

# Near-site utilisation of demolition materials: a value network analysis

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## Abstract

**Purpose** – This study analyses the actors and transactions in the value network of circular near-site utilisation of materials generated in the demolition of buildings. The study aims to increase the knowledge of such value networks and thus enable more efficient project planning and construction design from the point of view of circular demolition material use.

**Design/methodology/approach** – A multiple case study methodology with semi-structured interviews was utilised. Four demolition cases were chosen for analysis, with 60 identified value transactions between actors. The actors were categorised based on their position in the value network to find out how different types of actors create value for each other in the network.

**Findings** – Four actor categories were discovered: legislative, ownership and finance, operational and intermediary. These categories have different types of value transactions with other actor categories in the network – legislative actors create the boundaries for the business- and operational environment, ownership and finance actors create the operational network for intermediary and operational actors, which create value based on opportunities in business collaboration. These findings complement previous studies and show that macro-scale models of circular economy implementation are also applicable in the meso-scale. Furthermore, missing or severed actors and transactions were found to hinder value creation in the network.

**Originality/value** – This article provides novel insights into the value networks of demolition materials, especially in terms of near-site utilisation, and suggests developing means to optimise their use in a demolition/construction project setting.

**Keywords** Multiple case study, Construction, Circular economy, Demolition, Near-site utilisation, Value network analysis

**Paper type** Case study

## Introduction

Construction and demolition waste is one of the largest waste streams in the European Union (Moschen-Schimek *et al.*, 2023), and the amount of it is growing globally because of the growing trend of urbanisation (Kabirifar *et al.*, 2020). The EU has set a goal of utilising 70% of the waste materials from construction and demolition instead of disposing of them (European Parliament and the Council, 2008). Thus, there is a clear need for the efficient utilisation of demolition materials. Circular economy (CE) principles that replace linear take-make-use-dispose material streams with circular material loops where waste streams are reconnected to production as raw material sources (Ellen MacArthur Foundation (EMAF), 2013), could mitigate this issue by reducing the need for virgin raw materials and waste creation.

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One interesting use case of circular materials is utilising demolition waste streams, such as concrete and stone waste, in the groundwork of new buildings and roads constructed in the direct vicinity of the demolition site – referred in this article as near-site utilisation. This enables the utilisation of demolition waste streams effectively and can decrease the environmental impact of construction by reducing the need for virgin raw materials as well as reducing logistics costs; not only does the demolition waste stay near where it is created, but also the need to transport new materials to construction sites is reduced (Hart *et al.*, 2019; Munir *et al.*, 2024). Thus, the ecological and economic promises of utilising materials near the demolition site seem lucrative. However, utilisation of demolition materials instead of landfilling requires more care in demolition and the types of materials created in demolition, their composition, as well as logistics considerations from the demolition site and the point of utilisation (Chen *et al.*, 2022). Furthermore, contaminants in the materials can inhibit the reuse of materials. Hazardous materials, such as asbestos and PAH compounds, limit how the materials can be safely utilised and testing is required to ensure that hazardous chemicals are not embedded in the materials utilised, which could end up contaminating the ground and waters (Wright *et al.*, 2023; Zhang *et al.*, 2022). Furthermore, the near-site utilisation of demolition waste streams is currently not well researched, which makes it hard to assess the economic and environmental opportunity costs of it.

Previous studies on the value chains of construction and demolition waste materials include, e.g., research on product lifecycle data (Nik-Bakht *et al.*, 2021), the effect of industry 4.0 practices in circular construction (Talla and McIlwaine, 2024), value stream mapping of inert construction waste (Rabnawaz Ahmed and Zhang, 2021), the identification of demolition waste value streams (Vilventhan *et al.*, 2019), and the creation of circular value chains for construction and demolition waste (Christensen *et al.*, 2022). However, studies of the actors and transactions in the near-site utilisation of demolition materials are limited. This study aims to address this gap by identifying the value network of near-site utilisation of demolition waste. Existing literature sources and multiple case study method are utilised to identify, categorise, and analyse relevant actors and their roles in the value network. This leads to the first research question of this study:

**RQ1.** What actors and transactions form the value network of the near-site utilisation of demolition materials?

Answering **RQ1** will provide insight into the value network of near-site utilisation of demolition materials and show the main actors involved in it. This will also enable the categorisation of these actors based on the types of value transactions they have with other actors in the network, i.e., what value they deliver to which actors in the network (e.g. Allee, 2008). Furthermore, the analysis will reveal missing actors and transactions within the value network. This information is used to create recommendations on how the value network can be improved. This leads to the second research question:

**RQ2.** What kind of actors or transactions are missing in the value network of near-site utilisation of demolition materials and how does it affect the value creation within the network?

Finally, the near-site utilisation value network can show what kind of decisions throughout a building's lifespan affect the use of demolition materials. As most of the environmental impact of a product is defined in the design phase (European Union, 2014), the effect of the design phase must also be considered. Furthermore, renovations can alter structures and affect the materials found in buildings, which can affect the demolition phase. This creates uncertainty in demolition work and can affect the usability of demolition materials. Thus, the third research question of this study is:

**RQ3.** How do the decisions made throughout a building's lifespan affect the utilisation of demolition materials?

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The rest of this article is structured as follows: [Section 2](#) provides theoretical background and key concepts utilised in this study, [Section 3](#) describes the research methodology, [Section 4](#) presents the results of this study, [Section 5](#) discusses the findings, and [Section 6](#) provides concluding remarks and recommendations for further studies.

### Theoretical background and key concepts

*The circular economy* is a concept, where materials remain in use for a long time and are redirected as new raw materials for new products at their end-of-life (EOL) ([Korhonen et al., 2018](#)). Processes, such as reuse, repair, remanufacturing and recycling enable the circularity of materials in practice, and help in retaining the value of materials invested in products ([Ellen MacArthur Foundation \(EMAF\), 2013](#)). Even though the CE is gaining traction in legislative arenas (e.g., [European Commission, 2022](#)), there are still areas, such as construction and demolition, where there is much potential for improvement in the area ([Ogunmakinde et al., 2022](#); [Oluleye et al., 2022](#)). In general, the construction industry faces many barriers in moving towards CE; cultural, regulatory, financial and sectoral barriers have been found to hinder the transition to circularity in the area ([Ghafoor et al., 2024a, b](#); [Hart et al., 2019](#)).

*Demolition* of buildings is a process that produces large amounts of materials, which are currently largely underutilised in CE processes ([Oluleye et al., 2022](#)). Causes for the underutilisation of demolition material streams include operational issues, such as lacking on-site waste management planning ([Vilventhan et al., 2019](#)), and more overarching barriers in the construction industry, such as the low price of virgin raw materials, the changes in ownership over the long lifespan of buildings, and the industry focusing on short-term profits over long-term payback ([Hart et al., 2019](#)). On the other hand, increasing awareness and training for demolition material use in construction, careful on-site waste management, organisational adoption and development, circular design and development, as well as regulatory incentives are key enablers in utilising demolition materials ([Pittri et al., 2024](#); [Swarnakar and Khalfan, 2024](#)). Furthermore, maintaining reliable information about the buildings' history with building information modelling (BIM) systems can help with determining how much of the materials utilised in them can be utilised after demolition ([Kamari et al., 2022](#)). Understanding and addressing these barriers and enablers are crucial for demolition material utilisation to be successful ([Swarnakar and Khalfan, 2024](#)).

