflod 31:09

Yes. We have to manufacture or not manufacture, sorry we have a painter here on Foon. Do you know how powder coating works? (Giulia Sollenni shakes her head)

I'll just give you a very quick like a run through, you know normally would be something that you paint on and then you know just over time it will harden because there will be some binders in the material.

Powder coating is something you do where you magnetize an object and then you blow on just a brow powder that has more metallic pieces in it and then it will only hold on to the material while it's magnetised, and then you burn it at a high temperature and then it happens. But that also means that everything that won't hit the object in the 1st place when you paint it will fall to the ground. This exact same dust or or paint that they use for painting in the first place. So this company has they have like a built in Hoover in the system. So all the pain that falls to the ground will be sucked out and then they can use it again and again and again and again until they change into a new colour because obviously otherwise they will start mixing red and black and blue and everything and that would be some **** to get through the system. So they completely emptied the system. And then we get those.

Backs of the paint that they've been using again and again and again, but instead of them throwing it out and burning it because the amounts are too small for large scale manufacturing, then we buy those small packages of reused paint. So that once we start up like a manufacturing line, then we can take all those pieces of waste together. Knowing that that might be like smaller imperfections, but it's something that we can live with compared to if we would have taken a new paint.

Giulia Sollenni 33:18

Mm hmm. And it gives us a more character.

Emil Underflod 33:21

Oh yeah. I mean you basically won't see it. We use a structured paint because it's a nice surface, it's good for withstanding dust it's also. Something where you don't see if you put like fingers on it, so you'll it's a. It's a

nice piece of material, but has structures you won't necessarily see it the same way. If something has gotten into the back.

Giulia Sollenni 33:48

But that is so fascinating. You find so many creative ways to reuse the different materials and.

Emil Underflod 33:56

I mean we figured out back when we started we wanted to make a company where no matter what you looked at in our products, no matter if it would be painted for example, we wanted people to sit back with that. Whoa, that sounds absolutely insane.

Giulia Sollenni 33:56

And it does.

Emil Underflod 34:15

Feeling so, especially for the people, probably that they care a bit about it. You know that most people won't know the difference between reused and reusable, but that's sadly just the way that things are. But you know, we can only do it. What we can do ourselves, you know, we. Don't make products. We always try to go that little bit extra to make it more circular or find new ways of doing things or reducing waste. Because we would very much like to see the industry become more circular. But that's also something that the people that are industry in the industry admire. And that's also why we have a lot of collaborations with other brands.

A large part of our revenue stream comes from manufacturing for other brands. So we will have brands contacting us that they would like a new product in their line or they have a waste material that they want to figure out what could be used for. And sometimes they have both a need for a product and they will have a waste material and then we will be looking into how we can create it, creating something that fulfils the needs for the product with a piece of waste that they have within their own. Line of manufacturing. And if it's possible for us, then we also take it into the social workshops. And the social workshops also obviously are a big part of our way of doing things. We work closely together with protective workshops, as they are directly translated to, which are workshops for people with disabilities.

There's many different kinds of these workshops. We have one in Odense where it's people that are born with brain disease. Or, like a brain malfunction. And we have. A workshop in Aalborg where there will be people with low IQ that is for my inmates. We have. Some we have a workshop on * where it will be young criminals that has to go out and come back into society somehow. We have. It can be many, many different things, but that's all under the term protected workshops. It will be something where you have like a traditional workshop. But you will have like a mix of everyone that works there as professionals will be. Both. No idea what a peace was called in English, sorry. It will be professional staff that can both help them on a personal level and on a professional manufacturing level. And then we also have the Danish prison organisation. That administers all the Danish prisons. We also work closely together with that organisation during manufacturing in the prisons. The thing in Denmark is that it's written in law that you need to offer Occupation to the inmates. Because otherwise, you know, people would simply grow insane if they would have nothing to do to get up to.

Giulia Sollenni 38:05

Mm hmm. Yeah, and learning skills is also important. It for when they eventually come out and they need to re enter society.

