IMPLEMENTING THE DESIGN FOR DISASSEMBLY (DfD) PRINCIPLE IN THE PUBLIC PROCUREMENT PROCESS OF BUILDINGS IN THE NETHERLANDS.

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IMPLEMENTING THE DESIGN FOR DISASSEMBLY (DfD) PRINCIPLE IN THE PUBLIC PROCUREMENT PROCESS OF BUILDINGS IN THE NETHERLANDS.

By
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PREFACE

This is the Master's thesis report written for obtaining the degree MSc in Construction Management and Engineering from TU Delft, Netherlands. The objective of this thesis was to conceptualize a system for implementing the Design for Disassembly principle in the public procurement process of buildings in the Netherlands to achieve circular ambitions. This research was conducted with the help of the organizations Royal HaskoningDHV and Rijksvastgoedbedrijf.

Before starting this research, I was unaware of the word “circular economy”. When I read about this term for the first time, I realized how interesting the topic was and how necessary it is for the world to transition to CE. This was when I decided I would do my research on Circular Economy. Throughout the journey of my thesis, I have become more and more passionate about this concept and I would love to take up another opportunity to work more on the same. My thesis also inspired me to implement some of these principles in my day to day life. I also now try encouraging people around me to practice them.

The journey of my thesis was like a roller coaster with a lot of ups and downs. But every up and down that I encountered taught me a new lesson. This just did not just make me learn more about the concept of Design for Disassembly and Circular Economy, it also taught lessons for my life. It made me a stronger person in general and helped me understand how to deal with tough situations.

This quality of my thesis definitely could have not been achieved without the help of my graduation committee. I would like to firstly thank my chair Prof. Marleen Hermans who has given me invaluable feedback to improve my report. Every meeting with her gave me a totally different perspective which I had never considered before. Furthermore, I would like to thank Bart Gundel for accepting to be the first supervisor and for helping me out by having numerous meetings throughout the journey. I would like to also specially thank Daan Schraven. Though he started as the second supervisor, he provided me immense help and guidance in the last months of my research by taking time out of his busy schedule.

The objective of this research definitely could not have been reached without the help of the organizations Royal HaskoningDHV and Rijksvastgoedbedrijf. I would like to thank my company supervisors Ellis ten Dam, Rob van Roon and Ad Heeman for providing me with the cases, the case study material, the contacts of the right people, the guidance and support throughout the journey of my thesis. They always stood by me and encouraged me to give my best. I would like to also thank Bert Alberts and Jille Koop for their help in my research.

Finally, above all, I would like to thank my parents and my sister for immense encouragement and support. Their encouragement and motivation helped me give my best at every point of my Masters. I would like to also thank my flatmate Nagarjun Reddy for always being there for me throughout this journey. Lastly, I would like to thank my friends Yash, Abhishek, Atul, Nikhil, Khyathi, Jyotsni, Pratul, Harsh, Ragav, Swarna, Asmeeta, Sai Pranay, Akshaya, Sumant and Naga Gautham who always provided me with the ever needed support throughout my Master’s journey.

Enjoy reading the report!

Akshay
Delft
8th May 2020

SUMMARY

The construction industry is tainted as unsustainable, and there is a need to switch to a Circular Economy. Circular Economy is a concept that is based on regenerative principles and reuse of raw materials. This transition to a CE could be brought about by public clients by incorporating it in the public procurement process. The public client, while procuring buildings has a unique opportunity to implement CE and its principles. Out of the principles, the Design for Disassembly (DfD) principle is considered useful for the fundamental inclusion of CE in buildings. This principle refers to the method of designing a building that facilitates adaptation and eventual dismantlement for recovery of systems, components and materials. Therefore, the public clients need to stimulate the implementation of DfD in the buildings that they procure to stimulate the transition to CE.

This stimulation, however, is heavily underexploited, and there is a lack of implementation of DfD in the procurement process. This is supported by the fact that less than 1 percent of the existing buildings is demountable and that DfD is not a mainstream topic. Also, even though DfD has existed in practice for three decades, these existing practices of DfD are far from reaching its waste minimization potential, and they can benefit from further implementation. *Provided the above, this study focuses on the problem for public clients who appear to have insofar lacked an effective and clear system to implement DfD in the procurement process to achieve circular ambitions.*

The objective of this research is to conceptualize a system for the implementation of the DfD principle in the public procurement process of buildings in the Netherlands and study the implementation of the DfD principle in the procurement process of known circular buildings in the Netherlands to refine the conceptualization. To achieve this objective, the research question that will be answered is "***How should the implementation of the DfD principle be conceptualized in the public procurement process of buildings in the Netherlands? "***

The research approach firstly involved conducting a literature study to conceptualize a procurement process for the implementation of the DfD principle. This was done by adding the important aspects of the DfD principle to the general procurement process followed for buildings. This DfD based procurement process derived by literature is depicted in Figure A below:

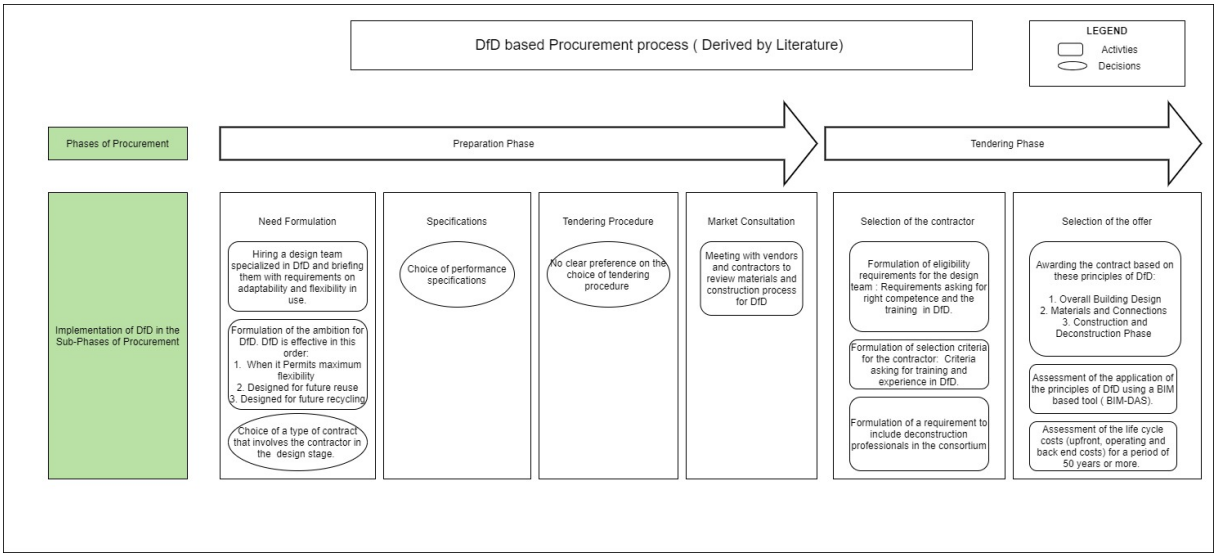

Figure A: Conceptual Framework as derived by literature (own illustration)

The main findings from the literature study are: In the need formulation phase, the client needs to hire a design team specialized in DfD. The design team needs to set the ambition for DfD based on the consideration that DfD is most effective when it allows for maximum flexibility. Beyond that, they need to design for future reuse and only when it is not possible, resort to future recycling. The client needs to choose a type of contract that involves the expertise of the contractor in the design phase.

In the selection of the contractor phase, the client needs to set eligibility requirements for the design team asking for the competence and experience with DfD. Also, the client can set selection criteria for the contractor asking for experience with DfD. The client also needs to set a requirement to include the deconstruction professionals in the consortium to ensure that they are involved from the design phase of the project.

In the selection of the offer phase, the client can award the contract based on certain principles of DfD that act as a design guide for DfD and indicate how effectively the DfD principle has been implemented in the design. These offers can be assessed for the application of these principles using BIM-based tools. Also, the client can assess the costs of offers using the life cycle costs (upfront, operating and backend costs).

Once the literature study was completed, two case studies were conducted to understand how public clients are implementing DfD in the procurement process. The two cases were “The Temporary Court House” and “The Circular Pavilion”. These cases were studied by conducting explorative interviews with the personnel involved in the procurement process (both from the client's side and the contractor’s side) and by studying the important documents pertaining to procurement. The interview questions asked how they implemented DfD in every phase of procurement and also based on their experience, how are they planning to implement it better in future projects. Once these case studies were completed, individual case reports were written. These individual case findings were confirmed by conducting a confirmation meeting with some of the previously interviewed personnel for the case study. The candidates in the confirmation meeting confirmed the findings for both the cases and mentioned that it was representative of how the cases were conducted.

After the confirmation meeting, a cross-case analysis was conducted by finding out the similarities and differences between the cases. Based on this cross-case analysis, the main findings of the case study are (Figure B):

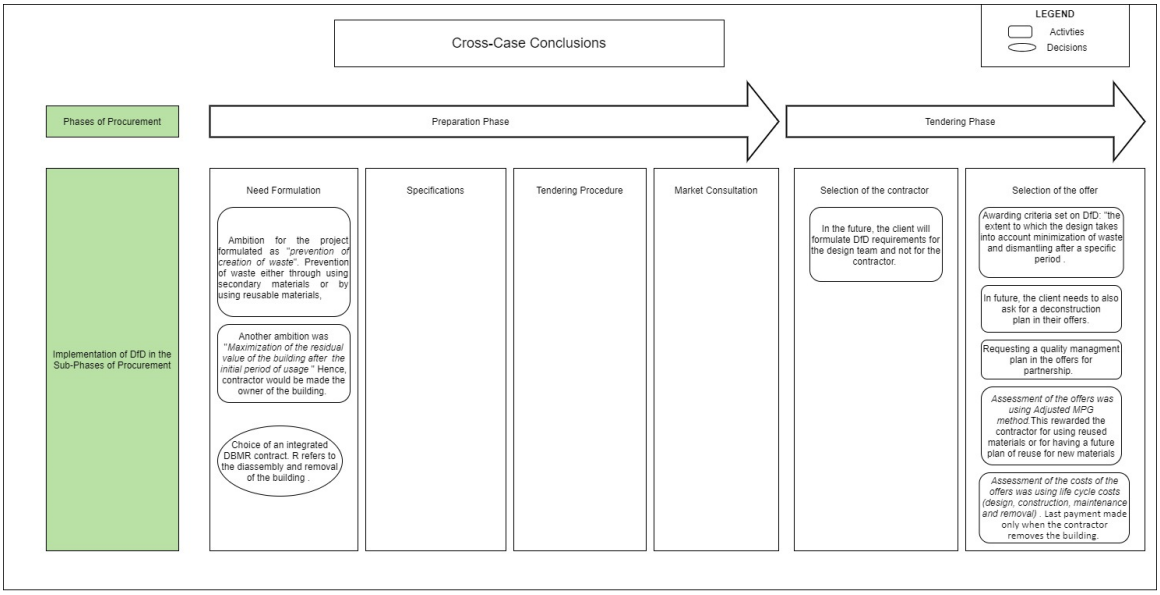

Figure B: Cross-Case Conclusions (own illustration)

In the need formulation phase, the client formulated an ambition for minimization of the creation of waste. The client encouraged the contractor to design for reuse (and also use secondary materials). The client also made the contractor the owner of the building to ensure the contractor is financially stimulated to reuse the building after its period of usage. Also, the client chose the DBMR integrated contract, where R refers to the removal and disassembly of the building.

In the tendering phase, for the selection of the consortium, the client mentioned that they would set requirements for the design team and not for the contractor as it is essential for the design team to have experience with DfD to work on a project on DfD.

For the selection of the offers, the client had an awarding criterion that checked the extent to which the design minimized on the creation of waste. Mention was also made about the importance of asking for a deconstruction plan in the offers as this stimulates the designer to think on how they can undo their work. Also, in the offers, the client can ask for a quality management plan where the strategy for co-operation with the client is worked out by the contractor. This is needed as there might be quite some innovations and uncertainties involved in the project on a DfD.

For the assessment of the offers, the modified MPG method was used. This rewards the contractor for using secondary materials or biomaterials, and if new technical materials are used, the method rewards for the future plan of reuse and its credibility. For the assessment of the costs, life cycle costs were used. Also, an arrangement was made such that the last payment is made only when the contractor removes the building.

When the case study results were discussed, the results of the need formulation phase, selection of the contractor phase and the selection of the offer phase were partially reflective of the theoretical results (in the conceptual framework). Some of the main points from the discussion were: firstly, the ambition of the client in the case study was to design for future reuse, and they did not consider adaptability. The reason was that the cases studied were temporary in nature, and hence function would remain the same.

Secondly, the client assessed the offers only on one material principle of DfD. The client did not assess the offers for other principles of DfD, thereby, not assessing how effective the design was for disassembly. The reason for this could be that in the case study, the contractor was responsible for the disassembly of the building. For the same reason, the client might have not set requirements to include deconstruction professionals in the consortium, which would have ensured their involvement in the design. Also, the cases had completed only the design and construction phase of the life cycle. Therefore, the client is yet to see how the disassembly phase takes place and how they could have better influenced this removal phase through the procurement process. Thereby, the cases were only partially reflective of a DfD based procurement process.

Based on the comparison between the empirical results and the conceptual framework, the conceptual framework was refined. A decision was made to refine the conceptualization to include only the key activities or decisions that contributed to the DfD implementation.

Though there were some new activities that were found in the cases which were not present in the conceptual framework, they were not added to the conceptual framework. Firstly, the new finding was the choice of a DBMR contract. However, this did not imply this was the best type of contract for DfD implementation. The second new finding was making the contractor the owner of the building. However, this did not individually contribute to the implementation of the DfD principle. The third new finding was asking for the quality management plan. However, this is valid only for a certain period of time until DfD becomes a mainstream topic. The fourth new finding was for asking for a future plan of

reuse. Though this is a good solution for CE, this does not offer the best strategy for achieving circular ambitions. Hence, none of these activities was added to the conceptual framework.

Also, from the case study, the key activities contributing to the implementation of the DfD principle were from the need formulation phase, selection of the contractor and the selection of offer phase. Therefore, the activities or decisions from other sub-phases were removed from the conceptual framework as they did not individually contribute to the implementation of the DfD principle. They could be applied only as an addition to these other important activities. The updated conceptual framework is depicted in Figure C.

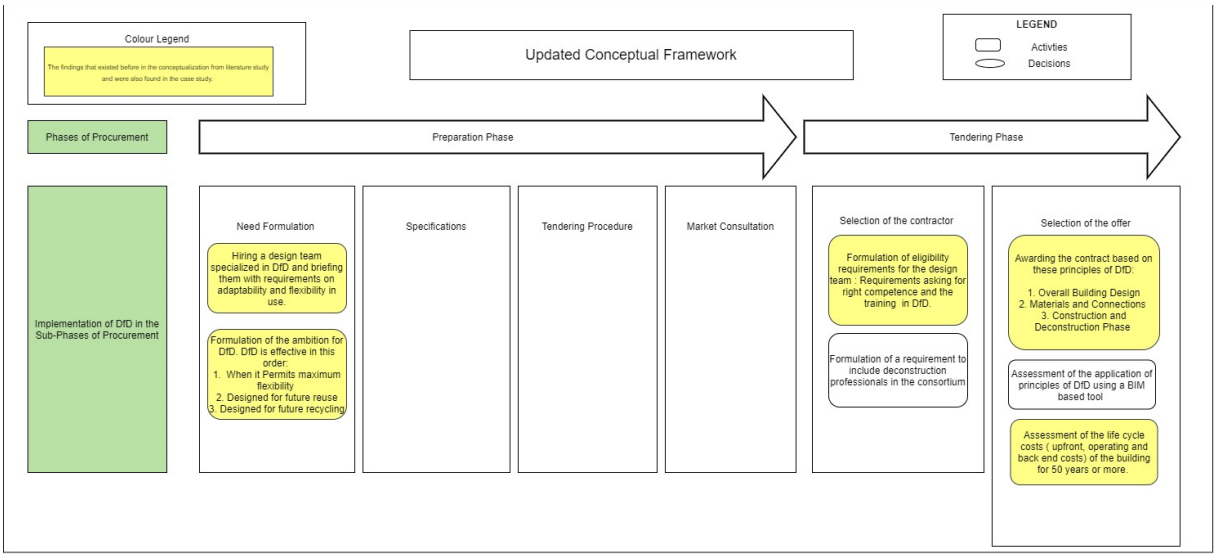

Figure C: The conceptual framework updated after the case study (own illustration)

The most important conclusion was that implementing DfD in the public procurement process does not bring a fundamental change in how a general public procurement process is conducted. This implies that implementation of DfD did not bring in any addition of a new phase or significant changes to the already existing phases. Only the activities that were conducted or the decisions that were taken in some of the phases were made in line with DfD.