*Value* is a very subjective and multifaceted concept, and previous studies have recognised different dimensions of value being produced in projects. Value is transferred between actors through *deliverables*, which can be tangible, e.g., monetary transactions or work, or intangible, e.g., knowledge or social capital. Intangible deliverables can be divided into five fundamental elements: performance, knowledge, innovation, legitimacy, and reputation ([Gerhardt et al., 2025](#)). The transfer of deliverables from one actor to another is called a *transaction* ([Allee, 2009](#)). Tangible delivered value is usually easily measurable, while intangible deliverables are more abstract and harder to measure ([Allee, 2008](#)). Financial value being created is one key measurable dimension of value in projects (e.g., [Ahola et al., 2008](#)), but value can also be created in environmental and social dimensions ([Kivilä et al., 2017](#)) or systemic values ([Vuorinen and Martinsuo, 2019](#)), where value is being created in the connections to other projects or the general surroundings.

*The value network* can be seen as an evolution of the value chain concept. The complex business needs of, e.g., sustainability, global collaboration and digitalisation have rendered the concept of value chains insufficient to depict the value creation process ([Peppard and Rylander, 2006](#); [Ricciotti, 2020](#)). In contrast to the linear value creation concept of value chains, the value network considers the fluidity and non-sequential nature of actions done by a network of actors that participate in value creation in complex business environments ([Ricciotti, 2020](#)). Value network analysis can be done to study the roles of each actor in the network, what value they create and what resources they require ([Allee, 2008, 2009](#)), which can help to understand the value creation process in complex, multi-actor environments and

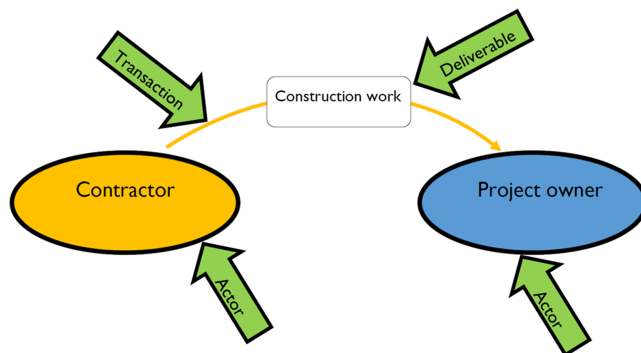
hence support management decision making (Allee, 2009). The analysis can also point out key actors in the network, which are crucial for the value creation process, as well as missing links, which affect the whole network.

Actors are the building blocks of value networks. They consist of individuals and organisations that pursue their interests in the value network. Actors are connected to the network through the transactions they have with other actors in the network, and thus the value creation in the network is dependent on the actors in it (Ihlström Eriksson *et al.*, 2009). The way actors transfer value through transactions with specific deliverables is described in Figure 1 with the example of a simple two-actor transaction, where a contractor delivers construction work to the project owner.

Demolition and construction are complicated processes with multiple actors affecting the projects and processes in them. To understand how different actors are involved in the value network of such complex systems, classification of different types of actors can be utilised to classify and analyse the parties involved. This can be done, for example, by categorizing them based on the value they create with other actors in the network (e.g., Breuer and Lüdeke-Freund, 2017). In line with this, Vuorinen and Martinsuo (2019) identified four main influence strategies that actors use to influence infrastructure projects: communicating, complaining and resolving disputes, setting rules and supervising, and using decision making authority. In a similar way, Lieder and Rashid (2016) found that to apply CE on a macro scale in manufacturing industries, different types of actors should affect each other in different ways. Business realities of companies steer towards a bottom-up approach, where business opportunities lead to collaboration in CE implementation. In contrast, legislative actors influence CE implementation top-down with orders, regulations and rules (Lieder and Rashid, 2016).

### Methodology

This study aims to analyse the value network of the actors involved in the near-site utilisation of demolition materials. The analysis requires an understanding of previous literature on value networks, CE, demolition, and the actors involved in it. This study is grounded on a pragmatic research philosophy, emphasising the creation of usable knowledge, while acknowledging the subjectivity of personal experiences and their effect on the results (Kelly and Cordeiro, 2020). Thus, the results and conclusions of this study have been written in a way that highlights their usefulness in the studied context. Theoretical background and key concepts from previous literature were utilised to form the basis of the analysis. The value networks of near-site utilisation of demolition materials have not been well researched, and



**Figure 1.** Elements of value network mapping exemplified with a contractor delivering construction work to the project owner (modified from Allee (2008)). Source: Authors' own creation/work

increasing the knowledge in the area called for studying relevant cases of businesses that have adopted demolition material utilisation into their operations. Thus, this study adopts a multiple case study methodology to increase the understanding of the subject (Yin, 2018). Empirical data about the actors involved in the local utilisation of demolition materials was gathered through semi-structured interviews of the recognised actors. The cases needed to be comparable to each other to provide relevant information on the general structure of value networks in the studied area, enable cross-case analysis, and create generalisable results (Allee, 2008; Eisenhardt, 1989). This methodology and case selection rationale also support the pragmatic approach of this study by providing relevant data from the industry with multiple points of view of multiple interviewees. This also called for coherent case selection criteria, which was established by studying the industry and factors that influence the near-site utilisation of demolition materials in urban areas. The cases were selected based on the following criteria:

- (1) The cases must involve medium-to-large demolition projects in an urban area
- (2) Demolition materials must have been studied for utilisation, be currently utilised or have been utilised in a circular way near the site they were produced in
- (3) The cases must be located within the same country

With these criteria, the analysis of selected case interviews provides a general overview of the local utilisation of demolition materials, their challenges, benefits and other characteristics. Strict selection criteria also enabled the inclusion of only replicable cases with comparable results, which supports the aim of this article for generalisable results (Yin, 2013). This resulted in four studied demolition cases in Finland – three public projects and one project led by a private company. The public projects were also chosen to highlight the characteristics of publicly funded projects, and the privately led project highlighted the difference between public and private projects. The selected cases are geographically limited to Finland with cases from different urban areas. The strict geographical and business-size-related selection criteria with specific project sizes can cause bias in the results (Collinson and Rugman, 2010). However, the geographical and regulative context affects the construction industry heavily, making the risk of bias unavoidable. The studied cases are listed in Table 1 with a short summary of the studied case and the position of the interviewee(s).

Case A is a large-scale public demolition project in an urban area, where the work has not yet started, but pre-demolition audits have taken place. Case B is a heating plant demolition project where local material utilisation was studied and partially executed. Case C is an ongoing demolition project of a large hospital complex, where new hospital premises are simultaneously being built. Case D is a construction project of office and commercial spaces that utilise load-bearing frames of architecturally protected buildings as a part of the new buildings. Unlike most projects involving protected buildings, the facades are also demolished

**Table 1.** Studied demolition cases

Case	Summary of case	Interviewee(s)
Case A	Demolition of a large healthcare services building in a densely populated urban area	Consultant
Case B	Demolition of a heating plant situated near to a residential urban area	Technical manager
Case C	Large hospital demolition and construction project close to a city centre	Lead supervisor and safety coordinator, project manager
Case D	Partial disassembly of research/production facilities and rebuilding them into an office and commercial facility in an urban area	Project manager

**Source(s):** Authors' own creation/work

and rebuilt to look similar to the protected appearance. This is done to remove the microbial growth in the outer walls and thus make the building a healthier environment, as well as to increase energy efficiency of the buildings.