Emil Underflod 38:15

Exactly, exactly. And there's a lot of difference. Things that you can occupy yourself with within these prisons, we work closely together with the larger prisons that have like. Facilities for professional manufacturing, for example, we have one in mid, mid Jutland that are the ones that makes all the furniture within the Danish prisons. They are like self, self sustained on that on that part. So they are the person that

makes all the beds, benches, everything. So they have a lot of super professional gear. And they will be the ones that do our, like, heavy machinery work because people will be. You know they have a criminal record, but it will be fully functional, smart people that just for some reason, you know. Made a mistake that cost them to get behind the prison gates. So we have to do all the heavy machinery like the CNC milling machines and stuff. They have some super heavy equipment for that. And then we have the social workshops. Do a lot of the like finer work with sanding and oiling and some of these things that take a lot of patience. Because even though they. They might not be like the fastest workers, then they are extremely passionate about the work that they do.

And when it comes to like. Because that's an important part of it as well. We never wanna work with these workshops because of pricing and that's also something that is written into Danish law. There's something called the service loan. There's paragraph 106, I think. Where it's written that they can't be competitive to the private market. So they need their pricing to match what it would cost in a professional workshop. So what we then often do is that we take an assignment, we have this cutting board for example, then we will give that to the people in charge at the prison like the. Or people in charge and the people running the workshops, the workshop assistants, and they will usually be like. An educated Carpenter or similar. And then we would have a look at how long it would take for them to manufacture this product. And then we would set a time frame saying that this cutting board takes 20 minutes for them to do.

And then we pay this hourly rate. That is the official, like amount that can't be competitive for 20 minutes of work. Then in the social workshops, for example, they get a pension for or from the government. Just you know to pay their general bills and everything because often they have, like a pension. That's a requirement for many other shops. And then they have all the time in the world to finish their task, and then they get like an hourly add on to that task. So the money that we put into the workshops are solely going to the wages of the people working there. But you know, we we never pay the we never pay them directly. But we just buy the service through the organisations. If that makes sense, and then it will be a little bit different from place to place, how they do it with.

Giulia Sollenni 42:04

It does. Mm hmm.

Emil Underflod 42:11

Like the prisons, for example, they would often put more people on a task. Because, you know, maybe someone doesn't want to leave the cell that day, or someone has to go into a hearing, so then they might put two or three people on a task that takes one person so they could be very fast at delivering where in the social workshops you would have something that takes 15 minutes to send. That could take a citizen two hours. But there's nobody there. They will be rushing them, you know, nobody will be telling them. You need to get this task done right now, which also gives them a lot of peace to do their work.

Emil Underflod 42:53

But doing it this way has put the quality of our manufacturing up by a whole lot compared to. Far back in the days when we did the manufacturing ourselves. So it's really something that has upped the both the quality of of product but also. Definitely the the storytelling behind it.

Giulia Sollenni 43:12

And then it's super nice. I just wanted to let you know that we are like over the time frame.

Emil Underflod 43:19

Oh, I see. I see. I don't have any meetings after this. Right now, I only have some internal ones with the design team. Ah, thanks. I mean, I. Yeah, yeah, I Isee. I'll. I'll try and be a bit more brief. Do you have more questions?

Giulia Sollenni 43:25

OK. Yeah. I just wanted to let you know because you were now already 15 minutes. What about like the people? Like mostly like customer. How do you see the like their attitude towards products that are made with Secondhand materials and reused.

Emil Underflod 43:53

Well, I can start off by saying that we back. When we started, we did like a persona. We were like, who are the customers or who do we believe the customers are for one of those products. And we figured that it would be. Mostly, I think we did like, I don't even remember her name. Camille or something was like a persona that we that we did. Camilla would be like 32 or something and she would be living like in a suburb area of Aarhus, Copenhagen. She would Like, have a long education, might have a kid or two, or be thinking about it Buy organic stuff. All these things like really care about everything that she does. What we found out to be the reality is that we don't. We sell most of our products to like Media old people that just care about the Danish design and they don't give a they don't often give a **** about sustainability. Which is kind of ironic now that we put so much effort into it. They like the storytelling more than the fact that it's made from reused materials. They, you know, they like the story about it. They don't really care about sustainability in that way.

It will be someone where, you know, we explain to them that the coaster for coffee, for coffee cups is made out of old table legs that are just cut in the slices and then it'll be alright. That's great. They like the story about it, but they don't necessarily care about it from an environmental perspective. We expected that we would have a lot more of these environmentalist customers Or environment interested customers. I think what we came to realize is that those customers will often go into a thrift shop or something To fulfil their needs because they can do it at a much lower price than what you can do in here. And a lot of the products that we have are given as a presence to others. So it's not necessarily always the customer that is the end user.