The main limitation of the research was that only two cases could be studied due to time constraint and also from the same client, therefore, this research did not provide an approach that could be generalized for the public procurement process as a whole. A recommendation was made to conduct similar research on more number on cases and from different clients.

Another limitation was that both the cases studied were temporary in nature. Therefore, they did not consider the adaptability feature in the building, and some of the activities that were adopted in the procurement process could be adopted only for a temporary building. Therefore, a recommendation was made to study the implementation of DfD for permanent buildings.

Finally, both cases adopted an integrated way of contracting. Therefore, only the approach that is suitable for an integrated contract could be studied. A recommendation was made to study the implementation of DfD for the traditional way of contracting, which is often used by public clients.

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CE Circular Economy
DfD Design for Disassembly

1 INTRODUCTION

In the Netherlands, the construction industry accounts for 50 per cent of the total raw material usage and produces 40 percent of the total waste generated (Government of the Netherlands, 2019). This current rate of consumption already requires 1.5 Earths to sustain and suffice the entire population (ING, 2015). One of the reasons for this is the linear nature of the construction industry (Macarthur, 2012). The current practice in construction considers the assembly of materials and the components of a building as a unidirectional practice, or linear, with the single goal to construct a building (Crowther, 2005). Thereby utilizing the aforementioned amount of raw materials and demolishing it after use. In essence, this behaviour by the sector has placed unprecedented pressure on natural resources (Arup Foresight, 2016) and has left the construction industry stained as not-sustainable in the long run (ING, 2015).

In essence, there is a need to treat materials and building with a more restorative and cyclic economic mindset (Ellen MacArthur Foundation, 2013b). This mindset is proposed in the concept known as the Circular Economy (CE) (Ellen MacArthur Foundation, 2013b). This concept focuses on the reuse of raw materials and the restorative capacity of natural resources (Bastein, Roelofs, Rietveld, & Hoogendoorn, 2013). The transition to a circular economy is particularly crucial for the building industry because it offers significant opportunities to reduce its adverse environmental impacts (Pomponi & Moncaster, 2017). For example, reusing materials can reduce the consumption of new raw materials or on energy, creating less waste and greenhouse gas emissions (Pomponi & Moncaster, 2017). Furthermore, buildings are unique entities, as they are often the results of one-off projects. This feature adds to their inherent complexity, where each of the materials used has its own specific life cycle, and all interact dynamically in time. Also, their long lifespan, and changes of use during their service life, lead to increased uncertainty about future scenarios (Pomponi & Moncaster, 2017). Therefore, the application of CE to the building industry plays a crucial role.

One of the biggest influential parties in the building industry that could help the transition towards a CE is the government (Bastein et al., 2013). One of the ways through which the government can stimulate this transition is through the public procurement process (Bastein et al., 2013; European Union, 2015). Public procurement is the process by which public authorities (government departments, regional and local authorities governed by public law) purchase works, goods and services from companies (European Union, 2015). The Dutch government procures around 73 billion of works, goods and services every year (Piano, 2019a) and publishes around 800 tenders for design, build, maintenance or demolition of works in the built environment (Hardeman, 2013). Hence, the Dutch government is responsible for a significant amount of work in the Netherlands and incorporating CE in public procurement can play a pivotal role in the transition to the CE in the built environment (Chao-Duivis, 2018; European Union, 2015; Jones, Sohn, & Bendsen, 2017; Philips, 2019).

To incorporate circularity in the procurement process, the principles of the CE need to be considered. An overview of the principles of the CE (Schut, Crielaard, & Mesman, 2015) is shown in Table 1.

Table 1: Principles of the circular economy on buildings (Schut et al., 2015, pg 22)

Principle	Explanation
Low Material Design	Focuses on the usage of fewer materials for construction which ultimately leads to reduced waste creation and reduced adverse environmental effects
Adaptive Design	Focusses on designing the building that can be adapted to meet the different requirements over time

Design for Disassembly	A method of designing a building taking into consideration that valuable elements or materials can be disassembled for its reuse or reconfiguration
Design for Recycling	Process of designing the building considering the recyclability of materials.
Material Passports	For material or a product to be reused at the end of the life cycle of the building, sufficient information is required about its composition and the quality. This information must travel with the product with time, and this can be provided using the "Material Passports."

When a public client is procuring new buildings, it has a unique chance to adopt CE and its principles completely anew. Out of all the principles of CE in Table 1, the Design for Disassembly (DfD) principle is especially useful for fundamental CE inclusion inside a building (Ellen MacArthur Foundation, 2013a). In fact, in order to easily restore the materials used in the building and reuse (or recycle) them, the building has to be designed from the outset for disassembly (Crowther, 2005; Ellen MacArthur Foundation, 2013a). The DfD principle looks at the design stage as to how the building and its materials can be easily disassembled. Applied in this way, the life cycle of a building ends with the disassembly of the building instead of demolition (Crowther, 2005).

In addition, DfD provides an opportunity to adopt a modular design and modular construction (Densley Tingley, 2012). It reduces the consumption of raw materials and the creation of wastage on-site (Ellen MacArthur Foundation, 2013a), leading to low material design. The DfD principle also enables adapting the building as per the needs of the user, thereby encouraging adaptive design (Rios, Chong, & Grau, 2015). Finally, the DfD encourages the preparation of material passports for components and materials as it will be required to reuse the recovered components in the future. Therefore, the DfD principle contributes to the other principles of CE, and this makes DfD suitable for fundamental CE inclusion inside a building.

1.1 Problem Statement

In the Introduction, it is argued that public clients need to stimulate the implementation of DfD in the buildings that they procure to stimulate the transition to CE. This stimulation is, however, heavily underexploited. On this note, a study by Kanters (2018) found that less than 1 percent of the existing buildings are fully demountable, and DfD is not a mainstream topic. On the side of the public client's influence, it has been pointed out that not enough is done. Akinade et al. (2017) point out that one of the reasons for this is the lack of implementation of DfD in the procurement process. Hence, the procurement function can contribute more significantly to successfully adopting DfD principles into future buildings.

Next to this further need for research to implement DfD through procurement, it is also worth noting that the DfD concept has a lot to offer. Specifically, the concept of DfD has been around in practice for three decades. Despite that time, the existing practices can still benefit from further implementation. On this, Akinade et al. (2017) mention that existing practices are far from reaching their waste minimization potential with the help of DfD.

Provided the above, this study focuses on the problem for public clients who appear to have insofar lacked an effective and clear system to implement DfD in the procurement process to achieve circular ambitions.

This research is novel in itself. More in general work by Alhola et al., (2018) and Sönnichsen & Clement (2019) point out that there has been limited research conducted on how to implement principles of circular economy in the procurement process altogether.

1.2 Research Objective

The objective of this research is to conceptualize a system for the implementation of the DfD principle in the public procurement process of buildings in the Netherlands and study the implementation of the DfD principle in the procurement process of known circular buildings in the Netherlands to refine the conceptualization.

1.3 Research Question

How should the implementation of the DfD principle be conceptualized in the public procurement process of buildings in the Netherlands?

1. *What are the potential areas within which the DfD principle can be implemented into the public procurement process of buildings in the Netherlands?*
2. *How can the implementation of the DfD principle be captured in a public procurement process of known circular buildings in the Netherlands?*
3. *How is the DfD principle implemented inside the public procurement process of representative circular building projects in the Netherlands?*
4. *What are possible implications for the public procurement process when changing its practices as guided by the DfD principle?*

1.4 Research Approach

The methodology (Figure 1) will firstly involve conducting a literature study to understand the general public procurement process followed for buildings in the Netherlands. Later, a literature study will be conducted on the aspects of DfD principle that are important for the procurement process. Using the general procurement process as a basis, the results of the literature study on the DfD principle will be added to it, and a procurement process will be conceptualized for the implementation of the DfD principle. This forms the conceptual framework of the research. Ven (2007) suggests that a “how” research question be studied using a process model where it narrates a plot in the form of a sequence of events that occurred in the chronological order. Therefore, the conceptual framework of this research will be framed in the form of a process model where it explains and depicts the plot of the DfD based procurement process as a sequence of phases in the chronological order.

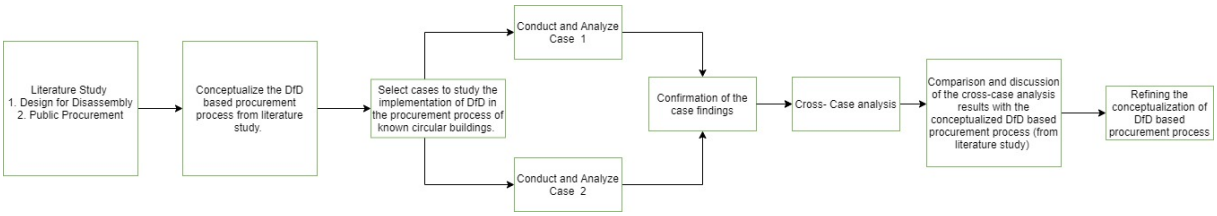

Figure 1: Research Methodology (own illustration)

The next part of the research involves studying how public clients have implemented DfD in known circular buildings. Yin (2008) suggests that the case study approach is suitable when: firstly, the research has to answer "how" or "why" questions, secondly, when no control is required on the events that are studied and thirdly when the focus is on contemporary events.

In this research, the question focusses on knowing "how" the public clients have implemented DfD in the procurement process. Secondly, this study does not intend to have control while studying the public procurement process of the clients. Finally, the focus of this research is on DfD to achieve circular ambitions, which is a contemporary phenomenon. Thereby, the case study approach will be adopted for this research.

Two case studies will be conducted to understand what approach is being followed for the implementation of DfD in the procurement process. These cases will be studied by conducting explorative interviews with personnel involved in the procurement process (from both contractors and the client's side) and by studying the procurement documents. The findings of each case study will be later confirmed by conducting a meeting with previously interviewed candidates for the case study. Later, cross-case conclusions will be drawn by comparing the findings of individual case studies.

Furthermore, results from the cross-case analysis will be discussed and compared to the conceptual framework. Finally, based on this discussion, the conceptual framework will be refined.

1.5 RESEARCH SCOPE

This research looks at the implementation of DfD for ***non-residential buildings*** (Figure 2) such as offices and courts. In the Netherlands, the non-residential buildings are being demolished and downcycled (reduction in quality). They are being used as the foundation material for the construction of infrastructure (roads, hydraulic structures) (Schut et al., 2015). Therefore, there is a need for applying DfD principle on non-residential buildings for stimulating the transition to a CE (Government of Netherlands, 2016). Also, two cases studied for this research were non-residential buildings. Since, only by studying these cases, the conceptualization of the DfD based procurement process could be refined, the scope of this research was chosen as non-residential buildings.

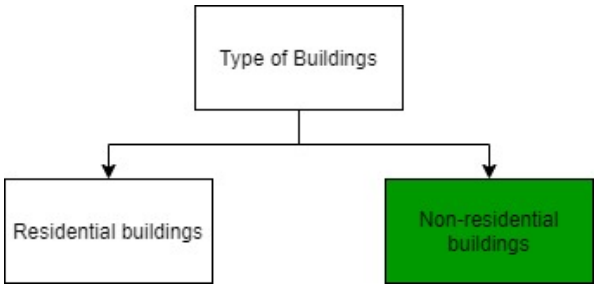

Figure 2: Focus on Non-residential buildings (own illustration)

The procurement process can be mainly conducted in two ways: the traditional method or the integrated method. In the traditional method, the client provides the design to the contractor and the contractor is responsible only for the construction. In the integrated method, the public client makes the contractor responsible for both the design and construction (and/or maintenance) of the building (E.D. Love, O'Donoghue, R. Davis, & Smith, 2014). The two cases studied for this research adopted integrated contracts in the procurement process. Therefore, the focus of this research is only on ***integrated contracts*** (Figure 3). The conclusions of this research provide an approach for the implementation of DfD that is applicable for integrated contracts.

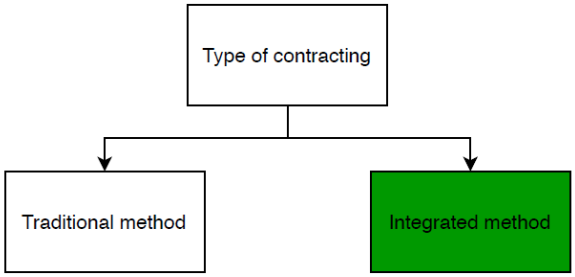

Figure 3: Focus on integrated contracts in this research (own illustration)

1.6 SCIENTIFIC RELEVANCE

There has been limited research conducted on the implementation of principles of CE in the procurement process (Alhola et al., 2018; Sönnichsen & Clement, 2019). This research fills this knowledge gap by conceptualizing a system for the implementation of the DfD principle in the public procurement process for buildings. This research is unique compared to the earlier research for two reasons, firstly, due to its focus only on the DfD principle of circular economy and secondly, due to its total focus on buildings. This total focus on buildings helps in understanding the approach that is more suitable for buildings, thereby contributing better for achieving the ambitions of CE.

1.7 PRACTICAL RELEVANCE

The government of the Netherlands wants to achieve 100 per cent CE in the construction sector by 2050 (Government of the Netherlands, 2016). To achieve the same, the government needs to construct buildings that are designed from the outset for disassembly (Ellen MacArthur Foundation, 2013a). There arises the need to implement DfD in the public procurement process (European Union, 2015).

This research aims to conceptualize the implementation of DfD principle in the public procurement process. Thereby, this research will help the public clients in the implementation of DfD principle in their procurement process for their future projects to achieve CE.

2 LITERATURE REVIEW

This chapter explains the results of the literature study conducted on the different phases of public procurement and the DfD principle. Based on these results, a conceptual framework is proposed that explains how the DfD principle can be implemented in the different phases of public procurement.

Section 2.1 explains the different phases of public procurement, and in section 2.2, the different concepts of DfD principle are introduced. Finally, in section 2.3, the conceptual framework is explained.

2.1 PROCUREMENT

This section provides an overview of the literature study conducted on procurement. The procurement process is described in the form of a process model. This model will explain the different phases involved in public procurement (for integrated contracts) of buildings in the Netherlands in chronological order.

In section 2.1.1, an introduction to the public procurement process is given, and later, the different phases of public procurement are explained in section 2.1.2.

2.1.1 Public Procurement

As explained in the introduction, Public procurement refers to the acquisition of goods and services required by government institutions (Kodym & Kiiver, 2014; Manunza & Schotanus, 2018). It refers to the process that is followed from the formulation of the need and drawing of specifications until choosing the right contractor and awarding the contract to them (Chao-Duivis et al., 2017). Public procurement can be divided into three categories: supplies, works and services (Chao-Duivis et al., 2017). *Supplies* refer to the buying of items like paper and pens (office supplies) computers, telecommunication hardware. The category of *works* mainly involves construction *work,* i.e. building of roads, buildings, bridges and other structures. Finally, the category of *services* generally involves the non-construction services like garbage collection, transport, insurance and cleaning services and also engineering consultancy services like preparing architectural and structural drawings (Boer & Telgen, 1998; Chao-Duivis et al., 2017; Piano, 2019c).

This research focuses on the procurement of buildings (works) as incorporating circular economy in the built environment offers significant opportunities for the reduction in the usage of energy, production of greenhouse gases and waste (Pomponi & Moncaster, 2017)

The different principles of public procurement, the European Directives and the Public Procurement Act 2012 have been explained in Appendix A: Public Procurement.

2.1.2 Phases of Public Procurement

In this section, the general phases or steps (Figure 4) involved in public procurement will be explained in detail. The procedure described below is for an ***integrated contract model.***

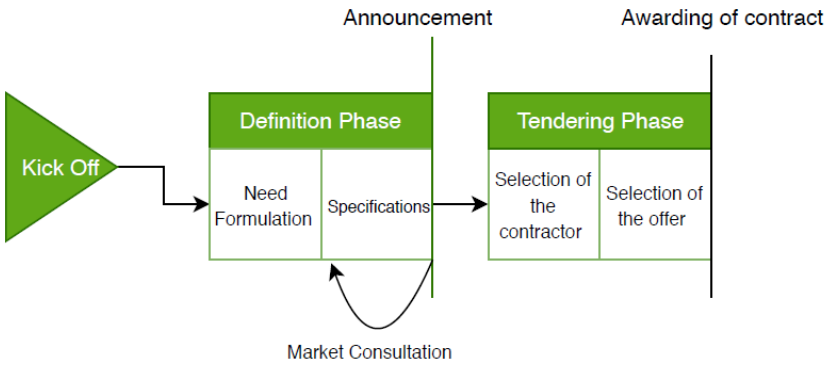

Figure 4: Phases of public procurement (own illustration)

1. *Kick-off*

This kick-off involves the creation of the procurement team for the project. A project manager is assigned for the project, and the project manager forms a team consisting of technical personnel and the procurement advisors (de Iongh, 2019). This team mainly consists of employees of contracting authority, and sometimes external experts are hired to join the team. The members of the procurement team need to have sufficient knowledge to prepare the tender documents, assess the offers and execute the procedure (van Veenen, 2018).