The semi-structured interviews included six main topics – interviewee background, actors in the demolition, the demolition project, the demolition process, summary of challenges and best practices, and thoughts on new practices in near-site utilisation of demolition materials – this structure guided the interviews and was used as a foundation for further discussion. The interviews aimed to identify value network actors both directly by asking interviewees to list actors present in their respective cases, as well as indirectly by inquiring them about ideal circumstances and opinions on improving the state of near-site utilisation of demolition materials. The full interview guide can be found in [Appendix 1](#).

The interviewees were chosen based on their knowledge of the demolition projects. It was acknowledged that the interviewee's comments would contain objective statements of the value network, but also personal opinions. This bias was mitigated by recognising questions, where personal opinions weigh less (e.g., “*Were circular economy goals set for the project?*”) and those where they have significant importance (e.g., “*Who do you think are important actors in developing new operating models in demolition?*”) (Meyer, 2001). All interviews were recorded and transcribed word-for-word in Finnish and analysed inductively to identify and analyse actors and value transactions in the cases. The interview data was analysed by listing all recognized value transactions and coding them according to the organisation they originated from and to which organisation(s) they were delivered to. This was then used as a basis for the categorisation and analysis of the structure of the value network. This allowed the value network analysis to be based on comparable data from multiple similar real-world cases. The full research process is visualised in [Figure 2](#).

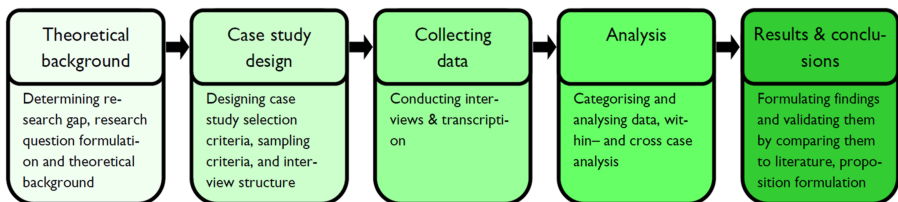
Citations of the interviewees in this article have been translated into English with care to retain the meaning and context of the original statements. Analysis of the interviews resulted in 60 distinct value transactions between actors with different types of tangible and intangible deliverables. The full list of identified actors and transactions in the studied cases can be found in [Appendix 2](#). The results of this study were presented to 13 researchers and two industry representatives in a workshop in November 2024 to validate the findings of this study and the suggested categorisation of value network actors. The workshop attendees had the opportunity to comment on the findings and propositions of this study.

## Results

The following sub-sections present the multiple case study's results including value network actor categories, value creation within actor categories, value creation between actor categories, and missing actors and transactions.

### *Value network actor categories*

The interviews showed that different types of actors' have differing ways of influencing value creation in the value network. Based on the findings, the actors were categorised into four



**Figure 2.** Research process. Source: Authors' own creation/work

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categories based on their influence and transactions with other actors in the network. This was done to point out the different roles of actors and make results more generalisable.

Legislative and regulatory actors guide other actors' operations by creating and enforcing regulations and granting permits, and thus they determine the boundaries of the operational environment in construction and demolition. This means that other actors' operations work within the legislative limits set by these actors. Their influence on the business and operational environment set the minimum requirements of other actors' operations and actions – contractors, financial actors, consultants, project owners and all other actors outside the legislative and regulatory area were affected by them. Environmental regulations for construction materials define the realities of utilising demolition materials in construction, and without environmental permits their utilisation is not legally possible. These actors also have a large influence on how demolition materials are utilised in construction. As the interviewed project manager and safety coordinator in case C summarized the effect of legislative push for demolition material utilisation: *“The same laws would apply to everyone, and everyone would need to adapt to them accordingly. [...] financial realities guide actions very strongly. Beyond that, if there are no legislative requirements to do something, it is hard to see why it would be done.”* The relationship between legislative and regulatory actors with the value network was found to be based on the legislative boundaries set by them and was not perceived to be particularly collaborative. These actors will be referred to as *legislative* actors from now on in this article. These actors include governmental organisations, municipal actors for construction, demolition and environmental permits, and other legislative actors, who grant permits or supervise operations.

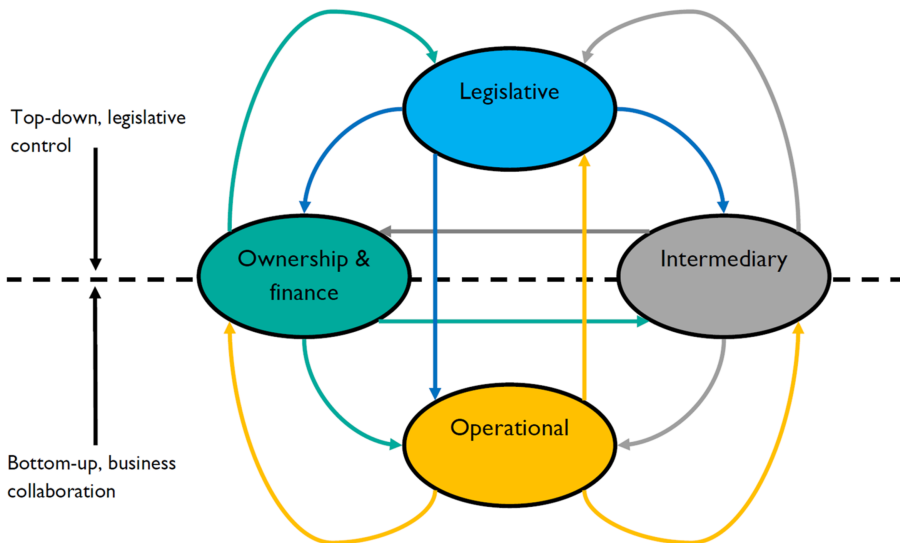
The owners and financers of buildings, sites, and projects were also recognised as another clear category. They were also widely acknowledged as the main driving force behind the near-site utilisation of demolition materials because they had the largest effect on how the projects were actualised within the limits of the legislative environment. As it is currently not mandated by regulative authorities, without input from owners and financers to utilise demolition materials, the incentive for their use in construction is limited. Case D showed a clear example of the effect of this group's role in the utilisation of demolition materials: *“It (utilising demolition materials without incentive from customers) would require a circularity consultant and other actors as well as a lot of time in project planning which I do not have. However, if the customer specifies it, it becomes customer service.”* These actors will be referred to as *ownership and finance* actors in this article. These actors include the owners of the sites, buildings or lots, financial institutions and public organisations when they are in an ownership role, as well as the users of the buildings.