So I mean, you can only do so much to persuade people to choose something that is. Made reused, but often they will be like the fun stories about the products more than the actual environmental perspective. But it's also important for me to say that we chose quite early. Not to have a lot of these. Normal. What do you call certifications on the things? You know there's the FSC certification. If you work with wood for example, saying that things come from a sustainable going to do. Put that in brackets because sustainably sustainability doesn't really exist.

But you know, then stuff would come from a sustainable forest where, you know, it doesn't make sense for us to have. Paperwork on the forest when we get stuff as waste. You know. So. So we put a lot of thought into like.

If would there be certifications that make sense for us on a product perspective? And we didn't really find anything good that reassembles everything that we stand for in a in a product perspective. The only thing that we've looked at that would probably be the one that we would choose is the B Corp certification. If you know of B Corp. Because it will be something that gives a more complete. Valuation on on the company and not just sole product because what we see is an issue is also if you have a big company manufacturing a lot of different products. Let's say it could be a Swedish clothing or furniture brand that will have a million different. Products in line, if they would then make one product that is circular. Then you know they could do a lot of branding like.

Giulia Sollenni 48:37

Yeah. Misleading and yeah.

Emil Underflod 48:38

By yeah by circular products from us. Where it won't tell **** about any other products, it will just be saying something about 0.001% of their products, where the B Cup will be the whole organisation. And

that's, you know, you need to look at the bigger picture and not just a single product. And therefore beacop would make sense, but it wouldn't make sense for us to have if the C certification on one product and that not. All the others. So and also there's not a lot of really good certification when certifications when it comes to circular products, at least not that we know of.

Giulia Sollenni 49:28

So it's mostly the narrative which makes sense because we also see there are a lot of labels.

They, even if they supposedly do something good, they don't really follow up with what they promised sustainable was sustainability wise. So it makes more sense.

Emil Underflod 49:47

But yeah, but we also know that, as I said before, sustainability. Doesn't or sustainability does exist, but sustainable manufacturing doesn't exist because you can never manufacture something in a sustainable way because you'll always be using energy. You'll be always be using material. You'll always create waste like you could never be. Manufacturing something 100% sustainable. That's also why you'll never see something in one of those marketing assess that we are manufacturing something sustainable. We don't want to use the term sustainable in our manufacturing because it actually means something to us with sustainability and we know that it's basically impossible to reach A level high enough of. Sustainability to be worth mentioning. Even though we do a lot of things in a way that.

Giulia Sollenni 50:43

So when you think about sustainability. You think more about like the zero waste movement?

Emil Underflod 50:50

Yes, we put it as a mission to make the furniture industry more circular that that's what we are trying to accomplish. And then at the same time, obviously we're trying to like work very hard in the local environments to create the job opportunities for people that are like not fitting into the norms of a workplace, no matter if it's yeah, criminals or or people with disabilities.

Giulia Sollenni 51:14

Yeah. Which is fantastic. Yeah, which is fantastic for my opinion. I also think sometimes the weird zero waste narrative it's not ideal because it would. It stops a lot of people to actually doing something. And then like, even if you move to be in like more sustainable. And perfectly, it's always a move in the good in the right direction and it's impossible to be human and be zero. Totally zero waste in our society or like. You know, well. Most of the societies.

Emil Underflod 52:02

Yeah. Definitely. But it's also like it's also a point of view from us. We talked about a lot in the beginning if we would be contacted by a bigger brand. That is. Very not sustainable. In the beginning, we were thinking, you know, they can, they can fix their own ****. You know, we are doing everything in the best way. The way we see it. And if they were generating problems, then they should solve them themselves. What we then very quickly came to the conclusion of is that you know a lot of these big companies. Are huge organisations and they have problems that are difficult to solve with the size of organisation that they are and if they would reach out to us now. With the idea of. Trying to become more circular then we would happily be the first ones to reach out and make it happen, you know, because we can only do these things if we help out. And also if you have an organisation with a large. The amount of sales. Or large group of customers. Then it's much easier for us to make an impact when it comes to generating or regenerating waste into to products. If we do it through all other company sales channels, because then we can, we can focus on what we are really good at, which is the the manufacturing that is circular and our social socio economic. And then they can focus on the sales that they're good at. So. Yeah. Do you have some more, more questions?