2. *Preparation/ Definition*

Preparation is the first phase of public procurement. In this phase, decisions are taken regarding the specifications for the project, type of project delivery method and the tendering procedure that will be followed. The preparation step consists of need formulation, specification, tendering procedure and market consultation. This is a crucial step, as the decisions taken during this step will have an impact on the result and the effectiveness of the tender (van Veenen, 2018).

a) Need Formulation

In this step, the procurement team formulates the need or wish. The procurement team determines what needs to be procured by the contracting authority. The scope of the project is defined, and the contracting authority takes decisions regarding when the project needs to be realized, the budget for the project, what activities can be performed inhouse and what activities need to be outsourced (van Veenen, 2018).

The scope of the project is defined in line with the goals or the ambitions that have been set for the project. The goals are then translated into critical success factors, suitability criteria, and awarding criteria for the selection of suitable suppliers (Capota & Castelein, 2019). For example, the project goal can be sustainability, and this can be translated as BREEAM certification as one of the critical success factors (de Iongh, 2019) .In the formulation of the need, the procurement team also needs to make sure it is formulated in line with the procurement policy of the organization if there is any followed by the organization (Haagen, 2018).

A risk assessment is also performed (based on the project goals) to identify what risks could be encountered in the project, what its frequency would be and its impact on the project. Then, a decision is made as to what risks the contracting authority would be responsible for and then later, the requirements for the project are framed based on this decision (Capota & Castelein, 2019).

Another decision that needs to be taken in this step is the type of contract that will be chosen for the execution of the project. The choice needs to be made between traditional and integrated contract (van Veenen, 2018). In the traditional contracts, contracting authority gives technical specifications (design) to the contractors, and they are only responsible for the design. The execution of the work is carried out by the contractors whereas, in the integrated contracts, the contracting authority provides functional specifications and contractor is responsible for both the design and execution (can also include maintenance) of the work (E.D. Love et al., 2014).

b) Specification

When the contracting authority decides what part of the need will be outsourced, the need has to be translated into requirements or specifications (Article 2.75 of AW). The tenders are later reviewed against these specifications, and this will be done to check the technical compliance of the tenders, i.e. to check if the contractors are offering what the contracting authority is asking for (Kodym & Kiiver, 2014). The need can be translated into two types of specifications (Article 2.76 of AW):

Technical specifications: When the contracting authority is using technical specifications, the requirements of the work is explained in detail. E.g., the dimensions or the properties of the product or the work will be given as specifications.

Functional or Performance Specifications: When the contracting authority is using these requirements, the intended function or the performance of the product or the work is given as the requirements. These requirements are less detailed than technical specifications, and they provide more room for innovation (Kodym & Kiiver, 2014).

The type of the specification is decided based on several factors such as type of the project, the capability of the contracting authority, the capability of the market (de Iongh, 2019). With any type of specifications, the contracting authority has to ensure they are non-discriminatory, transparent and proportional to the object of the contract.

c) Tendering Procedures

The contracting authority can make a choice between the sixteen different tendering procedures mentioned in the Works Procurement Regulations 2016 (Chao-Duivis et al., 2017). The most commonly used procedures are the open procedures, the restricted procedure and the competitive dialogue (de Iongh, 2019). These procedures are mainly differentiated by the type of contact that happens between the contracting authorities and the tenderers during the process and also on the number of tenderers whose tender is ultimately evaluated (Chao-Duivis et al., 2017). The most commonly used tendering procedures are explained in this section.

- *Open Procedure*

Open Procedure is the tendering procedure in which there is no limit on the number of tenderers submitting their tenders. In this method, both the tenderers and the tenders are assessed

simultaneously. The advantage of this procedure is that everyone in the industry is allowed to participate. However, the disadvantage is that the contracting authorities have to assess a large number of tenderers and their tenders (Chao-Duivis et al., 2017). The tendering procedure that needs to be followed for the open procedure is mentioned in Appendix A: Public procurement.

- *Restricted Procedure*

The characteristics of the restricted procedure are similar to that of the open procedure, but only a limited number of tenderers are allowed to submit a bid. In this procedure, initially, any number of tenderers can apply, but a pre-selection takes place where the contracting authority assesses the tenderers using objective selection criteria. Only the tenderers that meet the selection criteria in the pre-selection phase are allowed to submit a bid (Chao-Duivis et al., 2017). The tendering procedure that needs to be followed for the restricted procedure is mentioned in Appendix A: Public procurement.

- *Competitive dialogue*

The competitive dialogue tendering procedure was introduced in 2014. The first step of this procedure is to advertise the contract to invite all the interested participants. Then a selection is made from them based on certain objective selection criteria. After the selection, a dialogue is held with all the selected tenderers. The contracting authority can conduct the dialogue in certain phases and gradually reduce the number of tenderers based on certain award criteria. When the dialogue is completed, the tenderers that remain are allowed to submit their bid. The contracting authority must ensure that at the end of the dialogue, there are enough participants to ensure genuine competition (Chao-Duivis et al., 2017). The conditions under which the competitive dialogue procedure can be used, and the tendering procedure that needs to be followed for the competitive dialogue procedure is mentioned in Appendix A: Public procurement.

d) Market Consultation

The contracting authority needs to ask for the requirements that can be delivered by the market. In order to frame the right specifications, the contracting authority can decide to meet some suppliers (contractors) to find out what is currently available in the market (de Iongh, 2019). This gives an insight to the contracting authority on creativity, knowledge, innovativeness and experience of the market suppliers (Kodym & Kiiver, 2014). This outcome can also help the contracting authority to know what is the best approach for the procurement of the project (van Veenen, 2018).

The 2014 EU Public Procurement Directive explicitly states preliminary market research as a valid means for obtaining information provided it does not distort competition and violate the principles of transparency and non-discrimination. To ensure transparency in the process, the contracting authority needs to ensure the results of the market research are shared publicly (Kodym & Kiiver, 2014)

3. Tendering phase

When the preparation phase is completed, the contracting authority can invite the contractors to submit their offers. This phase starts with the announcement of the contract by the contracting authority on an online platform (Tender Net) (de Iongh, 2019) . Based on the information on the tender documents, the contractors can choose to apply or not. The selection process is divided into two phases: evaluation of the tenderer and the evaluation of the tender. The evaluation of the tenderer is based on the suitability and selection criteria, and the evaluation of the tender is made on the basis on

the award criteria. Before these two phases, the tenderers can be excluded from the process based on certain exclusion grounds (Chao-Duivis et al., 2017).

a) Grounds of exclusion

The grounds of exclusion ensure that the contracting authorities only work with honest players in the market and exclude the others from the process. The European Directive makes a distinction between mandatory and optional grounds of exclusion (Chao-Duivis et al., 2017). A mandatory ground of exclusion, for example, is the exclusion of tenderers who have been convicted of a criminal offence (mentioned in the regulations) in the last five years (Article 2.86 of AW). Referring to article 2.87 of AW, the contracting authority can apply certain optional grounds of exclusion if they feel that it is necessary for the project. Suppose the procurement process is taking place in a sector which is in poor financial condition, the contracting authority can choose to exclude all the tenderers who are on the verge of bankruptcy or the tenderers who have filed bankruptcy before (Piano, 2019b). In all the cases, the tenderers must be allowed to provide evidence to prove that they are reliable and that they have taken appropriate measures to ensure that the problem will not be repeated (Chao-Duivis et al., 2017).

b) Suitability and selection criteria

The suitability requirements are to check the capability and the suitability of the tenderers to perform the contract that will be awarded to them at the end of the procedure (de Iongh, 2019). The requirements and the criteria must be based on the general suitability of the tenderer for the project, their economic and financial standing and their technical and professional competence (Article 2.90 of AW). The contracting authority can request the tenderers to submit their bank statements, annual or sales statements to prove their economic and financial standing (Piano, 2019b). For the technical and professional competence, the tenderers can submit the list of the works that they have completed in the last five years, or/and the list of the technical personnel working at the company of the tenderer or/and the description of the technical equipment available for the execution of the project (Piano, 2019b).

In the open procedure, only the suitability requirements are used to assess the capability of the tenderers while in the other procedures, a distinction is made between the suitability requirements and the selection criteria. This is to assess the tenderers in a two-stage procedure. In the first stage, the tenderers are assessed based on the suitability requirements, and these requirements are the minimum requirements that need to be met by the tenderers (de Iongh, 2019). After this stage, the shorter list of the eligible candidates is assessed based on specific predefined criteria. Both the suitability requirements and the selection criteria must be mentioned beforehand in the tender notice (Chao-Duivis et al., 2017; Piano, 2019).

c) Assessment and Award criteria

Once the suitability and the capability of the candidates are assessed, the selected candidates are allowed to submit their bids (expect in the open procedure). Selection of the bid is based on minimum requirements and awarding criteria. The bids are first checked for minimum requirements which set the lower limit for the quality and the performance of the offer. Later, the best offer is determined by assessing the offers using certain awarding criteria (Oppen, Croon, & Vroe, 2018). The European Directive specifies to the contracting authorities to award the contract based on the Most Economically Advantageous Tender (MEAT) criteria (Chao-Duivis et al., 2017).

The contracting authority can determine the most economically advantageous tender on the basis (Article 2.114 of AW) of:

1. the best value for money
2. the lowest cost determined based on cost-effectiveness. E.g. life cycle costs
3. the lowest price

When the contracting authority chooses the best value for money criterion, the contracting authority must also mention what further criteria will be used to evaluate the tender. These criteria must be proportionate and related to the subject matter of the contract, and they must be mentioned in the contract notice (Article 2115 of AW). The criteria can include:

1. quality
2. aesthetic and functional characteristics
3. accessibility
4. suitability of the design for all users
5. social, environmental and innovative characteristics
6. customer service and technical assistance
7. organisation, qualification and the experience of the staff that will be involved in the project when the quality of the team will have a significant influence on the performance of the contract.

The criteria can also relate to the process used for the production or construction of the works (Article 2115 of AW). The contracting authority needs to mention the relative weighting of each of the criteria that will be used to evaluate the tender. When the contracting authority cannot determine the weighting of the criteria objectively, they need to mention the criteria in the decreasing order of their importance (Article 2115 of AW).

The second criterion 'life cycle costs' refers to the costs incurred by the contracting authority or the other users during the entire life cycle of the project. These costs include the acquisition costs, maintenance costs, operation costs and the costs incurred during the end of the life cycle of the project. The life cycle costs can also relate to the external environment impact caused by the product, service or the work during its life cycle provided its monetary value can be determined and checked. When the contracting authority opts for the 'life cycle costs', they need to mention what data they will require from the tenderer and what method will be used to determine the life cycle costs (Article 2115a of AW).

When the contracting authority opts for the second or the third criterion 'lowest price' or the 'lowest cost'; they need to justify its application in the tender document, and the application of these two criteria is not allowed for certain contracting authorities and certain types of contracts (Article 2114 of AW).

2.1.3 Summary

Table 2 displays a summary of the literature study conducted on the different phases of public procurement.

Table 2: Summary of public procurement

Concept	Theory	Authors
Phases of Public Procurement		
1. Definition Phase	The first phase of public procurement. The different steps involved in the definition phase are explained below:	
1.1 Need Formulation	The ambition or the need for the project is formulated, and the scope of the project is determined. The ambition is converted to critical success factors,	(van Veenen, 2018;Capota &

	eligibility requirements, and awarding criteria. A risk assessment is also performed.	Castelein, 2019)
1.2 Type of contract	A choice is made between traditional or integrated contracts.	(van Veenen, 2018, E.D. Love et al., 2014)
1.3 Specifications	The need is translated to requirements or specifications. The choice is made between detailed technical specifications or functional and performance specifications for the project	(Article 2.76 of AW).
1.4 Tendering Procedures	A choice is made between the different tendering procedures.	(van Veenen, 2018; Green Deal Circular Inkopen, 2019)
1.5 Market Consultation	It is important to ask for the requirements that can be delivered by the market. The client can choose to meet some contractors to check if their ambitions are realistic.	(de Iongh, 2019).
2. Tendering Phase	In the second phase, the client invites the tenderers to apply for the project. The different steps involved are:	
2.1 Selection of the contractor	Selection is based on eligibility requirements and the selection criteria. The eligibility requirements check the capability and the suitability of the tenderers. After this stage, the shorter list of the eligible candidates are assessed based on certain predefined selection criteria.	(de Iongh, 2019; Chao-Duivis et al., 2017; Article 2.90 of AW)
2.2 Selection of the offer	Selection of the offer is based on minimum requirements and awarding criteria. The offers are first checked for minimum requirements which set the lower limit for the quality and the performance of the offer. Later, the best offer is determined by assessing the offers using specific awarding criteria.	(Chao-Duivis et al., 2017; Article 2.114 of AW)

2.2 DESIGN FOR DISASSEMBLY

2.2.1 Introduction

As mentioned in the introduction chapter, Design for Disassembly (DfD) refers to the method of designing a building that facilitates adaptation and eventual dismantlement for recovery of systems, components and materials (Guy & Ciarimboli, 2005; Kanters, 2018). The DfD principle looks at the design stage as to how the building and its materials can be easily disassembled. Applied in this way, the life cycle of a building ends with the disassembly of the building instead of demolition. The difference between the two end-phase scenarios is shown in Figure 5. In comparison to demolition, the principle of DfD signifies the active inclusion of multiple alternative end of life scenarios which offers more opportunities to reduce the generation of waste (Crowther, 2005). Hence, if the principle would be applied more thoroughly in the building industry, then it would directly help the sector to transition to a CE.

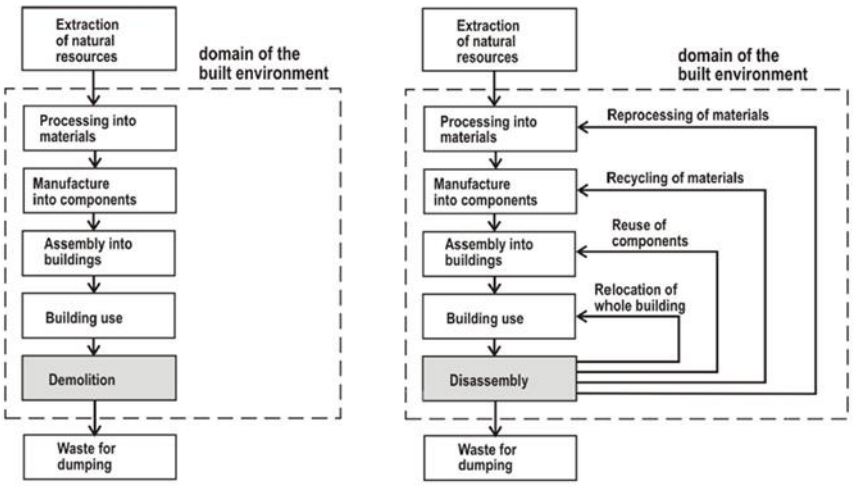

Figure 5: The flow charts represent the scenario of demolition and disassembly respectively (Crowther, 2005)

DfD is also known as "construction in reverse" or Design for Deconstruction, and it is a newer terminology for an old practice (Crowther, 2005; Salama, 2017). The native Americans used to build their shelters with the disassembly principle due to their migratory behaviour. Also, the Mongolian's yurt is the well-known structure that is designed for disassembly and deconstruction (Salama, 2017). The colonial cottages of Australia and London's crystal palace of 1851 are also some of the examples of successful assembly, disassembly, relocation and reassembly (Densley Tingley, 2012).

A literature review was conducted on the DfD principle using the keywords "Design for Disassembly", "Design for Deconstruction", "Demountable buildings" and "Flexible buildings". From the reviewed articles, the following six categories were considered important for the procurement process. The reason for considering them important has been mentioned next to the respective categories below:

1. **Ambition for DfD**- the client formulates the ambition for the project during the need formulation phase (van Veenen, 2018). Therefore, it is crucial to understand what ambition needs to be formulated for a project on DfD.
2. **Type of Specifications for DfD**- During the preparation phase, the client makes a choice between technical and functional specifications based on the type of the project (Article 2.76 of AW). Therefore, it is necessary to understand what type of specifications would be more suitable for a project on DfD.
3. **Roles of Client, Designer and Contractor in different phases**- The client needs to understand the role they play in the entire procurement process to ensure right people are chosen in the procurement team to work on the project on DfD. Also, the client needs to select the right contractor for the project based on specific requirements (Chao-Duivis et al., 2017; Piano, 2019). Therefore, it is also important to understand the role of a contractor and the design team for a project on DfD.
4. **Principles of DfD**- The reviewed articles mentioned "how to design for DfD" in the form of certain principles or design techniques (Crowther, 2005). An understanding of these principles will help the clients in assessing the effectiveness of the offers on DfD.
5. **Tools for DfD** – The client requires tools to assess the offers in the tendering phase (Oppen et al., 2018). A study on the tools will provide knowledge on the important tools available in the market for measuring DfD.