The requirements of project owners and financial actors are transferred to contractors and subcontractors doing the actual demolition and construction work and these actors' effect on the value network was seen as collaborative. The collaboration between contractors and project owners was seen as an essential part in actualising the targets in utilising circular materials, as their operations in demolition were crucial in producing usable circular materials. These actors were guided by contractual agreements from owners of projects to actualise the circularity goals set by them and legislative actors. Some actors were seen as essential members of the value network for their operational experience or superior machinery for utilising demolition materials. As the project manager in case D elaborated on the requirements of the main contractor for the project: *“The main contractor needs to have experience with both (new construction and renovation). [...] we realised that having two contractors for the same work would complicate the definition of project responsibilities too much.”* Thus, these operational actors were seen to affect the value network based on business opportunities and collaboration. These actors will be referred to as *operational* actors in this article.

Finally, the fourth distinct group recognised from the analysis consisted of actors that worked between the other groups – consultants, that provide the ownership and finance actors with services that help them meet regulatory requirements or guidance in setting requirements

for operational actors. These actors usually do not have ownership, legislative power or operational responsibilities over the projects they work in, but they provide services that actors in the other categories cannot produce by themselves. These actors included, for example, laboratory services for hazardous materials testing and other actors, that provide information, that is essential in utilising demolition materials in construction. The interviewed consultant in case A stated that “*They (circular economy goals for demolition cases) are defined based on the reports we make [...] and if needed, we can also help with making tendering criteria that help in reaching those goals.*” These actors will be referred to as *intermediary* actors in this article, and they include consultants, laboratory services, trade unions, and associations, and they provide information, guidance, documentation and other non-operational services, that are not in the reach of other actors’ own knowledge or abilities.

Some actors were mentioned outside these groups, but their significance on the projects and the utilisation of demolition materials were very low. They were named *outside* actors, and were present as the general public, outside private organisations, property owners near demolition sites, and hospital patients. The recognised actor categories and their relationship to each other is illustrated in Figure 3 with coloured ovals depicting the actor categories and arrows showing value transactions between the categories. The positioning of actors in Figure 3 describes how the categories affect each other – actors influencing the utilisation of demolition materials by top-down influence on other actors are positioned high up on the figure, while actors influencing bottom-up are placed lower down on the figure. This highlights the relationship between actors and their respective roles in the near-site utilisation of demolition materials. Legislative actors being positioned highest in the figure demonstrates their role in setting the operational environment for other actors. Ownership and intermediary actors, being in the middle of the figure, demonstrate their role in working in the environment set by legislative actors and setting the business environment for the near-site utilisation of demolition materials. Operational actors being positioned lowest in the figure demonstrates that they affect value creation in the network by providing business collaboration opportunities in the environment set by other actors.



**Figure 3.** Actor categories, their relations between each other, and the transactions between them. Source: Authors’ own creation/work

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### *Value creation within actor categories*

Legislative actors' role in demolition and construction is complicated and the legislative actors' category includes many different actors. Legislative actors are spread on an international level (e.g., European Union-level), national level and local level. Also, each of these levels include multiple actors that are involved in the area. For example, in demolition of buildings, local legislative actors involved at a minimum consist of zoning authorities, environmental authorities, building inspection authorities and the regional state administrative agency (AVI). The interviews found that communication between different legislative actors was lacking and no direct transactions between legislative actors were mentioned. This was hindering the near-site utilisation of demolition materials, as these actors have the information about projects producing demolition materials and other projects possibly requiring them via permitting and other actions with legislative actors. The project manager in case D stated: *"We recognized the possibility of them (a company doing construction work near their site) utilising the materials we generate by ourselves. [...] if city officials or some organisation knew how to connect the generation and demand for these materials, they could be utilised more efficiently."* However, the information of the material being produced and needed is not connected between different authorities, and thus the chance of "matchmaking" between these actors is lost.

The value creation within the ownership and finance category was found to consist of financial commitment to projects, monetary transactions from selling pre-demolition materials, delivery of projects, as well as sustainability reporting gains, which lead to possible public image gains. The relationship between financing, ownership, and usage of projects and the buildings created was found to be motivated mainly by these factors, which also guides the specifications of projects. In this context, the utilisation of demolition materials in construction was not seen to reduce costs, and their implementation was still at an early stage because of uncertainties about material properties and a lack of up-to-date knowledge of them. This makes virgin materials still lucrative. The risk of utilising demolition materials was countered by project owners' or financiers requirements for environmentally conscious operations. Optional environmental certificates were found to be a clear way to affect and attract funders or buyers for properties, especially with offices and buildings sold to corporate buyers. Even though they are not mandated, they are important for the buyers' environmental, social and governance (ESG) reporting needs. The interviewee of case D even stated: *"It (having an environmental certificate) is not even a question of added value – you will not be able to find a buyer if you do not have one."*

Value creation within the operational category consisted of collaboration between contractors and subcontractors. Depending on the number of contractors and the size of the project, the complexity of these networks varied from one main contractor and its subcontractors to a wide network of actors. These relationships were also guided by the guidelines set by the owners of the project, such as circularity goals or special operational settings (e.g., demolition close to an operation hospital, such as in case C). Furthermore, project size and used organisational models had an impact on how these actors were linked. Larger projects utilising project alliance models (case C) had different responsibilities for operational actors compared to medium-sized projects with fixed-price contracts (case D).

The internal value creation in the intermediary category is largely based on information exchange between consultants, laboratory services, unions, and organisations. The information exchange between consultants and laboratory services is essential in creating factual up-to-date information about possible hazardous materials in demolition projects, which is needed to create demolition work plans and material reusability assessments. This connection was mentioned in all case interviews. Trade unions and organisations create value for these actors by informing the state-of-the-art of demolition practices and equipment, which can enable new ways of utilising the materials created in it.

*Value creation between actor categories*

Each value transaction from the legislative actors was linked to ownership and finance actors in some way, which indicates the responsibilities they hold towards legislative actors. The most prevalent theme in the value transactions between legislative actors and all other actors was them setting the legislative landscape within which the other actors operate in. This means that the operational settings and boundaries that other actors work inside are set by the legislative actors. Legislative actors were also responsible for permitting activities, which included environmental and operational permits. Environmental permitting concerned mainly the ownership and finance actors, but operational permits concerned all actor groups. Besides legislative boundaries and permitting, the legislative actors also provided opportunities for material utilisation through providing opportunities with legislative and financial means. These means included providing land utilisation possibilities through zoning, funding projects with aligning interests with their goals, collaborating in projects, setting protection statuses for historical buildings, and granting environmental certifications.

The ownership and finance category is the economic driver of the value network. It pays for the operational and intermediary actors for their work and receives goods and services in return. Other transactions they have with other actor groups include providing up-to-date information about the buildings to be demolished to operational actors as well as setting project schedule targets and delivery specification goals as well as coordination to operational and intermediary actors. However, no direct value transactions from this category to legislative actors were mentioned. This could be due to the selected interviewees' view on legislative actors, or other biases that make them not note such transactions. It could be argued that ownership and finance actors create value for legislative actors by actions that align with their goals, for example by enabling regional development or reaching sustainability goals. As an example, the interviewee in case D stated that the project was well perceived with other property owners in the area: *"When it comes to demolition and the whole project, dealing with them has been easy. [...] we are actively developing the area and increasing the attractiveness of the area, and the local property owners appreciate that."* This could be seen as a positive value for legislative actors as well, but it was not recognised as such in the interviews.