Giulia Sollenni 53:51

I think most of it has been answered in one way or another during the trend. Now it's something that comes to my mind and I don't. If you need to go, just tell me because I don't want to take more time that.

Emil Underflod 54:04

I'll just give it a give it a go.

Giulia Sollenni 54:06

Have you ever been contacted by like designers? So like interior design, the ones that are like renovating a space and want to use your products or right or like.

Emil Underflod 54:22

Like in what way? Like just decided that are making something where they want to incorporate our products into.

Giulia Sollenni 54:30

Into their project? Yeah, also or or also companies that wants to like.

Emil Underflod 54:34

We we've had. We have a projects going on at the moment where we are doing tiny houses.

Giulia Sollenni 54:45

Interesting.

Emil Underflod 54:46

Circular tiny houses where we are doing all the interior and also we are also sourcing a lot of the materials for the exterior. So the wall clapping and roofs and stuff like that. So it does happen occasionally we also doing a hotel in.

Enable software where we are doing a lot of the, you know, custom made pieces for the bar and some of the shelves and. Like bigger pieces of furniture where we will then do it in. An hour away. And so I said that might be a good company to look into if you want to look at cases. It's a hotel called Totten Abeltoft the top of Abletoft. They are rebranding an old like hostel kind of vibe into. Something that they call A 5 hearted hotel. So where it's not about the stars, it's about like, you know, the hearts and they have like every half means something. But you know, they want to do everything in a in a very conscious way. So.that's also like a project that we are very proud of being part of. But it's still very new, so there might not be that much until to get and it might very likely all be in Danish.

Appendix C: the opened question survey

C.1 Preparation for the second round of Questions

Objective of this round of questions is to discuss the benefits and potentials encountered, along with recommendations for others interested in recovering and reusing waste in their business.

PIHLMANN:

1. In the previous email, we discussed some of the challenges and solutions that Pilmann encountered while upcycling used wood. These challenges include a significant amount of bureaucracy, uncertainty regarding the quality of the wood, and potential damages to the materials. If there are any other challenges you would like to add, please feel free to do so. Additionally, what positive aspects of your work—beyond the obvious environmental benefits—do you think suppliers, customers and other architecture studios should be aware of?
2. Given the large amount of waste materials in today's society, it is increasingly important for more businesses to adopt circular practices in their work. What recommendations would you offer to other businesses which may be interested to start recovering their own or others' discarded materials in buildings' renovation?
3. Considering your experience, what unexpected lessons have you learned that will be important to keep in mind during future projects? For example, in regards to communication with suppliers or contractors, the targeted deconstruction and storage of the materials, managing how to reuse them, etc.
4. How long did the renovation take? Was it much longer than a common renovation? And what do you think was the process that took the longest?
5. What challenges arise with materials that have been used for many years and hold significant roles, such as being structural? Was it difficult to obtain the necessary information regarding the properties of these materials to reuse them safely?
6. Additionally, how was communication coordinated with contractors who were not accustomed to this approach when determining how to reuse the various materials? Did you find an efficient system?

UNDERFLOD (to them I need to mention that the focus now is on post-consumption waste, so I am interested more on their reclaimed wood sourcing):

1. In the previous email, we discussed some of the challenges and solutions that Underflood encountered while upcycling used wood. These challenges include a significant amount of bureaucracy, uncertainty regarding the quality of the wood, and potential damages to the materials. If there are any other challenges you would like to add, please feel free to do so. Additionally, what positive aspects of your work—beyond the obvious environmental benefits—do you think suppliers, customers and other interior companies should be aware of?
2. Given the large amount of waste materials in today's society, it is increasingly important for more businesses to adopt circular practices in their work. What recommendations would you offer to other businesses which may be interested to start recovering their own or others' discarded materials that you wish you had known before?
3. Considering your experience, what unexpected lessons have you learned? For example, we talked about how your current customer base is quite different from your original target audience. Are there similar stories with regards to product development, market opportunities, supply chain challenges etc.?
4. Additionally, what steps does the wood need to go through from the moment it is donated until it is deemed usable for crafting the products?

C.1.1 Survey for Pihlmann

26/05/25, 12:59

Pihlmann renovation of Thoravej 29

Pihlmann renovation of Thoravej 29

Hi!