6. **Costs for DfD**- During the assessment of the offers, the client also assesses the offers based on costs (Oppen et al., 2018). Therefore, it is essential to understand what costs need to be considered for a project on DfD.

These six categories will be explained further in detail in this section.

2.2.2 Ambition for DfD

When considering the ambition for DfD, DfD is most effective when it permits for maximum flexibility of spatial configuration within the given structure, as this preserves the building structure as a whole (Guy & Ciarimboli, 2005). Beyond this, the designers need to think about how they can design in a way that maximizes the possibilities for the future reuse of the building assemblies and the sub-components. Only when these strategies are not practical, the designer needs to resort to designing for future recycling (Guy & Ciarimboli, 2005). Crowther (2005) established the same in the form of a hierarchy and hierarchy is:

1. Designing for relocation or reuse of the whole building
2. Designing for reuse of the components in the new building
3. Designing for reuse of materials for manufacturing of new building components
4. Designing for recycling of materials into new building materials

2.2.3 Type of Specifications for DfD

Zeegers, Hermans, & Ang, (2001) studied the concept of Industrial, Flexible and Demountable Buildings and recommended that the clients define the requirements for these buildings in the form of performance specifications. This is due to the difference of knowledge between the client and the contractor. Since the client is usually not well acquainted with the technical solutions to achieve their goal, it is suggested they define their goal as performance requirements. This also offers better opportunities for innovation for the contractor.

2.2.4 Roles of Client, Designer and Contractor in different phases

Guy & Ciarimboli (2005) mentioned the role of the client, designer and the contractor in the different phases of the life cycle of a project on DfD. In the pre-design phase, the client needs to hire an architect or a design team experienced in sustainable design and DfD. They need to brief the design team on critical requirements for upgrading and adaptability in use. Later, based on the building type and the client needs, the design team needs to demonstrate the best practice of DfD to the client. The design team also needs to develop goals and priorities for DfD (Guy & Ciarimboli, 2005).

In the conceptual phase, the role of the client is to involve the contractor's expertise on design implications for DfD whereas the design team needs to hold meetings with the contractor and the vendors to identify reused materials and construction process that support DfD. The role of the contractor in this phase is to receive initial briefing and training on DfD (Guy & Ciarimboli, 2005).

In the schematic and final design development phase, the design team needs to work on producing a detailed deconstruction plan whereas the contractor needs to advise the design team on the deconstruction process and the potential reuse (or recycling) priorities for material types. (Guy & Ciarimboli, 2005).

Finally, in the construction phase, the client needs to ensure that all the contractors and the maintenance staff are thoroughly briefed about DfD strategies. The client needs to allow for additional time in the contract period to ensure the construction implements DfD through careful practices. The role of the design team during the construction phase is to make or update the construction documents to create comprehensive "as-built" documents. The contractor's role is to ensure the quality of the workmanship to maintain the integrity of DfD details as designed. They also need to train the sub-contractors if necessary (Guy & Ciarimboli, 2005).

2.2.5 Principles of DfD

Although DfD has not been a common practice, there have been examples of significant historic buildings that have adopted the principle of DfD. Review of these buildings has provided a pattern of common approaches that offer solutions for the difficulties of design for disassembly (Crowther, 2005). These approaches offer recurring principles as design guidance. These principles can be seen as design guidelines or design techniques for architects and building designers (Crowther, 2005).

These principles have been categorized into the following themes: 1. Overall Building Design, 2. Materials and Connections, 3. Construction and deconstruction phase (Kanters, 2018).

1. Overall Building Design

The overall design of a building has a great impact on facilitating flexibility and disassembly (Kanters, 2018). The principles that enable flexibility and easy recovery of building components are:

- Design building so that elements are layered according to their anticipated life span (Crowther, 2005; Densley Tingley, 2012).
- Use a modular, simple design (Akinade et al., 2017; Crowther, 2005)
- Use an open, flexible building system that allows functions to change in the future (Akinade et al., 2017; Crowther, 2005; Densley Tingley, 2012)
- Use a standard structural grid (Akinade et al., 2017; Crowther, 2005; Densley Tingley, 2012; Guy & Ciarimboli, 2005; Webster & Costello, 2005)
- Separate mechanical, electrical and plumbing systems (Guy & Ciarimboli, 2005; Webster & Costello, 2005)
- Design for steel construction (Akinade et al., 2017; Densley Tingley, 2012)

2. *Materials and Connections*

The selection of the right materials, connections and components is a significant task for the design team to achieve a higher degree of detachability (Kanters, 2018). The principles that guide the selection of the materials and connections are:

- Use reused (or recycled) or reusable (recyclable) materials (Akinade et al., 2017; Crowther, 2005; Guy & Ciarimboli, 2005; Webster & Costello, 2005)
- Use lightweight materials (Akinade et al., 2017; Crowther, 2005; Guy & Ciarimboli, 2005)
- Use nontoxic, non-composite, durable, and high-quality materials that can be reused (Akinade et al., 2017; Crowther, 2005; Guy & Ciarimboli, 2005; Webster & Costello, 2005)
- Use mechanical joints (bolts and nuts) instead of chemical joints (Akinade et al., 2017; Crowther, 2005; Guy & Ciarimboli, 2005; Webster & Costello, 2005)
- Minimize the number of different materials, connections and components (Akinade et al., 2017; Crowther, 2005; Densley Tingley, 2012; Guy & Ciarimboli, 2005; Webster & Costello, 2005)
- Design joints that are accessible and durable (Crowther, 2005; Densley Tingley, 2012; Guy & Ciarimboli, 2005)

- Avoid the use of binders, adhesive, resin and secondary finishes (Akinade et al., 2017; Crowther, 2005; Densley Tingley, 2012; Guy & Ciarimboli, 2005)

3. *Construction and Deconstruction Phase*

The principles that enable easy disassembly and recovery of the building components are:

- Develop and design a deconstruction plan already in the design process. Information, documentation about used materials, and deconstruction method need to be stored. (Densley Tingley, 2012; Guy & Ciarimboli, 2005)
- Use pre-fabricated components and materials (Crowther, 2005; Guy & Ciarimboli, 2005)
- Make sure components are sized to suit handling (Crowther, 2005; Guy & Ciarimboli, 2005)
- Allow for parallel disassembly (Crowther, 2005; Guy & Ciarimboli, 2005)
- Deconstruction must be possible with standard tools and equipment (Akinade et al., 2017; Crowther, 2005)
- Provide access to all the parts of the building and all components (Crowther, 2005)

2.2.6 Tools for DfD

Currently, there are not many tools in the market that help the design team design for deconstruction or to measure the potential of design for DfD (Kanters, 2018). However, the usage of Building Information Modelling (BIM) has increased in the construction industry, and this usage of BIM by the design team has benefits for DfD. Especially the usage of 7D BIM has clear benefits, as for instance, it has detailed information on material specifications, the schedule for maintenance and the exact location for each of the embedded elements. In conclusion, BIM can play a significant role in developing DfD tools (Kanters, 2018).

Akinade et al. (2015) developed an objective BIM-based tool for deconstruction. The author studied the various critical principles of DfD and the key features for assessing the performance of DfD for developing the mathematical model. The model provides a score (Deconstructability Assessment Score or BIM-DAS) that determines the extent to which the building can be deconstructed right from the design stage. For instance, the model checks the set of materials, the components and their connections, and if they are reusable. The model can be used as a design requirement benchmark for effective deconstruction.

2.2.7 Costs for DfD

Guy & Ciarimboli (2005) mentioned that for DfD, the “upfront, operating and the back-end costs” must be considered during the initial building design. This will incorporate the entire life cycle of a building into the decisions made before a building is built, thereby, increasing the value and effectiveness of the building in the view of its future use and costs. Guy & Ciarimboli (2005) encouraged that the investigation for DfD is made through life-cycle cost analysis based on the initial building use and with a consideration of 50-year time-frame or greater based on the building type.

2.3 THE PROCUREMENT PROCESS FOR THE DFD PRINCIPLE

The procurement process was introduced in section 2.1, and the different concepts of DfD were explained in section 2.2. For this research, it is imperative to understand what changes to this procurement process could occur due to the implementation of the DfD principle. Therefore, using the procurement process model as the basis, the results of the literature study on the DfD principle are added to it to conceptualize a procurement process for DfD implementation (Figure 6).

The DfD based procurement process is explained in the form of a process model where the implementation is explained for different phases of the procurement process (which were introduced in section 2.1) in chronological order.

2.3.1 Preparation Phase

a) Need Formulation

In this phase, the client formulates the ambition for the project. Guy & Ciarimboli (2005) mentioned that it is important that the client evaluates the site conditions, proposed life span, project budget, building functions and the proposed construction delivery process for setting the ambitions on DfD.

The client needs to hire a design team who is specialized in sustainable design and DfD, and brief them on critical requirements for upgrading, adaptability and flexibility in use. The design team can demonstrate the best practices of DfD to the client, and investigate what strategy of DfD would be suitable for the project (based on building type and client needs). Based on the same, the design team can make goals and priorities for DfD (Guy & Ciarimboli, 2005).

As explained in section 2.2.2, DfD is most effective when it permits for maximum flexibility of spatial configuration. Beyond this, the designers need to think for the future reuse of the building assemblies, and when that is not possible, they need to resort for future recycling (Guy & Ciarimboli, 2005). The hierarchy of effectiveness of the DfD principle is explained in section 2.2.2. The designer needs to set the ambitions for DfD based on the same hierarchy.

A decision is also taken on the type of contract that will be chosen for the execution of the project. Guy & Ciarimboli (2005) mentioned the importance of involving the contractor in the conceptual design stage for a project on DfD to involve their expertise while making the design. This will help in identifying the reusable materials and the construction process that support DfD. Based on this, only an assumption can be made that between traditional and integrated contract, the integrated contract would be more suitable for a project on DfD. However, there are other types of contracts like an alliance model, design team, or innovation partnership, which also involves the involvement of the contractor in the conceptual design stage. Therefore, the only conclusion that can be made is that the type of contracts that involve a contractor in the conceptual design stage is more suitable than a traditional contract. However, no preference for any one type of contract cannot be made.

b) Specifications

In this stage, the ambitions are translated to specifications. A choice is made between technical and functional (or performance) specifications. As mentioned in section 2.2.3, it is recommended that the client defines the specifications for DfD in the form of performance (or functional) specifications. For

instance, the client can set the requirement in terms of the percentage of the building that can be reused (Guy & Ciarimboli, 2005).

c) Tendering Procedure

During this phase, a choice is made between the different tendering procedures. In the reviewed articles, there was no mention of what type of contact is required between the client and the contractor during the tendering process. There is no clear preference for a tendering procedure suitable for DfD that pre-exists in the literature.

d) Market Consultation

Guy & Ciarimboli (2005) asks the client to hold meetings with the contractors during the conceptual design phase to identify the construction process that supports DfD. The client can also hold meetings with manufacturers and suppliers to identify the reusable materials that could be used in the building.

2.3.2 Tendering Phase

a) Selection of the contractor

During this phase, a selection of the contractors is made based on certain eligibility requirements and selection criteria. Akinade et al. (2017) and Densley Tingley (2012) mention that the design team needs to have the right competence, training, and will to work with DfD. They need to be trained in the design process for designing demountable buildings, knowledge of the code for acceptable DfD, design documentation for DfD, use of BIM-based software and other tools for DfD, design for effective material handling and design for safe disassembly. Therefore, it would be imperative for the client to set certain eligibility requirements for the design team while selecting the consortium for the project.

Guy & Ciarimboli (2005) and Densley Tingley (2012) mention that contractor has to obtain initial briefing and training on DfD during the conceptual design stage. Later, in the schematic and the detailed design stage, they need to advise the design team on the deconstruction process and potential reuse (or recycling) priorities for material types. However, none of the reviewed articles mentions any competencies for a contractor as a pre-requisite to participate in DfD project. Therefore, having some experience with DfD or training on DfD can be beneficial, but it would not be a pre-requisite to taking part in the project. Thereby, the client can make it a selection criterion and not an eligibility requirement.

Akinade et al. (2017) mention that it is important that early involvement of demolition and deconstruction professionals occurs in the project on DfD to ensure they are involved in the design stage. Therefore, the client can also set a requirement for demolition professionals to be a part of the consortium during the tendering phase.

b) Selection of the offer

In this phase, the offers submitted by the contractors are assessed based on certain minimum requirements and awarding criteria. As mentioned in section 2.2.5, the reviewed articles mentioned "how to design for DfD" in the form of overall building design principles, material and connection principles and construction and deconstruction phase principles. The client could award the contract based on these techniques or principles to select the best offer.

In order to evaluate the offers based on these principles, the client requires certain tools to assess them on DfD. As mentioned in section 2.2.6, currently, there are not many tools in the market that help the design team to design for deconstruction or to measure the potential of design for DfD. However, the usage of BIM by the design team has benefits for DfD. For instance, it can be used to store detailed information on material specifications, the schedule for maintenance and the exact location for each of the embedded elements. One of the tools available in the market was developed by Akinade et al. (2015) on the same BIM platform. This is an objective tool that provides a score (Deconstructability Assessment Score or BIM-DAS) for the extent to which a building can be deconstructed. Therefore, the client could ask for designing on BIM as a requirement and use the above-mentioned tool to assess the offers.

Another vital aspect used for assessment of the offers is the cost of the offers. Guy & Ciarimboli (2005) mentioned the importance of considering the upfront, operating and back end costs for DfD during the design stage. This will incorporate the entire life cycle of a building into the decisions made before a building is built, thereby, increasing the value and effectiveness of the building in the view of its future use and costs. Therefore, the clients could assess the offers based on life cycle costs with a time frame of 50 years or more.

2.4 DFD AND CHANGES IN THE PROCUREMENT PROCESS

The proposed framework indicates that the implementation of DfD does not bring any change in type (or number) of phases explained for the general procurement process (in section 2.1.2), but the activities or decisions that take place in each phase have to be conducted in line with the principle of DfD. During the literature study on the DfD principle, none of the aspects found implied that a fundamental change is brought about to the general procurement process. For instance, no new phase or a sub-phase had to be added to the procurement process for its implementation. Thereby, a conclusion is made that DfD implementation might not bring any changes in the type or number of phases that take place during the general procurement process.

2.5 CONCEPTUAL FRAMEWORK AS DERIVED BY LITERATURE

The conceptual framework is shown in Figure 6. In this figure, the activities that need be executed in the sub-phases for implementation of DfD have been represented in the form of rounded rectangles and the decisions that need to be taken to favor DfD in the form of ovals.

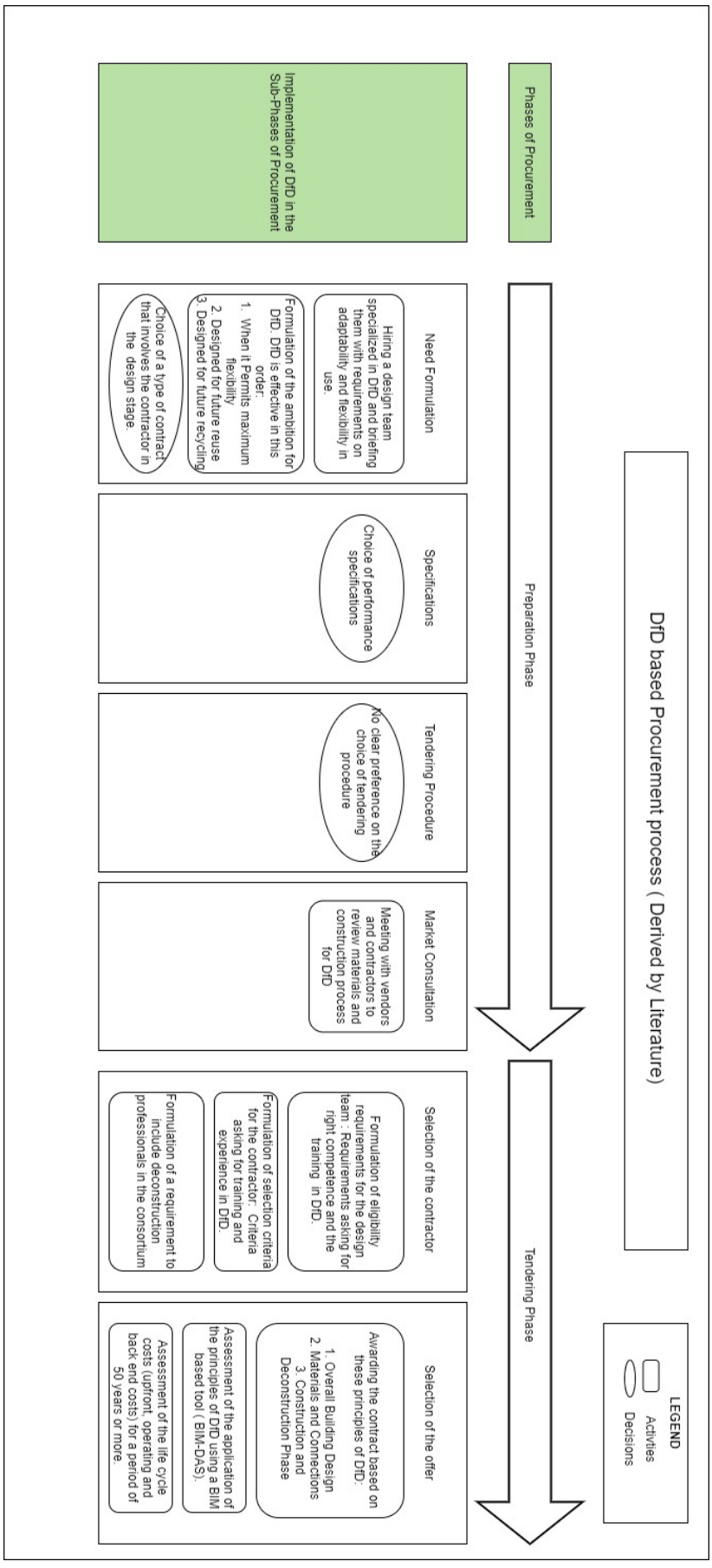

Figure 6: Conceptual Framework as derived by literature (own Illustration)

3 RESEARCH METHODOLOGY

This chapter explains the research methodology adopted for understanding how public clients have implemented DfD in their procurement process and how they plan for better implementation in the future. In section 3.1, the research strategy chosen for the research is described. Later, in the subsequent sections, each of the steps involved in conducting the research will be explained in detail.