The operational actors create value by conducting demolition work or related activities. Trust in the operational actors' abilities and motivation to follow these agreements was recognised as a key value in the relationship between operational actors and ownership and financial actors, as the realisation of the requirements is supervised largely by the operational actors themselves. Thus, transactions such as operational safety, knowledge and experience from previous projects, and dependable performance were recognised in the interviews. The interviewees also recognised that traditional demolition operations had not been done in a way that enables utilisation of different materials created in it (e.g., not separating different materials, destructive removal of useable items), and it is the operational actors' responsibility to supervise that the requirements for material utilisation are adopted and adhered to starting from the demolition worker level. As the lead supervisor and safety coordinator elaborated about supervision of asbestos removal: *"[...] there is no point in someone from our team going there to see how it is going. Instead, there needs to be a lot of trust (in the contractor)."*

The intermediary category is connected to other actors via the value they create between other categories of actors and their services help actors in the value network fulfil each other's demands. In other words, the intermediary category includes actors whose expertise is not present or otherwise available in other categories' actors. Legislative advice, permits, laboratory measurements and other services, that enable other categories to comply to other actors' requirements are present in the intermediary category. There are also intermediary actors, who provide ownership and finance actors with services, that help them reach their goals either in CE metrics or project planning. These can be, e.g., circularity studies done before demolition planning, setting CE goals based on those studies, and consulting in tendering to reach the set goals. As the interviewed consultant in case A described: *"We give a percentage on how much materials can be utilised in projects . . . And sometimes there are no*

clear goals for it (circularity). [...] based on the reports we make, those goals can be set.” Furthermore, trade unions’ and organisations actions and influence on legislative actors’ and legislation were recognised in the intermediary category.

The value transactions between actor categories are summarized in Figure 4. The actor categories are depicted similarly to Figure 3, while white rounded rectangles on the arrows list the deliverables between the categories. The figure shows all unique value transactions between the actor categories. This figure highlights the variety of value transactions between actors in different groups and the nature of those transactions.

### Missing actors and transactions

The interview analysis pointed out multiple occurrences of missing transactions between actors in the near-site utilisation of demolition materials value network or missing actors altogether. One missing transaction present in all studied cases was information from the construction and renovation phases of the building to be demolished. This often resulted in more operational work than anticipated and delays, as workers found that structures and materials did not match expected ones. This was especially problematic with asbestos – the unexpected materials need to be tested to make sure that workers are not subjected to hazardous asbestos particles when dismantled. The main reason for the lack of information was insufficient documentation about construction and renovations. The interviewed project manager in case B stated: “Cosmetically it is hard to say (whether materials contain asbestos

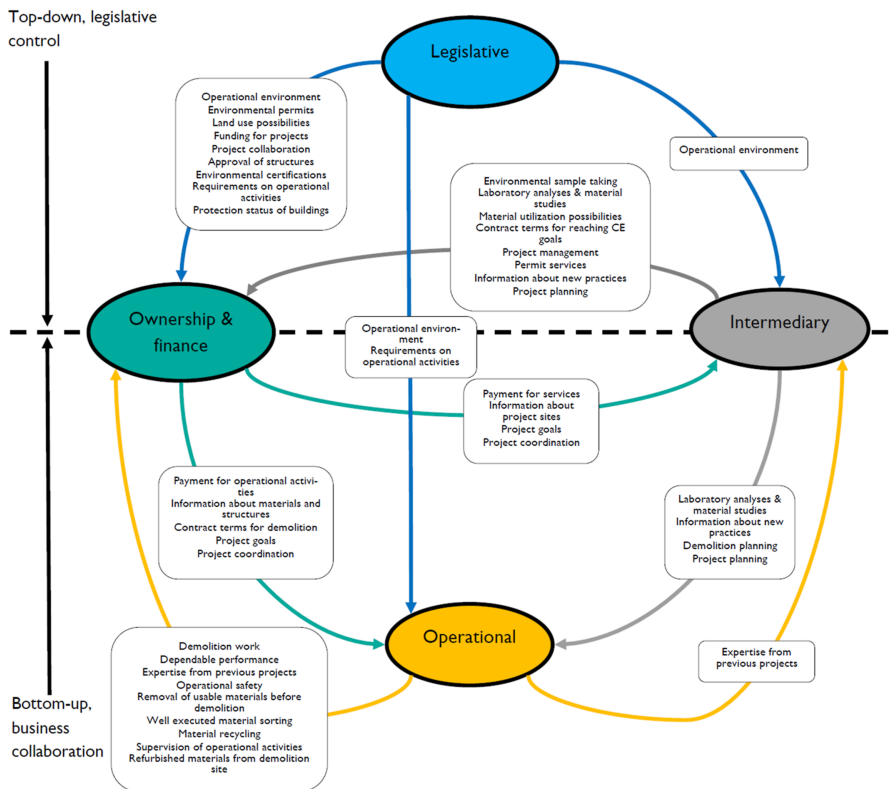


Figure 4. Identified value transactions between actor categories. Source: Authors’ own creation/work

or not). [...] In my experience, high quality asbestos testing cannot be done without taking material samples.”

Another common missing transaction was between actors creating demolition materials, temporary storage of the materials, and those in their vicinity that need materials to be utilised. In case D, the interviewee suggested a stronger presence from legislative actors, mainly city officials, on the subject – the information about both material creation and usage is available for them, as permits for both construction and demolition are granted by city officials. It was also noticed by the interviewee in case B that information does not transfer automatically between different organisations within the legislative actors group: “First, we applied permits for noise, then we learned that material utilisation permits were required before that (and the noise permit was declined). This caused a delay of approximately three months.” This was also recognised to hinder the utilisation of demolition materials, as the information about the supply of potentially usable materials and the need for them is also siloed in different departments. The storage of materials was also recognised in case A as an issue: in urban areas, where lots are small and often close to each other, there is little room to store demolition materials on site, which makes it hard to utilise the materials near to it unless they are utilised immediately after their generation.

Information about new demolition methods and material utilisation possibilities was also seen to be lacking in legislative, ownership and finance, and operational groups. The interviewee in case A thought that this caused problems in getting environmental permits due to the concern of noise and dust from demolition, which can be remedied by requiring the use of machinery and methods that mitigate them to a harmless level. Furthermore, the ownership and finance actors were seen to be slowly waking up to the possibility of demolition material utilisation, but the knowledge and incentive to use them were still limited. Operational actors were also found to be lacking information about material utilisation possibilities, and even sorting demolition waste to separate concrete, metals, glass, etc. were seen to require active supervision to make sure workers were sorting materials accordingly. The interviewee in case A elaborated on the issue: “There can be up to 10% of other materials in it (sorting for concrete waste). If supervision is lacking, other materials end up in the sorting container – windowpanes, all kinds of junk. [...] And it (negligence in sorting) is not about cost savings, it is just how it used to be done.”