I hope you are having a nice day. My name is Giulia, I am a student of Sustainable Design Engineering at Aalborg University. Currently, I am doing my master thesis, in which I am exploring how businesses recover post consumption waste materials from the building sector in order to reuse them and give back value to them. And the work that Pihlmann did in recycling the materials with in the building is admiring and highly relevant, so I would like to use Pihlmann work at Thoravej 29 as a case study.

I already had a meeting with Isabella about how Pihlmann reused the demolished materials of Thoravej 29 with in the renovation and some of the challenges and I have prepared some follow up questions. I would be thrilled to hear you opinion too. There are only 8 questions in total. You can answer or skip any questions you would like and write as such as you want. Also, feel free to answer me in Danish if you feel more comfortable. Thank you so much for taking the time to answer these questions. I really appreciate your help.

1. What is your name and a small description of your role during the renovation? You do not need to include your name if you would like to keep it anonymous.

2. Can I include your name on my thesis? Even if you wrote your name in the previous question, I will not include it if here you answer 'no'.

Mark only one oval.

☐ Yes

☐ No, I would like to keep it anonymous

3. In the previous meeting, we discussed some of the challenges and solutions that Pihlmann encountered while reusing the extracted materials within the renovation. These challenges were the fact that it is a time-consuming work and that contractors are not used to this type of approach. If there are any other challenges you would like to add, please feel free to do so.

4. Additionally, what positive aspects of your work—beyond the obvious environmental benefits—do you think suppliers, customers and other architecture studios should be aware of?

5. Given the large amount of waste materials in today's society, it is increasingly important for more businesses to adopt circular practices in their work. What recommendations would you offer to other businesses which may be interested to start recovering their own or others' discarded materials in building' renovations?

6. Considering your experience, what unexpected lessons have you learned that will be important to keep in mind during future projects? For example, in regards to communication with suppliers or contractors, the targeted deconstruction and storage of the materials, managing how to reuse them, etc.

7. What challenges arise with materials that have been used for many years and hold significant roles, such as being structural? Was it difficult to obtain the necessary information regarding the properties of these materials to reuse them safely?

8. Additionally, how was communication coordinated with contractors who were not accustomed to this approach when determining how to reuse the various materials? Did you find an efficient system?

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C.1.1 Survey Underflod

26/05/25, 12:56

Underflod's recovery of discarded wood

Underflod's recovery of discarded wood

Hi!

I hope you are having a nice day. My name is Giulia, I am a student of Sustainable Design Engineering at Aalborg University. Currently, I am doing my master thesis, in which I am exploring how businesses recover post consumption waste materials from the building sector in order to reuse them and give back value to them. And the work that Underflod does of upcycling discarded wood is admiring and highly relevant, so I would like to use Underflod as a case study.

I already had a meeting with Emil about how Underflod upcycles wood into interior design product and which challenges arise and I have prepared some follow up questions. I would be thrilled to hear your opinion too. There are only 6 questions in total. You can answer or skip any questions you would like and write as much as you want. Also, feel free to answer me in Danish if you feel more comfortable.

Thank you so much for taking the time to answer these questions. I really appreciate your help.

1. What is your name and a small description of your job position? You do not need to include your name if you would like to keep it anonymous.

2. Can I include your name on my thesis? Even if you wrote your name in the previous question, I will not include it if here you answer 'no'.

Mark only one oval.

☐ Yes

☐ No, I would like to keep it anonymous

3. In the previous meeting, Emil and I discussed some of the challenges and their solutions that Underflod encountered while upcycling post consumption wood. These challenges include: a significant amount of bureaucracy of dealing with waste materials, uncertainty regarding the quality of the wood, and potential damages to the materials. If there are any other challenges you would like to add, please feel free to do so.

4. Additionally, what positive aspects of your work—beyond the obvious environmental benefits—do you think suppliers, customers and other interior companies should be aware of?

5. Given the large amount of waste materials in today's society, it is increasingly important for more businesses to adopt circular practices in their work. What recommendations would you offer to other businesses which may be interested to start recovering their own or others' discarded materials that you wish you had known before?

6. Considering your experience, what unexpected lessons have you learned? For example, we talked about how your current customer base is quite different from your original target audience. Are there similar stories with regards to product development, market opportunities, supply chain challenges etc.?

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