3.1 RESEARCH STRATEGY

As mentioned in section 1.4, the case study is the most suitable strategy for this research. Case Study is an empirical method that studies a contemporary event(or phenomenon) in-depth in the real world context (Yin, 2003). The case study can involve either a single case or multiple cases and numerous levels of analysis within in each case (Eisenhardt, 2010). The case study can be used for an explorative, explanatory, or descriptive study (Yin, 2003). Certain characteristics of a case study are (Verschuren & Doorewaard, 2014):

1. A small number of research units
2. Intensive data gathering
3. Focus more on depth than breadth
4. A strategic selection of the cases
5. An open observation on site
6. More commonly qualitative data and research methods

The cases for this research are buildings with DfD (implementation) procured by public clients. Before the procedure for research was designed, decisions were taken if the research would involve a single case or multiple cases and if the case study would be an embedded case study or a holistic case study (Yin, 2003). This research involves multiple cases as the results obtained from multiple cases are considered to be more convincing and robust, and it provides a chance to check if the results from one case study are replicated in the other cases (Yin, 2003). Also, this research is a holistic case study research as the focus was on obtaining the global picture in each of the cases rather than having multiple units of analysis in each case (Yin, 2003). In conclusion, this research is a holistic multiple case study research.

3.2 SELECTION OF THE CASES

Selection of Cases is an important aspect of the case study research (Eisenhardt, 2010). A decision needs to be made on the number of cases that will be studied and on the criteria that will be used for the selection of the cases. There is no straight forward formula as in the case of a survey that can be used for selecting the number of cases (a sample based on the total population). Instead, it is a discretionary decision taken by the researcher based on the number of replications the researcher intends to achieve. The replication can be of two types: literal replication and a theoretical replication. In the case of literal replication, the cases are selected such that they all predict similar results, whereas, in the case of theoretical replication, the cases are selected such that they predict contradictory results for foreseeable reasons (Yin, 2003). The research on DfD procurement is limited, and this research aims to fill the knowledge gap on the same. Since the research topic is quite new, it

was logical to select the cases that can predict literal replications for this exploratory research. Therefore, two similar cases were studied in this research to obtain the results (Yin, 2003).

The criteria that were used for the selection of cases are:

1. The building must be designed and built using the principle of DfD. The application of the DfD principle can be limited to designing for future disassembly and may not mandatorily include the aspect of adaptability in the building.
2. The client must be a public authority.
3. The tendering procedure must follow European guidelines (does not necessarily have to be above the European threshold)
4. The project must be already be awarded to a contractor. The tendering process of the project needs to be completed.

DfD is most effective when a building has been designed for maximum flexibility and beyond that designed for future disassembly. The reason for making a selection criterion where the application of the DfD principle could be limited only to future disassembly is due to the limited number of DfD buildings accessible to the researcher. A strict criterion of a DfD application which includes both adaptability and future disassembly, and also procured by public authorities, would make it difficult to find cases for this research.

3.3 CASES

The two cases selected based on the selection criteria were the "Amsterdam temporary Court House" and the "Circular Pavilion". An introduction to both these cases will be given in this section.

3.3.1 Temporary Court House

The client, Rijksvastgoedbedrijf, required a temporary courthouse for a period of 5 years. Their main goal for this project was the prevention of waste and maximization of the residual value of building after its initial period of usage (Divisare, 2019). Keeping this mind, Consortium DPCP designed the temporary courthouse as a kit of parts that can be easily assembled, disassembled and reassembled (Koninklijke NLingenieurs, 2019).

3.3.2 The Circular Pavilion

Rijksvastgoedbedrijf needed a temporary building for vacant space to avoid the gap in urban development. The project was awarded to the consortium R Creators, and they came up with an idea of a restaurant named "The Green House". The Green House (or the Circular Pavilion) is a completely demountable building, and after 15 years, the pavilion can be moved to another location, and the vacated land can be used for another purpose (Ballast Nedam, 2019)

3.4 DATA COLLECTION

The case study was conducted by collecting data by interviews and from the project documents (procurement documents). The data obtained from these sources were later triangulated as triangulation provides stronger corroboration and substantiation of the results (Eisenhardt, 2010).

3.4.1 Documents

Various procurement documents were studied to understand what approach was followed by the client in each phase of the procurement process. The documents studied were ambition document, selection document, dialogue document, registration document and other related documents.

An overview of the documents used for both cases are:

Table 3: Documents used for the case study (own work)

Case number	Documents	Case number	Documents
Case 1	Tender Guide for Dialogue and Tendering phase	Case 2	Tender Guide for Registration
	Tender Guide for dialogue and registration		Tender Guide for Selection.
	Ambition document		Ambition document
	Awarding criteria		Awarding criteria
	Assessment framework for circular ambitions		
	Document on circularity.		

3.4.2 Exploratory interviews

Exploratory interviews were conducted for case study research. These interviews were conducted with the personnel from the procurement team both from the client's side and the contractor's side. Since they have already executed the procurement process for the implementation of DfD in the buildings, it was logical to know from them what changes in the procurement process led to the positive results in terms of the incorporation of DfD and how this could be done better in future for a better implementation. The questions that were asked in the interviews have been included in Appendix B: Questions for the Case study interviews. The questions basically asked how they implemented DfD in each phase (and sub-phases) of the procurement process (that were identified from literature review) and also on how they aim to implement it better in each of these phases. The questions also enquired about the best practices they followed for the implementation of DfD in both cases.

Selection of the candidates for the interviews

At the public clients, the procurement team that designs the procurement process is mainly led by a project manager, technical manager, and contract manager. The project manager takes decisions on the cost and the schedule of the project. The technical manager is responsible for technical details and the specifications of the project. The contract manager is responsible for legal aspects and checking if the market is ready for the project. Interviewing these candidates for each case provided a whole picture (different perspective of each manager) on how the procurement process was organized for DfD. Another interesting person in the procurement team is the sustainability advisor, who provided knowledge on how DfD can be incorporated into the projects. In addition, the other important people that were interviewed were the procurement advisor and the architect. The procurement advisor was chosen as he could provide knowledge on designing the procurement process for DfD, and the architect was chosen as he has knowledge of the techniques followed for building a demountable building.

From the contractor's side, the manager (project manager/ tender manager) involved in drawing up the tenders and the execution of the project were interviewed. They were interviewed to understand what they feel are the important adaptations that need to be made in the procurement process. It is important to understand their perspective because if the clients incorporate DfD in the procurement process and the contractors are unable to follow the same, this would imply an unsuccessful process.

In conclusion, the criteria used for selecting the candidates for interviews are:

1. From the client's side, the candidate must have been involved in designing the procurement process. Further, the candidate must have involved as a project manager, contract manager, technical manager, sustainability advisor, architect, or as a procurement advisor in the process.
2. From the contractor's side, the candidate must have been involved in drawing the tender in the role of a tender manager. Further, the candidate also must have performed the role of a project manager during the execution.

Therefore, a total of 5 to 7 candidates involved in each case were interviewed, and the contacts of the same were obtained from my supervisors at Rijksvastgoedbedrijf and Royal Haskoning DHV. These candidates were approached via email.

In the end, a total of 12 candidates were interviewed for both case studies combined. An overview of the candidates interviewed for both the cases are:

Table 4: Overview of the candidates interviewed for the case study (own work)

Interview Number	Roles	Organization
CASE 1		
1	Project manager	Client
2	Project manager/Contract manager	Client
3	Sustainability advisor	Client
4	Procurement advisor	Client
5	Architect/ Technical manager	Client
6	Tender/ Project manager	Contractor
7	Tender/ Project manager	Contractor
CASE 2		

8	Project Manager	Client
9	Technical Manager/ Sustainability advisor	Client
10	Architect	Client
11	Technical manager	Client
12	Project manager/ Tender manager	Contractor

3.5 Individual Case Report

The data collected from interviews and the documents were triangulated and later combined to write the individual case report.

3.6 Confirmation of Individual case findings

After writing the individual case report, a meeting was held with the previously interviewed candidates to confirm the recorded findings from each case. This meeting also had an additional expert on circular economy to know his opinion on the case findings. The meeting was conducted with five candidates in total, and the meeting was conducted for 1 hour. These candidates were approached via email.

An overview of the candidates who were a part of the meeting are:

Table 5: Overview of candidates for Validation meeting

Role	Interviewed previously during the Case study.	Organization
Project Manager	Yes	Client
Sustainability advisor	Yes	Client
Technical Manager	Yes	Client
Circularity Advisor	No	Client
Procurement Advisor	Yes	Client

3.7 Cross- Case Analysis

After the validation meeting, the results of the individual cases were compared. The comparison was made to understand the similarities and differences between each of the cases (Eisenhardt, 2010). This indicated how the results are similar in all the cases or how the results are contrasting for certain reasons (Yin, 2003). Based on this comparison, the main findings were concluded on how the public clients have implemented DfD in the procurement process.

3.8 DISCUSSION

In the discussion, the results of the empirical research (cross-case analysis) were compared to the conceptual framework created in the initial phase of the research. This comparison was required to understand what part of the empirical results were similar to the theoretical results and what part of it had contradicted each other and why. This was done to improve external validity, generalizability, and obtain conclusions that are at a higher conceptual level (Eisenhardt, 2010). Later, based on this comparison, the conceptual framework was refined.

4 CASE STUDY RESULTS

This chapter contains the findings of the two case studies conducted. In section 4.1, the findings of the case Temporary Court House will be explained, and in section 4.2, the findings of the case Circular Pavilion will be explained. For each case, firstly, an introduction to the case will be given, and later, the findings per each phase of the procurement will be explained. In the end, the best practices followed will be mentioned, and a summary of the case will be depicted in the form of a process model.

Finally, in section 4.3, cross-case analysis will be conducted.

These findings were obtained by interviewing the personnel involved in the procurement process of the project (both from the client's side and the contractor's side) and also reviewing the ambition document, request for proposal, and other important documents related to procurement.

In this section, the interview references are done by referring to them as "appendix" (where the appendix number corresponds to the interview number), and for privacy reasons, no names are included in the report. The references to the documents referred to have been made in the general APA style, and they have included in the reference list. Also, in this section, all the interviewees from the client's side have been referred to as 'the client', and the interviewees from the contractor's side (or the consortium) have been referred to as 'the contractor'.

4.1 TEMPORARY COURT HOUSE

4.1.1 Introduction

The temporary court house consists of a temporary new building (tower G) and already existing towers E and F. This temporary building has been realized on the Parnas-complex. The jurisdiction will function in this temporary court house for five years until the new permanent court is constructed. This temporary new building (Building G) has been constructed using a Design, Build, Maintain and Remove contract (cepezed, 2019a). The main goal of the client Rijksvastgoedbedrijf was the prevention of waste and maximization of the residual value of building after its initial period of usage (Divisare, 2019). Keeping this mind, the building has been built with an adaptable configuration, and it can be removed and reused after the usage period. The building was designed as a kit of parts that can be easily assembled, disassembled and reassembled. This building has won the Amsterdam Architectural prize 2017 (Koninklijke NLingenieurs, 2019).

Figure 7: Temporary Court House (Divisare, 2019)

Table 6: Details about the case "Temporary Amsterdam Court House" (Ellen MacArthur Foundation, 2016):

Client	Rijksvastgoedbedrijf
Contractor	Consortium DPCP, a combination of Du Prie bouw & ontwikkeling and developer cepezedprojects.
Net surface area	5400 m2 (along with tower E and F)
Type of Contract	DBMR
Date of Completion (of construction)	2016

The roles interviewed for this case are:

Interview Number	Roles	Organization
CASE 1		
1	Project manager	Client
2	Project manager/Contract manager	Client
3	Sustainability advisor	Client
4	Procurement advisor	Client
5	Architect/ Technical manager	Client
6	Tender/ Project manager	Contractor
7	Tender/ Project manager	Contractor

4.1.2 Procurement

This section contains a description of how the different phases of the procurement process were organized for awarding the contract for the temporary court house.

3. Preparation Phase

In this section, the findings for different sub-phases under the preparation phase: *need formulation, specifications, tendering procedure,* and *market consultation* have been given. The findings for the preparation phase are:

a) Need Formulation

The removal of the building after the limited period of usage was an explicit part of the assignment. Owing to this temporary nature (5 years) of the building, the ambition of the project included prevention of the creation of waste (Appendix 1; Appendix 2; Appendix 4; Appendix 5). The client believed that with the correct usage of materials in the design, reuse is possible or that the elements to be removed can be recycled with minimal modification. The client also suggested two ways of reducing waste (Appendix 2):

- On the front: This refers to the reduction in the usage of primary raw materials. For example, the contractors could use materials (or components) that are obtained from dismantling other buildings or from recycling (Rijksvastgoedbedrijf, 2014c).
- At the back: This referred to working with products that can be reused (at another location) or (biologically or technologically) recycled (Rijksvastgoedbedrijf, 2014c).

The ambition of the project to avoid waste was based on the conviction of the client that building still represents a considerable value after the usage. For the same reason, the materials used in the temporary building would be the property of the contracting consortium, and it was up to them to develop a business case to maximize the residual value of the building (Rijksvastgoedbedrijf, 2014b).

As per the research by NIBE, 70 per cent of the material-related environmental impact for a building is caused by the loading-bearing structure, façade, and the roof (Appendix 3). Owing to this, the focus of the project was the prevention of the creation of waste only for the load-bearing structure, façade, and roof (Appendix 3).

The project had four key success factors, and one of these success factors was limiting the wastage of resources after the period of usage of the building (Rijksvastgoedbedrijf, 2014b). The client mentioned in the interview that by re-establishing the ambition of the circular economy as one of the key success factors, the contractors were stimulated to include it in their offers (Appendix 1).

The type of contract that was chosen for this project was an integrated DBMR (Design, Build, Maintain and Remove) contract based on UAV-GC 2005 (Rijksvastgoedbedrijf, 2014b). The scope of the project also included disassembly and removal of the building after a period of 5 years.

In the interview, the client mentioned that the choice of an integrated contract brought all the chain partners together and that they set the requirements in such way that they could apply as a consortium that had the expertise for all the phases (Appendix 1; Appendix 2; Appendix 4)

b) Specifications

The question that was asked to the market was a concept for a temporary building that represented the image of Judiciary but also minimized on the creation of wastage (Appendix 2). Though the functional plan was given to the market, the question was open (functional), and the contractors could come up with any strategy or any solution (Appendix 3; Appendix 4). With the help of some professors at TU Delft, the client had developed a method to compare any solution (Appendix 3). The contractors could choose to make buildings made with bio-degradable materials or with technical materials; all the solutions could be compared (Appendix 3).

The client was surprised by the solution suggested by the contracting consortium. They got a better solution than what they had expected (Appendix 2). They attributed this to the choice of going for an open question. The client said that if they had described the solution to the contractor, they could never be sure if they are asking for the best solution available then. The functional question helped them in getting competitive solutions and that they could choose the best from them (Appendix 4).