Utilisation of pre-demolition materials was found to be lacking because of missing actors in the area. In case A, the interviewee noted that it is difficult to differentiate the cause from the effect in the low number of actors in this area: the market for pre-demolition materials is small – thus there are not many actors in the area; there are not many actors producing pre-demolition materials – thus the market for pre-demolition materials is small. As the interviewee described: “It is a bit like which comes first, the chicken or the egg. There are no operators because there is little demand, and there is little demand because there are no operators.” The market pull for these actors was clear in case D, where the actor for producing refurbished pre-demolition materials was found quite easily, when customer demand was driving their use.

In these cases, where a transaction or actor was missing from the value network, intermediary actors and transactions were required to replace the missing transactions and actors. For example, the missing documentation about materials used in construction and renovation resulted in more work in taking samples of materials and analysing them in laboratories to make sure workers are not subjected to hazardous materials and the materials are utilised or disposed accordingly. Another example would be the missing transactions between city organisations, which leads to materials being transported from demolition sites further than necessary to be utilised, while nearby construction projects purchase either virgin materials or circular materials that need to be transported to their sites from further away than necessary.

## Discussion

The goal of this study was to identify actors and transactions in the value network of near-site utilisation of demolition waste by conducting a multiple case study on relevant demolition

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projects. This study makes contributions to the literature on the value networks of the circular use of demolition materials by providing a novel framework on how to categorise actors in it and pointing out how to optimise value creation within the network. The four studied cases resulted in 60 recognised value transactions. Analysing the transactions resulted in the categorisation of the actors in the value network into four categories. The categorisation of actors helps to understand the roles that different types of actors have and the way they affect value creation in the network (similarly to, e.g., [Breuer and Lüdeke-Freund, 2017](#)) The four categories of actors recognised from the case studies are legislative, ownership and finance, operational and intermediary, and they hold the most interest and power over the near-site utilisation of demolition materials. These groups create value for each other with tangible and intangible transactions through monetary transactions; conservation of environment, health, and safety; information; labour; regional development, etc. This leads to the first proposition of this study:

*Proposition 1.* Actors in the value network of the near-site utilisation of demolition materials consist of four main groups: legislative, ownership and finance, operational, and intermediary actors.

The value transactions between these groups depend on the setting of the value network itself. In addition to geographical and other settings that the actors cannot affect, the actors themselves set the stage for the value network. The legislative actors set the boundaries for transactions in the value network through legislation and regulation and thus set the operational and business landscape for all other actors. Ownership and finance actors determine project goals and operational realities through budgeting and monetary limitations, which determines how operative and intermediary actors provide value to the network. Intermediary actors create the value transactions otherwise unavailable to other actors by providing services that other actors are not able to produce by themselves. Operational actors determine the operational field and deliver the demolition and other related work, and thus deliver the physical product created in the value network. This is similar to what [Lieder and Rashid \(2016\)](#) suggest for the implementation of CE in a larger, industry-wide macro-level setting, where legislative actors have the role of guiding the business actors towards sustainability goals by controlling the business environment, while businesses work based on the legislative and business environment available. This study found that the same setting can be found in the meso-level in how legislators, property owners, financiers, intermediary actors, contractors and other relevant actors work in the near-site utilisation of demolition materials in a local project-level setting. This resulted in the mapping of different actor categories based on their influence on other value network actors. This mapping of actor categories highlights the influence of legislative power and responsibility actors hold to each other, as well as the role of business collaboration in the value network of near-site utilisation of demolition materials. The created model can also clarify the roles of different actors affecting the utilisation of demolition materials, so that issues with collaboration between those actors (e.g., [Behzad et al., 2025](#); [Bello, 2025](#)) can be addressed more effectively.

Analysing the actors and transactions in the value network also showed the effect of missing actors and transactions within the value network: if an actor does not have the ability to create value in certain areas on their own, they need to outsource it and utilise other actors in the network. This is also true, if the value has been lost – such as in the case of missing documentation, or if value transactions with other actors have not been sufficiently established – for example, in missing transactions between operational actors with aligning interests. This also holds true for missing actors, such as in the case of missing pre-demolition actors hindering the reuse of otherwise usable materials. Thus, the value network is not only shaped by the transactions between actors, but also by the actors and transactions not available to it. This leads to the second proposition of this study:

*Proposition 2.* The value network of the near-site utilisation of demolition materials is not only shaped by its actors and transactions but also by missing actors and transactions.

The lost value in missing or severed transactions between actors – such as lost information about materials or missing information flow between actors – hinders the value creation of the whole value network. For example, lost information about construction materials or renovations causes unexpected delays in projects, as unexpected materials often need to be examined for asbestos and hazardous materials. These findings on information and data flow issues are similar to other industries' issues with implementing CE (Feldman *et al.*, 2024; Geboes *et al.*, 2022), which strongly suggest that the implementation of CE is significantly hindered by the lack or disconnection of information transactions between actors.

Information about construction materials and renovations is a transaction that, once severed (i.e., not documented), cannot be directly reconnected but needs extensive work through small-scale dismantling and materials sample taking and analysis to be reinstated. This is also true for other types of transactions – if legislative information is unavailable to an organisation, the value transaction of getting that information needs to be rerouted through another actor, e.g., a consultant. Near-site utilisation also requires many actors to be near the demolition site. Thus, the geographical location of actors – especially operational actors and intermediary actors with a role in handling or testing the material – can affect the viability of utilising the materials created in demolition. Furthermore, near-site utilisation is also time dependent – material storage in urban areas was found to be a challenge in utilising materials, and utilising materials at the same time they are created was recognised as the optimal scenario. These factors indicate, that the value network is most efficient, when missing transactions, such as missing information about materials or demolition/construction schedules, are recognised and remedied beforehand. This would result in more efficient material use, as utilisation cases are recognised early in the project, as well as more efficient scheduling with reduced delays due to surprises in materials and structures during demolition. This leads to the third proposition of this study:

*Proposition 3.* Missing or severed transactions between actors should be identified in the early phases of demolition project planning to respond to them accordingly.

The third proposition also implies that decisions made throughout the lifespan of a building starting from the development phase to construction and finally demolition have an effect throughout the value network: if transactions are severed at some point of the lifespan, it will require more transactions to reinstate the lost value. This is most evident in transactions considering data: information about materials, building technology, and structures from the construction phase – or changes done to them in renovations – can be lost only to be recovered by extensive and invasive materials testing during demolition. This is also true with other types of transactions: missing financial abilities beget a need for financial actors and missing operational abilities call for the need for a contractor or subcontractor, who can deliver the needed operational abilities, etc. This highlights the importance of recognizing key-value transactions that affect the demolition phase. The long lifespan of buildings and possible changes in ownership during it make some of these transactions hard to maintain and requiring effort for the transactions not to be disconnected. BIM systems have been suggested as a tool for better tracking the history of buildings until their demolition (e.g., Kamari *et al.*, 2022). However, BIM systems were not mentioned in any of the interviews. This is most likely due to the buildings being demolished being old and thus BIM systems have not been implemented in them, but the lack of using digital tools can also be observed in the construction of new buildings (Bello, 2025). Even though BIM systems offer a repository for the whole history of a building, the long lifespan of a building means that much care must be taken to ensure that BIM systems and data are future-proof at the building's EOL.