The contractor in the interview said that the client in the future could also give them specifications in terms of how the building should perform (performance specifications) during the period of usage, and that would help them innovate better (Appendix 6).

c) Tendering procedure

The tendering procedure chosen for the project was competitive dialogue (Rijksvastgoedbedrijf, 2014c). The dialogue was conducted in two phases, and in both the phases of the dialogue, the topic of reuse was discussed. The client mentioned that competitive dialogue is suitable for the incorporation of DfD as it helps them in boosting their ambitions and receiving far better solutions (Appendix 1; Appendix 5). The client also said that when they go for an open question, it helps them in making the contractors understand their questions better and also in optimizing their solutions. (Appendix 4).

The contractor was also of the same opinion that competitive dialogue is needed for these kinds of projects (Appendix 7). The contractor said it gave them a chance to understand what the real question was and what is behind the things asked on the paper. The contracted also said that it gave them a chance to show how their solution was efficient and intelligent (Appendix 6).

d) Market Consultation

There was no market consultation done for this project (Appendix 5). The client had a consultation with the professors of TU Delft to know if it is feasible to do a project on disassembly, and the TU Delft professors assured them that this could be done (Appendix 1; Appendix 5). Also, the procurement department did market research online and found out that there were contractors who worked on a temporary housing project in the south of the Netherlands. They also found out that there was more than one party who could make these kinds of projects (Appendix 2; Appendix 4). So, the client was sure that there were contractors who were capable of doing this project and who would be interested in this type of project (Appendix 1; Appendix 5).

4. Tendering Phase

In this section, the findings for the different sub-topics under the tendering phase: the *selection of the contractor and selection of the offer* have been explained. The findings are:

a) Selection of the contractor

The eligibility requirements for the contractors to take part in the procurement process was the ability to design a new building of 2000 m2, the ability to design complex security solutions, and the ability to conduct maintenance of a building of at least 5000 m2 (Rijksvastgoedbedrijf, 2014b).

Once the contractors met the eligibility requirements, the top three contractors were selected based on three selection criteria. However, they did not explicitly ask for the experience for the contractors with DfD. In the interview, the client mentioned that it was not made compulsory for the contractors to have experience with DfD as they were scared whether enough contractors would take part in the procurement process (Appendix 2).

After the project, the client realized that the construction of a demountable building is not a revolutionary task, and it has existed for decades. The contractor adopted a solution with a steel frame and a concrete floor, and there was only a little innovation on the concrete floors. Overall, it was bolting instead of glueing, which is an old-fashioned way of construction. However, designing for a demountable building requires some experience. So, in the future, if they were to do another project on disassembly, the client would set requirements only for the design team and not for the contractors (Appendix 5). Nevertheless, in conclusion, the client said that the designers and the contractors are ready to build a demountable building. However, the most significant revolution is with the suppliers who are not ready to change their business case.

One of the interviewees from the client's side also mentioned that in the future, if the circular economy is an important subject in the project, then a pre-selection would be made based on the vision of the contractors on circularity (Appendix 3).

b) Selection of the offer

The offers submitted by the contractors were assessed based on Most Economically Advantageous Tender (EMAT) criteria. The awarding criteria related to DfD was (Rijksvastgoedbedrijf, 2014c):

"The extent to which and the manner in which the design takes into account the minimization of waste of material in view of the temporary nature of the housing and dismantling after the use period of approximately five years."

The points of attention for this awarding criteria were (Rijksvastgoedbedrijf, 2014c):

- The application of circular design philosophy in the design.
- The materials used are such that the highest possible processing is possible after dismantling taking environmental impact into consideration.
- Demonstrability, verifiability of the dismantling concept in view of the design philosophy and environmental impact.

There was only one minimum requirement concerning the usage of materials, and it was that the contractors could use only those materials that belonged to the best environmental classes 1, 2, or 3 (Appendix 3).

When the clients were questioned on how they could stimulate the contractor to implement DfD in their offers, they said they could do it in two ways, by setting hard requirements or by using awarding criteria. For this project, they made it qualitative criteria and challenged the contractors to come up with the solution. For the next project, they realized that many market parties could do this, so they made it a minimum requirement and said that the building must be demountable with a lesser loss than 20 per cent. For the proof, the client looked at material passports and detailing and assessed whether there would be much demolishment in order to demount the building (Appendix 5).

When the contractor was asked as to how they could be stimulated for DfD, the contractor said that the client needs to ask them for a plan of disassembly. This is to make the architects think about how they can undo their work. The contractor mentioned that a building that can be disassembled is always more circular than a building that is difficult to disassemble as circularity begins with the chance to have different parts separated. So, the client needs to stimulate the contractor to think about it by asking for the plan for disassembly (Appendix 6).

The details about the offer that was submitted by DPCP consortium are provided in Appendix C: Temporary Court House.

Assessment of the Offers

In the interviews, the client mentioned that since they adopted an open question, they needed a method that could assess any type of solution. In consultation with TU Delft, they developed a method called adjusted Milieuprestatie gebouw (MPG) (Appendix 3). The basic functioning of this method is that the environmental impact of a material can be mathematically spread equally over its lifetime (Appendix 3).

The client mentioned that they had asked the contractors to minimize the wastage by either using the secondary materials in the front or having a strategy for reusing the materials after the five years at the back (Appendix 2). For instance, if the contractors were using a 25-year-old concrete floor (technical lifespan is of 50 years), they would be taking 50 percent of the environmental impact to the courthouse. At the courthouse, the slab would be used for 5 years. So, for the remaining 20 years (50-(25+5)) left for the concrete floor, the contractors had to come up with a reuse plan (Appendix 5). The credibility of their reuse plan was also evaluated (Appendix 3). However, in the interview, the client mentioned that evaluating the credibility was not completely foolproof as almost all the contractors scored the same on that part(Appendix 3).

So, the contractors had to fill in the excel sheet the kilos of the materials (components) they were using for the construction and the façade, then the MPG factor number. Later, they had to fill about the future plan for the component and then the credibility of the plan, which was multiplied with the MPG number to obtain the final number (Appendix 3). This way, the model could rank the offers based on the minimization of the creation of wastage (Appendix 1). An example of how the calculation was done is included in Appendix C: Temporary Court House

When the client was questioned if they could use the same method in the future, they said that they could use it when they knew the lifetime of the building. They said they could not ask for minimum wastage during the lifetime of the building without knowing the lifetime of the building (Appendix 3).

Assessment of the cost of the offers

For the price, the client had a maximum ceiling price of 14.5 million Euros. This price was the total price paid for all the phases of the life cycle of the building (life cycle costs). The client has broken down the payments in such a way that the last payment to the contractor is made only when the building is removed. So, there is a penalty if the contractor does not remove the building (Appendix 5). The client also added that there is not much rise in the price of the building when a building is made demountable, and the price is almost the same as a normal building (Appendix 5).

In the interview, the contractor said that on DfD projects in general, the client should invest in quality by stimulating the life cycle costs as this ultimately makes the building cheaper at the end. The contractor continued saying that they prefer when the client has a ceiling price for the project as then the objective for the contractor becomes the higher quality for the same price rather than minimum quality for the lowest price (Appendix 6).

4.1.3 Best Practices

In the interviews, the clients and the contractors were asked what the best practices were in this project. The client mentioned that the best practice was making one contractor responsible for all the phases of the life cycle of the building. This gave the best guarantee that the building would be reused as the contractor had a business in making a building that could be reused (Appendix 4). The client also added that giving the building back to the contractor stimulated the contractor to be involved financially in the process (Appendix 5).

Another interviewee from the client's side said that the best practice was them being very open-minded throughout the project and also open about the solutions (Appendix 1). The contractor also mentioned that they liked how the client was open-minded in this project and accepted the innovations. The contractor said that the client respected their way of working, and both them and the client were honest with each other throughout the process. The contractor openly could inform the client about all the problems that they were facing throughout the project (Appendix 7).

The contractor mentioned that the best part about the project was that both the client and the contractor had the same goal throughout the project. The goal of the contractor was to make a good building that has a lot of value after 5 years, and this automatically gave the client a high-quality building. Having a common goal helped in arriving at the best results and being transparent to each other (Appendix 6).

The contractor also mentioned that they adopted the new way of working; they had a conversation with every person (suppliers, laborers) arriving on the site about their vision and how they wanted to do it (Appendix 7).

The summary of case 1 is presented in the form of a process model in Figure 8.

4.1.4 Summary of Case 1

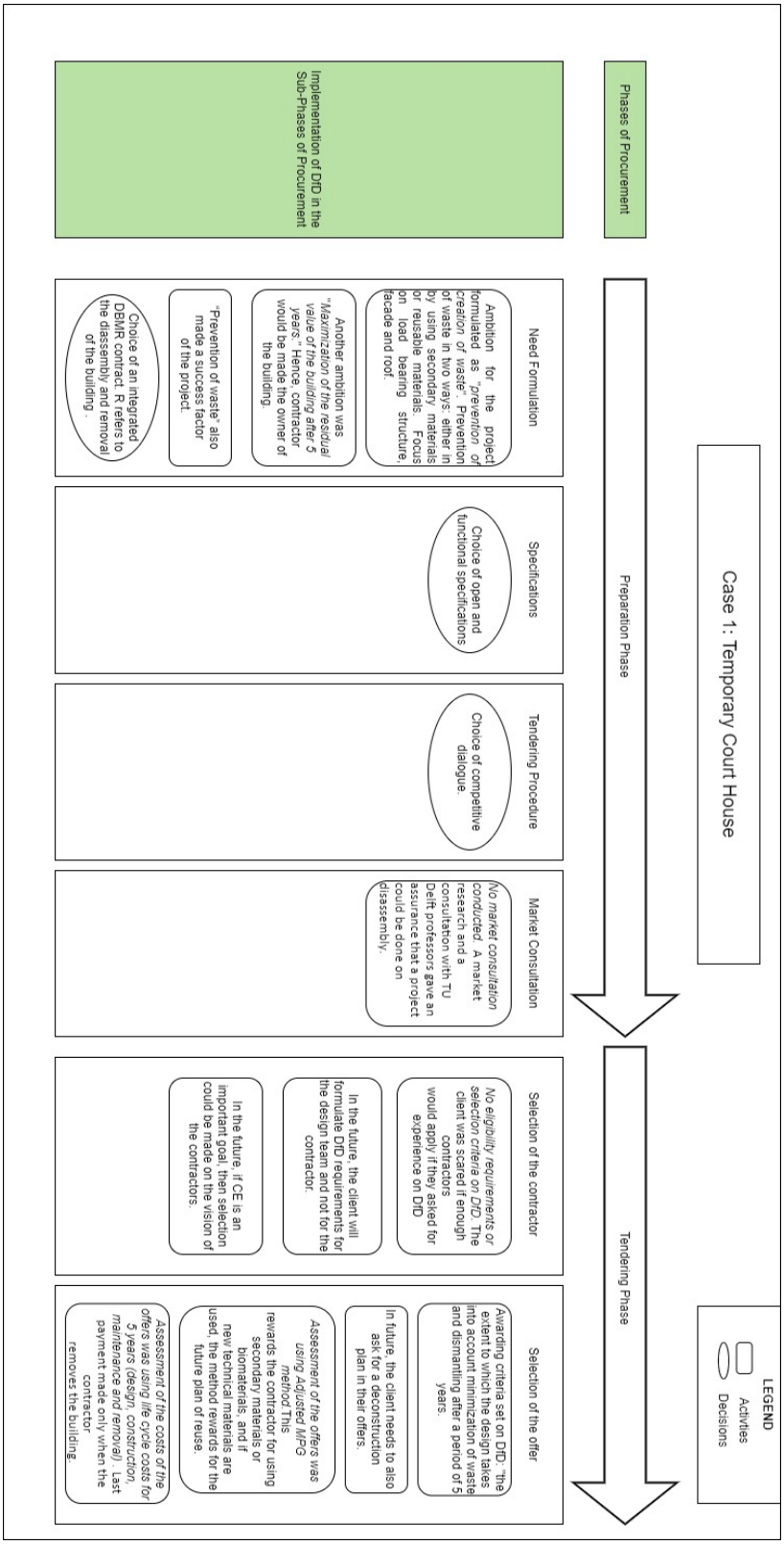

Figure 8: Summary of Case 1 (own illustration)

4.1.5 Confirmation Meeting

After writing the individual case report, a confirmation meeting was held to confirm and verify the findings of the case. This meeting was conducted at Rijksvastgoedbedrijf, with a total of five candidates. Out of the five candidates, three of them were previously interviewed for case 1, one of them for case 2, and the last one was an additional expert on the circular economy. The additional expert was involved to know his opinion on the case findings. The detailed information about the roles they played in the cases is mentioned in section 3.6. The meeting was conducted for an hour in the RvB office at Hague.

The candidates confirmed the findings presented for Case 1 and approved that the findings were representative of how case 1 was conducted. They also found the method followed for the reporting informative and logical to follow. The candidates did not mention anything about any aspect missing from the reporting of the cases.

The results presented during the meeting for Case 1 and the detailed explanation of how the confirmation meeting occurred has been included in Appendix D: Confirmation meeting for the temporary courthouse case.

4.2 THE CIRCULAR PAVILION

4.2.1 Introduction

Rijksvastgoedbedrijf, while procuring for the redevelopment of the Knoopkazerne office in the Utrecht, also requested for a solution for the vacant space between the Knoopkazerne and the adjacent Rabobank head office in the same tender. The reason for the same was that a definitive destination for that vacant space would be available only after 15 years (cepezed, 2019b). So, to avoid the gap in urban development and keep the area near the vacant space more socially safe and lively, Rijksvastgoedbedrijf asked for a temporary building for 15 years. The project was awarded to the consortium R Creators, and they came up with an idea of a restaurant named “The Green House”. The Green House (or the Circular Pavilion) is a completely demountable building, and after 15 years, the pavilion can be moved to another location, and the vacated land can be used for another purpose (Ballast Nedam, 2019). Even the foundation can be dismantled. The consortium also tried using secondary components as much as possible for the building; they used the glass façade cladding of the Knoop office building in the Green House. Another important characteristic of the pavilion is that many products inside the building are leased (thus remain in possession of the supplier), resulting in a fully circular business model (Albron, 2019).

Figure 9: The Green House (cepezed, 2019b)

Table 7: Details about the case "The Circular Pavilion" (Albron, 2019):

Client	Rijksvastgoedbedrijf
Contractor	R Creators- Strukton, Ballast Nedam, Facilicom and Albron
Net surface area	600 m2
Type of contract	DBMFO
Date of Completion (of construction)	2017

The roles that were interviewed for this case are:

Interview Number	Roles	Organization
CASE 2		
8	Project Manager	Client
9	Technical Manager/ Sustainability advisor	Client
10	Architect	Client
11	Technical manager	Client
12	Project manager/ Tender manager	Contractor

4.2.2 Procurement

This section contains a description of how the different phases of the procurement process were organized for awarding the contract for “The Green House”.

1. Preparation Phase

In this section, the findings for different sub-phases under the definition phase: *need formulation, specifications, the tendering procedure, and market consultation* have been given. The findings for the preparation phase are:

a) Need Formulation

As mentioned in the introduction, the client was looking for a pavilion for the vacant space for 15 years to make the space lively and socially safe. The client did not mention what the purpose or the function of the pavilion had to be and provided the contractor with the freedom to choose the function (Appendix 8; Appendix 9). The contractor could choose a barbershop or a restaurant; the client was okay with that (Appendix 10). The client procured a contractor for both the projects, the redevelopment of the Knoop office, and the pavilion together, but the main project was the Knoop office. Hence, there was only one requirement for the pavilion, and it was one of the output specifications (Appendix 9).

The ambition document had no ambition for DfD or on the usage of the materials for the pavilion, but the ambition document had a mention about the sustainable partnership, a new way of working together. The ambition document mentioned that the focus of the project was not just the content of the project but also on the relationship. The document read that the content of any project is temporary and subject to change, whereas the relationship is long and solid, so if the relationship is good, the content of the project does not know any insurmountable obstacles and the other way around is not the case. The client was looking for a partner who had the following core competencies: pro-active, flexible, innovative sustainability, co-creation, synergy, added value chain integration, creative, and respect and trust (Rijksvastgoedbedrijf, 2013b).

In the interviews, the client mentioned that circularity was not an item when the procurement process was started (Appendix 8). Nevertheless, the client said in general that the contractor could be stimulated to work on circular ambitions in two ways, one by asking for technical demands and the other one by working together (Appendix 9). The client mentioned that the contractors must not be looked at as an opponent but as someone who is required to reach the goal of the client (Appendix 8).

There was no key success factor concerning the circular ambitions mentioned for the pavilion in the ambition document (Rijksvastgoedbedrijf, 2013b).

The type of contract chosen for both the projects together was a Design, Build, Finance, Maintain and Operate (DBFMO) contract. In the interview, the client mentioned that quality is intrinsic in the concept of an integrated contract and that it stimulates circularity. It makes the contractor rethink every phase of the life cycle of the building. It is a trigger for the contractor to reduce, reuse and rethink and keep the operational costs lower (Appendix 9)

b) *Specifications*

For this project, the only requirement concerning DfD for the pavilion was (Rijksvastgoedbedrijf, 2015):

"*The materials or the entire pavilion must be reused after 15 years (the period of use).*" (Appendix 9; Appendix 11).

The client mentioned that this requirement was a minimum requirement and a light requirement. The contract was not awarded to the contractor based on DfD, so any contractor, once chosen, was bound to deal with the requirements of DfD (Appendix 9).

The client said that this requirement did trigger the contractor (consortium R creators) to think differently about the usage of materials or about the investments they made on the pavilion, but the contractor did what he did because he was their partner (a new way of working: sustainable partnership). The client said that once the redevelopment of the Knoop office was in full swing, the contractor asked himself "How he can contribute to the long term goal of the government of being circular" and how it is in line with his own goal. The client continued that the contractor thought how he could set an example for his company and the client he is working for. The client said that the investment they made in the relationship was very important and was the basis for the contractor to act as he did concerning the pavilion. In conclusion, the client told that if he were just another contractor that the client had selected in the process, the contractor would have taken the easiest way to fulfil the obligations that were written down. The new way of working made him challenge himself (Appendix 8)

Another interviewee from the client's side said that the freedom that was given to the contractor and having a sustainable partnership helped them achieve what they achieved in the project (Appendix 9; Appendix 10).

In the interview, the contractor mentioned that the requirement asked by the client inspired them but did not inspire them enough. What inspired them was their motivation to play an active role in contributing to the sustainable future and the new way of working together. The contractor continued saying that the client RvB wants to be completely circular by 2030, but they want to achieve that goal of the client in 2018+15 years (after 15 years when the pavilion is dismantled). So, in 15 years, when they removed the building, they wanted to be completely circular. Then, they started rethinking about the project and decided to no just fulfil the obligations and have a higher level than the client (Appendix 12).

The client said that for a project on DfD, they should go for open and functional specifications as if they are pinning down all the things, the contractor is not free in thinking of the best solutions. The contractor needs to be given the freedom to make the optimum and get good surprises (Appendix 10).

c) Tendering procedure

The tendering procedure chosen for the project was competitive dialogue (Rijksvastgoedbedrijf, 2014a). In the interviews, the client mentioned that they spent 50 per cent of the time during the dialogue on the topic of the sustainable partnership (Appendix 8).

The client mentioned that competitive dialogue is extremely important for the implementation of DfD as it helps the client make the contractor understand their ambitions, requirements, aim, and the purpose of the project better. The dialogue also helps the client understand what the contractors are thinking and what their vision is (Appendix 8). Another interviewee from the client also mentioned that it is necessary both for a client and a contractor as this helps the contractor know what the client wants and how the contractors can give their maximum (Appendix 10).

The contractor was also of the same opinion. The contractor mentioned that dialogue is essential and the most efficient way for the client to achieve a better level of goals. He mentioned that it is the right time to discuss what is written on the paper, and the client can take suggestions from the contractor for changing the demands if there are any (Appendix 12).

d) Market consultation

In the interviews, the clients told there was no market consultation conducted to check if the contractors were capable of meeting the requirement (Appendix 9). The client mentioned that the consortium R creators held a market consultation for the pavilion to check what is possible to achieve concerning CE (Appendix 10).

2. Tendering Phase

In this section, the findings for the different sub-topics under the tendering phase: *the selection of the contractor and the selection of the offer* have been explained. The findings are:

a) Selection of the contractor

In the interview, the client mentioned that the contractor was not selected based on DfD (Appendix 9). As the client mentioned in the interview, no eligibility requirements related to DfD were set. Also, all the eligibility requirements that were set were for the main project (the redevelopment of the Knoop office) and not for the pavilion.

The selection criteria were not related to the pavilion or on DfD. However, there was one selection criterion based on sustainable partnership. In the selection phase document, the client had mentioned that they would assess the candidate on the ability to work with the client in the exploitation phase of the project. This was in order to achieve optimal results for the client in a planned manner in terms of quality and efficiency (Rijksvastgoedbedrijf, 2013a).

The sub-criteria that played a role in the assessment of the criterion was: Representation of the interests of the clients, Guarantee of the co-operation, and Supply chain management.

The candidates were asked to submit reference projects to demonstrate their abilities. Later, each candidate was interviewed separately for the assessment of sustainable partnership (Rijksvastgoedbedrijf, 2013a).

In the interview, the client mentioned that if CE is an important goal of the project, the contractors can be selected based on their vision (Appendix 8; Appendix 10). Also, the client said that they need to make it explicit in the process that they need a party that has a common goal with the client; otherwise, there will be problems. Even if the interests are not fully aligned, the goal needs to be common (Appendix 8).

Another interviewee from the client's side mentioned that if needed, the client can prescribe the contractor to work with the leaders on DfD (as a consultant or as a sub-contractor). The client can do this without mentioning the names and describing the expertise a contractor must have (Appendix 11).

b) Selection of the offer

The offers submitted by the contractors were assessed based on Most Economically Advantageous Tender (EMAT) criteria. However, there was no awarding criterion related to the DfD (Rijksvastgoedbedrijf, 2014a). As mentioned before, the client told in the interviews that award of the contract was not based on circular ambitions or DfD, but once selected, they were bound to deal with the requirements of DfD (Appendix 9).

The sustainable partnership was one of the awarding criteria in the aspect of quality. The ratio of quality and price was 50/50 per cent in this project, and the criterion sustainable partnership weighted 30 per cent in the aspect of quality (Rijksvastgoedbedrijf, 2014a).

The client told that sustainable partnership was special in this project, and it helped them create much value in the project (Appendix 9). When they started the process, they had sessions with soft factors on how to work together and to be honest with each other (Appendix 10). Throughout the process, both the client and the contractor were honest with each other, and they had open communication about their differences. The client told that that they need to do it more often (Appendix 10). The contractor was also of the same opinion. The contractor told in the interview that they were not just stimulated by the demands or the contract but also by working together. Co-operation and working together had a considerable influence on the process, and it created a win-win situation. The contractor also told that for a project on circular ambitions, most of the influence in the process is after awarding the contract, so co-operation is vital (Appendix 12).

In conclusion, the client told in the interview that since this procurement process occurred in 2013, the requirements were not high. However, now, they ask for much more upfront in the procurement process (Appendix 10).

Assessment

Since DfD was not an award item, the client mentioned in the interview that the offers were not assessed on the basis of DfD (Appendix 9). However, the contractor used the Building Circularity Index to compare their different proposals and choose the most circular design (Appendix 12). To assess the award criterion 'sustainable partnership', a separate assessment team was set up (Appendix 8).

The contractor in the interview mentioned that circular ambitions could be measured using tools like building circularity index, MPG or LCA. However, there is no tool available in the market that can provide an absolute answer. So, it would be hard for the client to compare the contractors based on these tools as the contractors ask for an honest and safe way of measuring the offers (Appendix 12).

Assessment of the cost of the offers

Since the project was awarded using a DBFMO project, life cycle costs were used. In the interview, the client mentioned that the best approach for a DfD project is to have a fixed price and ask the contractors to strive for the highest quality with that price (Appendix 8).

4.2.3 Best Practices

In the interviews, the clients and the contractors were asked what the best practices were in the project. The best practices mentioned were: The client mentioned that the process followed for the project was the same as the other projects except for sustainable partnership. The client told that this was the first time in the Netherlands the project was awarded on the sustainable partnership, and it

brought a lot of added value for circularity. The idea of sustainable partnership was based on the idea that not just what the client demands from the contractor is important; it is also the way those results are achieved (Appendix 9).

The contractor mentioned that the best practice was that they adopted a new way of working together. The contractor told that the knowledge of every person on the team was required for circularity. Therefore, a definite ambition was formulated, and the process was facilitated to take everyone together towards achieving that goal (Appendix 12). The client also mentioned the same and told that co-operation with laborers was also required to achieve the highest level of circularity (Appendix 9).

A summary of the findings of the case has been made in the form of a process model in Figure 10.

4.2.4 Summary of Case 2

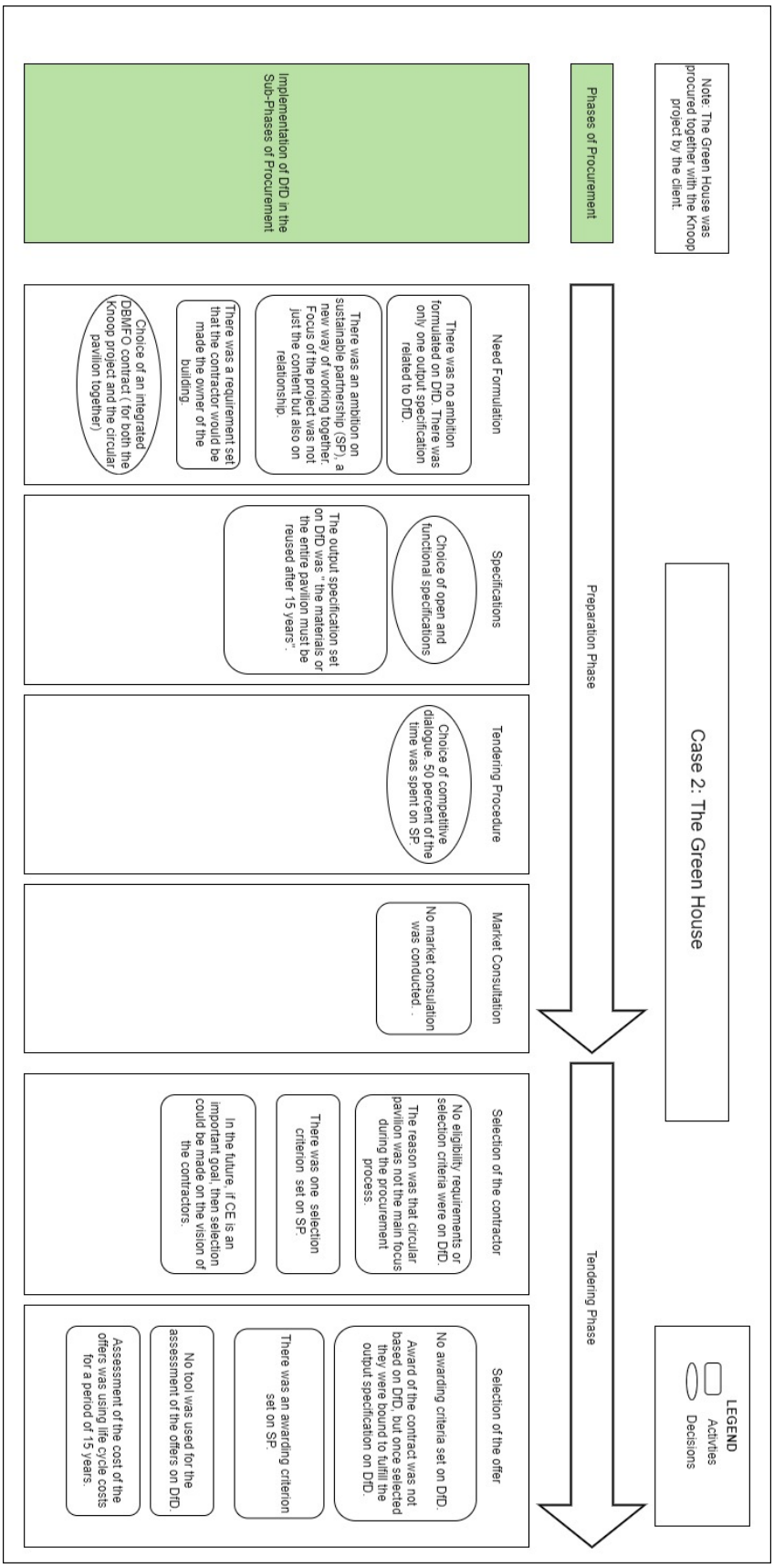

Figure 10: Summary of Case 2 (own illustration)

4.2.5 Confirmation meeting

As mentioned for Case 1, a confirmation meeting was held to verify the findings of the individual case report. The meeting was conducted for an hour at the RvB office (at Hague) with a total of 5 candidates. One of these candidates was previously interviewed for case 2, three of them for case 1, and one of them was an additional expert on the circular economy. The detailed information about the roles they played in the cases is mentioned in section 3.6.

The candidates confirmed the findings presented for Case 2 and approved that the findings were representative of how case 2 was conducted. They also found the method followed for the reporting informative and logical to follow. The candidates did not mention anything about any aspect missing from the reporting of the cases.

However, the candidates made a comment about sustainable partnership. They agreed about partnership being important for the DfD project, especially when a building is being made using secondary materials. Finding available materials and products that fit the technical standard, the architectural ambitions, the budget, and the planning requires partnership. They said that though it is possible to award a contract on this aspect, it is difficult to make it measurable. Therefore, they usually ask for a quality management plan where communication and co-operation with the client have to be worked out by the contractor.

The results presented during the meeting for Case 2 and the detailed explanation of how the confirmation meeting occurred been included in Appendix E: Confirmation meeting for The Green house.

4.3 CROSS- CASE ANALYSIS

After confirming the findings of both the cases, a cross-case analysis was conducted. According to Yin (2003), a comparison can be made between the two cases by creating word tables that display the data for individual cases according to one or more uniform categories. This approach was adopted for the cross-case analysis, and later similarities and differences between the two cases were found (Eisenhardt, 2010). This comparison was made to identify the commonalities and arrive at the cross-case conclusions.

In this section, firstly, the similarities and differences will be identified by placing the process models of both the cases next to each other. Following that, a discussion will be made on the similarities and the differences. Finally, based on this discussion, the main findings from the cross-case analysis will be listed.

4.3.1 Similarities and Differences

The similarities and differences between the two cases have been depicted in Figure 11. The similarities have been marked in green colour, and differences between the cases have been marked in orange colour.

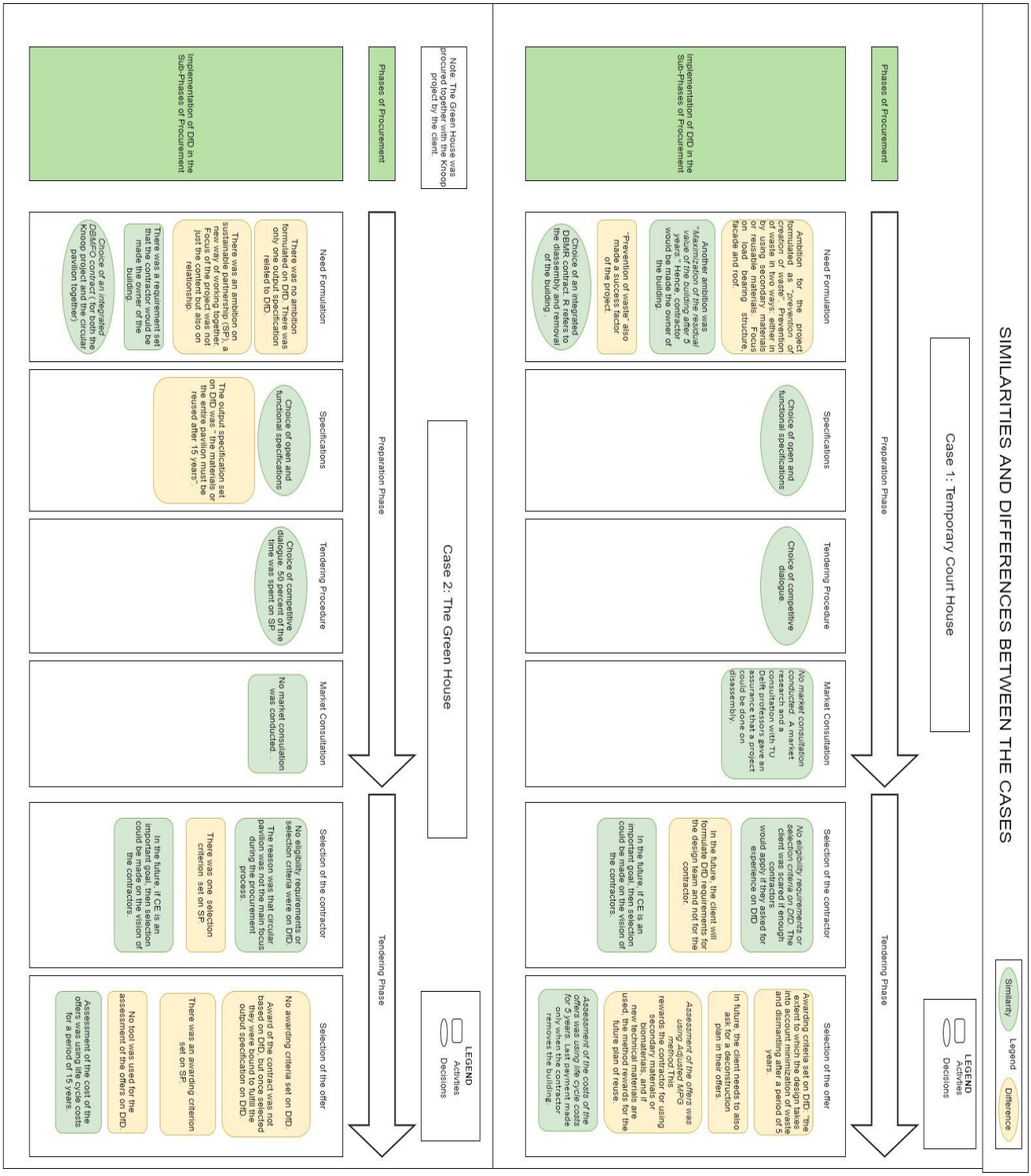

Figure 11: Similarities and differences between the cases (own illustration)

4.3.2 Discussion of the similarities and differences

In this section, the similarities and the differences identified in Figure 11 will be discussed.