The nature of long lifespan transactions suggests that [Proposition 3](#) also has implications for the design of buildings. Preserving data, structure, and material transactions through design could alleviate many issues in the matter and design specifications should support the preservation of relevant transactions during the lifetime of the building. For example, design for deconstruction and using materials that can be utilised in the technological or biological

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loop of the CE reduce the need for intensive processing of demolition materials (Ellen MacArthur Foundation (EMAF), 2013; Pittri *et al.*, 2024). This would also affect the value network by reducing the need for intermediary actors, whose main function is to reconnect lost transactions. Designing buildings with CE in mind has been recognised as a not well-researched area (Osobajo *et al.*, 2022), but has been recognised as an important aspect in CE implementation (Ghafoor *et al.*, 2024a, b). Factors such as durability, functionality, the ability to deconstruct and relocate, cost and environmental factors have been found to affect the value of end-of-life modular buildings, which are in line with the findings of this study (De Silva *et al.*, 2025). The findings of this study concerning the state of the construction industry's CE readiness are also in line with previous findings in the construction sector in different geographical areas (e.g., Bello, 2025; HaitherAli and Anjali, 2023; De Silva *et al.*, 2025), which supports the generalisability of the results. It must also be noted that many hazardous materials have been restricted from use in new construction. Thus, many of the materials testing and special demolition actors in the value network will be excluded from the demolition of buildings constructed today unless some of the materials currently in use are later found to be hazardous.

### Conclusions

This study focused on the value network of near-site utilisation of demolition materials and presented results on its structure, actors, relationships between actors, and rationales of interaction. A multiple case study methodology with semi-structured interviews was utilised to study four cases in Finland, where the near-site utilisation of demolition materials was planned, was currently being done or had been done. The main theoretical contributions of this study are the three research propositions presented in the discussion section and the mapping of actor categories in the near-site utilisation of demolition materials. Four categories of value network actors were found from the results: legislative, ownership and finance, operative and intermediary actors. These actors interact with each other based on business realities and the legislative environment, and the position of legitimacy or business collaboration was found to be a strong indicator of the type of value being created between the actors. Missing actors or transactions were found to hinder the utilisation of materials through unavailable information on materials utilised in buildings, lacking collaboration between authorities concerning the local creation and need for materials, or insufficient collaboration. Thus, the missing or severed transactions between actors should be identified in the early phases of demolition project planning. Furthermore, these issues could be addressed with business practices that aim to preserve these transactions, by implementing policy changes requiring documentation from the whole lifespan of buildings, or by incentivising near-site utilisation of demolition materials.

This study also has managerial implications for the construction and demolition industries and the management of demolition projects, especially in showing the importance of identifying key actors in material utilisation, as well as typical value network-related problems, such as missing actors and the lack of information transactions between actors. Key managerial implications include:

- (1) Importance of detailed planning in the front-end of a demolition project: This is one of the most crucial steps in ensuring a successful demolition project, and more resources should be invested in this phase.
- (2) Value creation should be viewed at the system level and new collaborative structures that support the development of demolition project practices and near-site utilisation are needed.
- (3) Coordination practices between demolition projects and new build projects need to be developed. The demolition project should be considered as the front-end phase of a new build project, which also requires changes to the established project lifecycle models.

- (4) Ensuring data flow and preservation can support near-site utilisation of demolition materials. The data flow has a vital role in enabling the transactions in the value network.
- (5) Project governance practices must be developed so that the CE principles are considered in the design phases of projects; incentive structures and KPIs that advance the integration of CE principles into project management practices are needed.

The conducted empirical studies included four independent cases in a single country and represent a small sample of cases in a similar geographical, legislative and operational settings. Thus, this study's limitations are in the generalisability of the results in a wider setting and further research would be needed to test the generalisability of these findings in other countries, legislative environments, etc. Conducting similar studies in other areas of construction and demolition, or even in other business sectors, would also provide better insights into the generalisability of the results. Furthermore, the interviewees mainly represented the ownership or intermediary functions of construction and demolition, and therefore, further research should also be conducted from the operational and legislative points of view on the subject. As design implications were found in this study, but no architects, HVAC engineers, or other building design-related professionals were interviewed for this study, further research should be conducted on the design of buildings that enable the circular utilisation of them at EOL. Studying the value propositions and transactions from the design phase to EOL would have implications in finding the economic and ecological optimisation of resource use in construction and demolition. Also, the role of BIM systems in preserving data transactions from different phases of buildings' lifespan was not discussed in the interviews and should be researched in future studies, as well as how established information transactions between legislative actors affect the utilisation of demolition materials.

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## Appendix 1

### Interview guide – near-site utilisation of demolition materials: a value network analysis

#### Interviewee background

What is your role in your background in demolition, what organisation do you represent and what are your responsibilities?

- Please describe the organisation/company you represent?
- What has your role been in demolition cases?

#### Case description

Actors involved in the demolition case and their roles.

- (1) How was the tendering done for the demolition project?
- (2) Were circular economy goals set for the project?
- (3) Other goals, requirements or preconditions?
- (4) What other actors were/are involved in the demolition? What roles did these actors have?
- (5) Were any of the actors mentioned especially important or hard to replace in the demolition project?
- (6) Can actors outside the demolition project affect the project? (e.g., citizens, organizations, companies not involved in the demolition project or public actors)

The demolition project.

- (1) How was the demolition project started?
- (2) What was the assignment?
- (3) What kind of contract was done? (total price contract, cost-plus-fee contract, etc.)
- (4) How was the project monitored?
- (5) How much and what kind of previous collaboration have you had with this project owner? (if project owner not being interviewed)

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- (6) What problems were detected during the demolition phase? What problems usually arise in it?
- (7) How are/were the demolition materials handled and why were they handled that way? Were materials reutilised?
- (8) What kind of challenges were present in the reutilisation of materials? Were materials sorted on-site and how?
- (9) Was the reutilisation of materials successful? What factors enabled success in it? What would you do differently?

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Detailed description of demolition process.

- (1) What phases did the demolition process include and what actors were present in them?
- (2) Did those include any actors that were especially important or hard to replace for the demolition project?
- (3) How long did the demolition process (and the different phases of it) take?
- (4) Were asbestos and/or hazardous materials studies made on the demolition site? Were any other studies/measurements made?
- (5) Was a demolition study done of the demolition site? If so, how did the study and its results affect the demolition project?
- (6) Were demolition materials sorted on site? How, and what materials were sorted and where? What amounts of materials were collected and where were they delivered to? What was mandated by legislation and what by the project owner?
- (7) How were brick and concrete structures dismantled? How were the waste materials handled and where were they delivered to? How was it utilised (e.g., on-site utilisation, did the receiver of materials utilise it in some way?) Were samples taken of the materials?
- (8) What are currently the largest issues in handling materials containing asbestos or other hazardous materials?
- (9) What would be ideal solutions to these issues in your opinion?

Summary of challenges and best practices.

- (1) What do you see as positive traits in the demolition practices in the case in question?
- (2) What challenges arose and what how the demolition process could be improved?
- (3) Were there challenges in the planning, contracting and permitting activities in the project?
- (4) Were there challenges in project coordination, information flow and collaboration between actors.

### **Thoughts on new practices in near-site utilisation of demolition materials**

Questions about the industry, practices in the industry and development needs.

- (1) What kind of changes do you see will happen in the industry in the future?
- (2) What do these changes require to realise?
- (3) On what timescale do you see these changes realising in?
- (4) How do these changes affect your work/company/organisation?
- (5) Who do you think are important actors in developing new operating models in demolition?

**Source(s):** Authors' own creation/work

**Appendix 2**

The recognized value transactions between actors are listed in [Table A1](#). The Actor column designates the originator of the listed deliverable, the To column designates the actor(s) the value is being created to and the Requires column specifies what preconditions are required for the value transaction to take place.

**Table A1.** Recognized transactions between value network actors

Case	Actor	Deliverable	To	Requires
Case A	Consultant	Demolition materials studies	Project owners	Money, material input, legislative boundaries
Case A	Laboratories	Asbestos and hazardous materials analyses	Project owners, contractors	Money, material input
Case A	Consultant	Contract terms for reaching CE goals	Project owners	Money, information about the project
Case A	Project owner	Circular economy goals	Consultants, contractors	Information about the industry
Case A	Pre-demolition contractor	Removal of usable materials from site before demolition	Project owners, contractors	Time allotted for pre-demolition
Case A	Environmental permit officials	Environmental permits	Project owners	Knowledge and documentation
Case A	Project owner	Sufficient time allotted to different phases of demolition	All other actors	Knowledge on how long different project phases might last
Case A	Contractor	Well-executed demolition material sorting	Project owners	Supervision and assimilation of CE practices in demolition
Case A	Asbestos removing contractor	Safe removal of asbestos	Contractors	Knowledge on location of asbestos-containing materials
Case A	Consultant	Demolition planning	Contractors	Knowledge on location of asbestos and other hazardous materials, knowledge on the project and building
Case A	Concrete crushing (sub) contractor	Demolished concrete in a more usable and efficiently transportable form	Contractors	Machinery that can crush concrete on site without disturbing surroundings
Case A	Project owner	Coordination of the project	All other actors	Knowledge about demolition projects
Case B	Zoning officials	Land utilisation possibilities	Public and private actors	Input from other actors
Case B	European union	Funding	Public and private actors	Reporting
Case B	Consultant	Demolition materials studies	Project owners and contractors	Money, material input, legislative boundaries
Case B	Laboratories	Asbestos and hazardous materials analyses	Project owners, operational actors	Money, material input
Case B	Finnish heritage agency	Protection status of buildings	Real estate owners, the general public	Legislative input, proof of architectural significance
Case B	Project owner	Funding for actors involved in the project	All operational actors in the value network	Financial input
Case B	Contractor	Demolition materials	Road and infrastructure contractors	Incentive from project owner
Case B	Laboratories	Environmental sample taking	Project owners	Money

(continued)

Table A1. Continued

Case	Actor	Deliverable	To	Requires
Case B	Centre for sustainable development	Utilisation of unsold pre-demolished materials	Project owners	Materials
Case B	Technical real estate management	Money from selling pre-demolition materials	Technical real estate management	Sellable materials from pre-demolition
Case B	Contractor	Demolition work	Project owners	Money
Case B	Contractor	Knowledge and experience from previous projects	Project owners, consultants	Experience
Case B	Consultant	Contract terms for reaching CE goals	Project owners	Money, information about the project
Case B	City traffic officials	Project collaboration	Project owners	Incentive from city officials
Case B	Other cities' public information	Benchmarking	Project owners	Available data
Case B	Environmental permit officials	Environmental permits	Project owners	Knowledge and documentation
Case B	Designer of buildings to be demolished	Information about materials and structures	Contractors	Up-to-date documentation
Case B	Remodelling contractors	Information about materials used	Contractors	Up-to-date documentation
Case B	Project owner	Information about project for all actors	General public	Communication channels
Case B	Legislation	Operational environment for all actors	All other actors	Knowledge, feedback from public
Case B	Trade unions and organisations	Information about new practices	Project owners, contractors, consultants	Information about the industry
Case C	Remodelling contractors	Information about materials and structures	Contractors	Up-to-date documentation
Case C	Contractor	Operational safety	Hospital staff and patients	Communication, Meticulous demolition planning
Case C	Laboratories	Asbestos and hazardous materials analyses	Project owners, contractors	Money, material input
Case C	Consultant	Asbestos and hazardous materials analyses	Project owners, contractors	Money, input from laboratories
Case C	Project owner	Contract terms for demolition	Contractors	Input from other members of the project alliance
Case C	Contractor	Dependable operational performance	Project owners	Clear contract terms, trust between actors
Case C	Consultant	Investigation on usable HVAC equipment and other machinery	Project owners	Information of machinery on the site
Case C	Outside private organisations	Utilisation of disassembled structures	Project owners	Willingness to pay for careful demolition, ability to utilize the materials safely in accordance with building code
Case C	Project owner	Delivery of safe and functional new hospital premises	End users	Communication, use of safe materials
Case C	Legislation	Operational environment for all actors	All other actors	Knowledge, feedback from public

*(continued)*

Table A1. Continued

Case	Actor	Deliverable	To	Requires
Case C	Trade unions and organisations	Information about new practices	Project owners, operational actors	Information about the industry
Case C	Regional state administrative agency	Requirements on operational practices	Project owners, operational actors	Information about the industry
Case C	Hospital staff	Requirements on the effects of demolition	Contractors	Communication
Case C	The general public	Acceptance of the project	Project owners	Communication, working in accordance of all legislation and project plans
Case C	Construction supervision officials	Acceptance of structures and construction methods	Project owners	Communication, information about structures and construction practices
Case C	Project owner	Project delivery on time, on budget, and within specifications	Project financiers and site owner	Communication, good collaboration between all actors
Case D	Finnish heritage agency	Protection status of buildings	Real estate owners, the general public	Legislative input, proof of architectural significance
Case D	Contractor	Demolition work	Project owners	Money, experience on similar projects
Case D	Project funder	Financial commitment to project	Project owners	Outlook on financial return on interest, suitable sustainability metrics (certificates)
Case D	Laboratories	Asbestos and hazardous materials analyses	Project owner, contractors, consultants	Money, material input
Case D	Consultant	Demolition planning	Project owners, contractors	Knowledge on location of asbestos and other hazardous materials, knowledge on the project and building
Case D	Consultant	Project planning	Project owners, contractors	Knowledge on the project and its timeline
Case D	Environmental certificate granting officials	Environmental certificate	Project owners	Information about the project
Case D	Contractor	Material recycling	Project owners	Materials from demolition site, a designated reuse for materials
Case D	Refurbisher of removed items	Refurbished lamps, door handles, etc.	End users	Items removed carefully from site, end-user need for refurbished old items
Case D	Property owners in the vicinity of the project	Acceptance of project	Project owners	Expectation of development of the area
Case D	General public	Acceptance of project	Project owners	Communication, positive media coverage

Source(s): Authors' own creation/work

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