The main similarity is that the aim of both clients was preventing the creation of waste. In the first case, they suggested that the contractor could achieve this either by using secondary materials or by using reusable materials. In the second case, they mentioned that the contractor had to reuse the

materials after 15 years. In both cases, this encouraged the contractor to adopt the DfD principle and build a building that could be completely reused after a specific period.

When questioned on the type of contract, both the clients mentioned that an integrated contract is suitable for the implementation of DfD. However, in both cases, there was no compelling reason given as to why an integrated contract is suitable for DfD implementation. Nevertheless, when we take a look at the first case, the client, through a DBMR contract, made the contractor responsible for also the removal phase of the building. Since the contractor themselves were responsible for the removal, this could have stimulated the contractor to focus on the deconstruction process while making their design. The client also had a penalty for the contractor if he failed to remove the building after 5 years. Therefore, a choice of DBMR contract can stimulate the implementation of DfD, but this could be done only when the lifetime of the building is known.

In the specifications phase, both the cases mentioned that open or functional specifications were more suitable for a project on DfD. They attributed this to the fact of them getting a better solution than they expected from the contractors. Since there exists a difference of knowledge between the client and the contractor, the open approach could be more suitable for a project on DfD.

In both cases, the contractor was made the owner of the building. This stimulated the contractor to use reusable components in the buildings as he had a business case only when he reused the building after the end of the contract. Also, this makes the contractor focus on the deconstruction phase while making their design as if he unable to deconstruct efficiently in the future; he is at a loss. However, the contractor can be made the owner only when the lifetime of the building is known.

Competitive dialogue (CD) was mentioned as a suitable procedure for implementing DfD. The client mentioned that it helped them make the contractor understand the open question better, and the contractor also agreed to the same. However, the reason given during the case study implies that CD is suitable when they adopt an open question, and it does not have a relation specifically to DfD.

No market consultation was conducted in both cases. In the first case, they conducted market research online and consultation with TU Delft to know the feasibility of working on DfD. However, in the second case, no market consultation was conducted. This could be for the reason that “The circular pavilion” project was not the main focus during the procurement process. Even during the explorative interviews (for both cases), the clients did not mention anything regarding the importance of having a market consultation for implementing DfD in their future projects.

While selecting the contractors, both the cases did not set eligibility requirements or selection criteria asking for experience with DfD. In the first case, this was because the clients were skeptical of finding a sufficient number of contractors for the tendering phase. However, in the second case, this was due to the Circular Pavilion project, not being the main focus during the procurement process. Nevertheless, in the first case, the client mentioned that in their future projects on DfD, they would set requirements for the design team and not for the contractor. This is due to the importance of the design team having experience with DfD to work on a project on DfD. Whereas for the contractor, the client realized that after the completion of the project that the construction of a demountable building is not revolutionary, and it mainly involved bolting instead of gluing. Therefore, they would set requirements only for the design team. However, there was no mention of the specific competencies that the design team needs to possess.

During the assessment, life cycle costs were used in both cases. In both cases, they mentioned the importance of looking at all the phases of the life cycle for DfD, as this could also make the building ultimately cheaper. In the first case, the client has also assigned some costs for the removal phase. So,

if the contractor demolishes the building, he will have to face a penalty. This strategy stimulates the contractor to implement DfD and ensure the deconstruction occurs.

While observing the differences, the main difference found between both the cases was: In the first case, the client got a demountable building through technical demands, but in the second case, they got it through technical demands and by having a good partnership. Even though in the first case, the partnership was not exclusively mentioned as their ambition, the client mentioned that the final result turned out to be good because of the co-operation between them and the contractor. The contractor also mentioned the same. Therefore, the partnership played an important role in both the projects. However, the partnership aspect could have been significant due to the innovations involved in the project. These innovations usually bring certain uncertainties in the project, and they could be better dealt with a partnership between the client and the contractor (*as mentioned in the ambition of the second case*). Since both the client and the contractor are quite new to the DfD principle, a partnership might be required to deal with the uncertainties that might come up in the project. Therefore, currently, the partnership could be regarded as one of the important aspects for the implementation of DfD. However, in the confirmation meeting, the experts mentioned that it might be difficult to award on this aspect as it is difficult to measure, so instead, they ask for a quality management plan in the offers. The contractor works out a strategy for co-operation and communication between the client and the contractor in this plan.

Another major difference between both the cases was on how the contract was awarded based on DfD. In the first case, the client awarded the contract based on the criterion 'the design that minimizes waste and also demonstrates dismantling after five years'. However, in the second case, there was no awarding criterion related to DfD, and this is due to the reason that this project was not the main focus. In the first case, this criterion stimulated them to implement DfD as it asked for a design that could be dismantled to minimize the waste. Also, in the first case, mention was made about the importance of asking for a deconstruction plan in the offers in future projects. This influences the designer to think about how he can undo his design from the first phase of designing in the project.

The last difference between the projects is the tool used for the assessment of DfD in both the projects. In the second case, the contract was not awarded based on DfD; hence, they did not use any tools for the assessment. In the first case, the adjusted MPG method was used, and it rewarded the contractor for using secondary materials. If they used new materials, the tool rewarded them for the future plan of reuse. Since this method rewarded for the future plan of reuse, it could have stimulated the contractor to implement the DfD principle in their design. Also, since the tool rewarded the credibility of future plans, the client also encouraged them to reuse it in the future and achieve circular ambitions. However, the client mentioned that assessing the credibility was not foolproof as all the contractors scored the same on the credibility part and also, this method could be used only when the lifetime of the project is known.

4.3.3 Cross-Case Conclusions

In the previous section, a discussion was made on the similarities and differences between the two cases. Based on this discussion, the main findings on how the client implemented DfD in their procurement process are (Figure 12)

In the need formulation phase, the client implemented the ambition for DfD as prevention of the creation of waste. They encouraged the contractor to use reused materials or reusable materials in

the building. The client made the contractor the owner of the building to ensure the contractor is financially stimulated to reuse the buildings after the project ends.

When choosing the type of contract, the client chose the DBMR contact for the project, where the contractor is also responsible for the last phase, the removal of the building.

While selecting the consortium, the client will set requirements for the design team as it is important for them to have the experience to work on a project with DfD.

In selecting the offer, the client awarded the design that demonstrated the dismantling concept and also minimized the amount of waste. The waste could be minimized by using reused or reusable materials. The client suggested the importance of asking for a deconstruction plan along with the offers. The client can also ask for a quality management plan in the offers as partnership plays an important role in dealing with the uncertainties involved in the DfD project.

For the assessment of the offers, the modified MPG method was used. This rewarded the contractor for using reused materials or for having a future plan of reuse for new materials. For the assessment of the costs, life cycle costs were used. The client has planned in such a way that the last payment will be made only when the contractor removes the building.

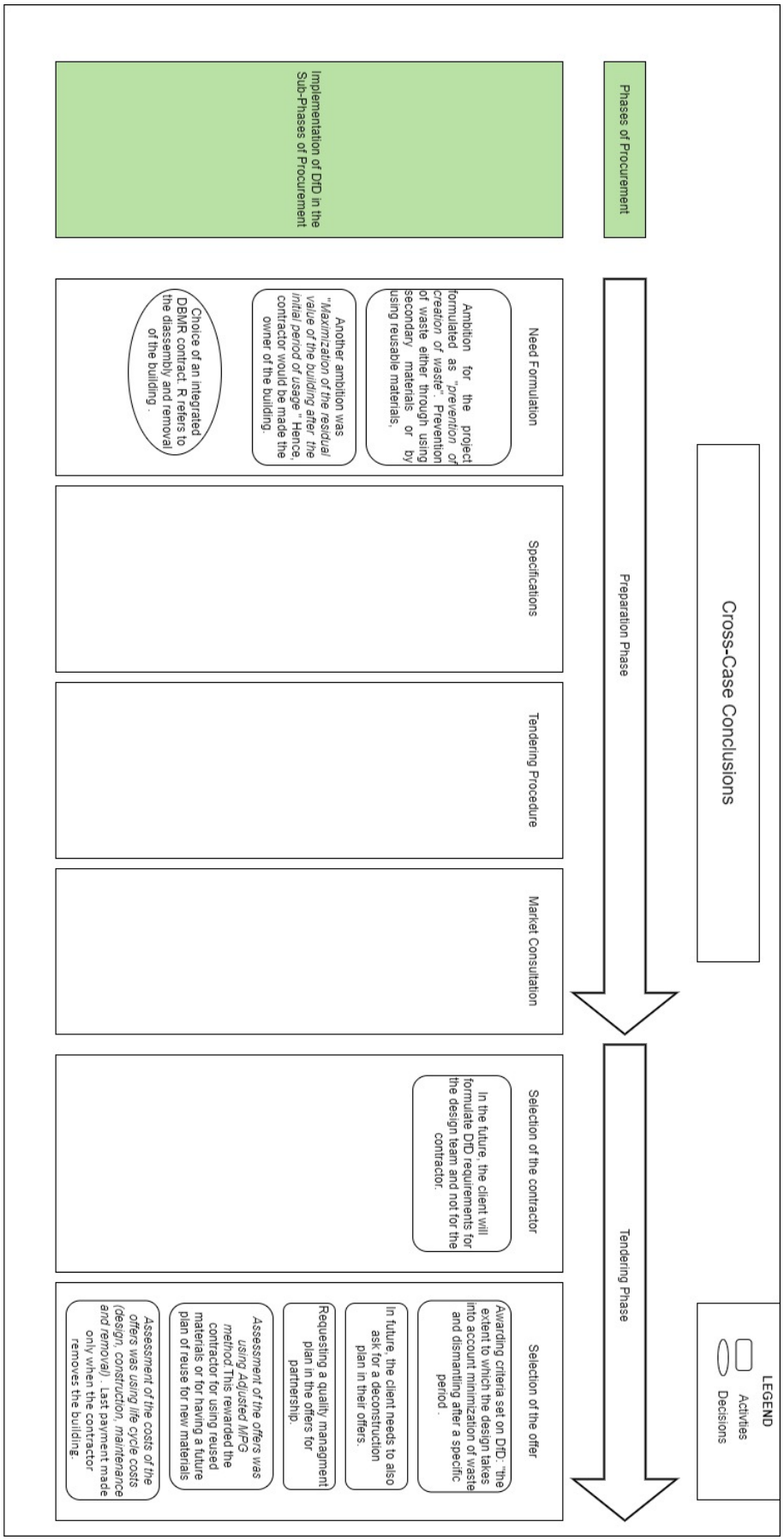

Figure 12: Cross-Case Conclusions (own illustration)

5 DISCUSSION

In this chapter, a comparison will be made between the results of the cross-case conclusions and the conceptual framework, and the conceptual implications of this comparison will be discussed.

In section 5.1, the comparison will be made between the empirical results and the conceptual framework. Later in section 5.2, a discussion will be made as to how reflective the empirical cases were of DfD based procurement process. Based on the discussion in section 5.1 and 5.2, the conceptual implications will be discussed, and the conceptual framework will be refined in section 5.3 Finally, in section 5.4, a discussion will be made on implications for the public procurement process when changing its practices as guided by the DfD principle.

5.1 COMPARISON OF THE EMPIRICAL RESULTS WITH THE CONCEPTUAL FRAMEWORK (CF)

For the need formulation phase, Guy & Ciarimboli (2005) mentioned that the client needs to hire a design team who is specialized in sustainable design and DfD for the formulation of ambition on DfD. In the case study, there was no comment made by the client regarding the same during the interviews. However, in the case, both the sustainability advisor and the architect who is specialized in sustainable design were involved in formulating the ambition for DfD in the project.

Also, in the need formulation phase, Guy & Ciarimboli (2005) mentioned that the design team needs to formulate an ambition on DfD based on the consideration that DfD is most effective when it permits maximum flexibility. Beyond that, they need to design for future reuse. In the case study, an ambition was formulated for DfD by the client, and this was to design for future reuse. However, no discussion was made about having flexibility in the design or on what would be the multiple functions of the building. A reason for this could be the temporary nature of the building. The client was certain that the building would be used only for a temporary period, and the function would remain the same. Hence, the client was aiming only for the design for future reuse. However, it would be important for the client to primarily consider the multiple functions of the building and aim at improving the adaptability and flexibility of the building through DfD.

Thirdly, for the need formulation phase, no clear preference for the type of contract existed in literature. The only recommendation was to have a contract that involved the expertise of the contractor in the conceptual design phase (Guy & Ciarimboli, 2005). In the case study, an integrated contract DBMR contract was chosen. This indeed involved the expertise of the contractor in the conceptual design phase and stimulated the contractor to understand the implications of the disassembly phase while making the design. However, a DBMR contract can be used only when the lifetime of the project is known, making it not suitable for projects where the lifetime of the project is not pre-determined.

In the need formulation phase, another important observation in the case study was that the client mentioned that the contractor would be made the owner of the building. This stimulated the contractor financially to design for reuse. There was no mention made regarding the same in the literature. Also, this strategy can also be used only when the lifetime of the project is known.

When looking at the selection phase, a recommendation was made in the conceptual framework to set eligibility requirements for the design team, asking for the right competence and the experience. Akinade et al., (2017) and Densley Tingley (2012) mention that the design team needs to have the right competence, training, and will to work with DfD. The same was found in the case study. The client

mentioned that they would set a requirement for the design team as it is important for them to have experience with DfD to work on a project on DfD. However, no mention was made in the case study on what competencies are essential for the design team.

Further, Guy & Ciarimboli (2005) and Densley Tingley (2012) mention that contractor has to obtain initial training on DfD during the conceptual design stage and advise the design team during the schematic design stage. Therefore, training or experience with DfD can be considered beneficial, but this is not mentioned as a pre-requisite to work on DfD. Therefore, a recommendation was made in the conceptual framework not to set eligibility requirements for the contractor. The same was mentioned in the case study. The client mentioned that in the future, they would not set requirements for the contractor as the construction for DfD was not revolutionary. It mainly involved bolting instead of glueing with little innovation.

Also, for the selection of the contractor phase, a recommendation was made in the conceptual framework that a requirement is set to include the deconstruction professionals in the consortium. Akinade et al. (2017) mentioned that it is important that early involvement of demolition and deconstruction professionals occurs in a project on DfD so that they are involved in the design stage. However, there was no such empirical finding regarding the same. The reason could be that in the case study, the contractor was the owner and also responsible for the removal of the building. Since the contractor was responsible for the deconstruction process himself, and the client might not have felt the need to influence the deconstruction process by involving a deconstruction professional. Another reason could be that the case study had completed only the design and the construction phase of the project. The project is yet to undergo the removal phase. Therefore, the client is yet to see how the disassembly phase takes place and how they could have better influenced this removal phase through the procurement process. This could have led to the client not making any recommendation for the inclusion of a deconstruction professional. However, it would be important that a requirement is included to include the deconstruction professionals, as this ensures effective implementation of the DfD principle in the design stage. This is especially true in the case where the client himself would be responsible for the deconstruction of the building.

While selecting the offers, a recommendation was made to award the contract based on the principles of DfD. Crowther (2005) mentioned that these principles offer design guidance for DfD and indicate the effectiveness of the DfD application. Based on all the reviewed articles, the principles were classified into 'overall building design principles', 'material and connection principles' and 'construction and deconstruction phase principles. In the case study, however, the client checked only if the contractor used reused or reusable materials. Therefore, the client focused only on one 'material and connections' principle of DfD. For instance, the client did not check if the contractor had designed in the form of layers, what connections were used between the components, or if it was designed to allow for parallel disassembly. The client did not assess for 'overall building design principles', 'construction and deconstruction' principles, and other principles on the connections between the components. The reason for this could be that, in the case study, the contractor was made responsible for the removal and deconstruction of the building. Therefore, the client might not have assessed how effective the design was for deconstruction by checking for other principles. Another reason is that the project is yet to undergo the disassembly phase. Therefore, the client is yet to see the application of which other principles would lead to effective implementation of DfD. This could have led to them not making any recommendation regarding the implementation of other principles of DfD for their future projects. However, it would be necessary for the client to award on other principles of DfD mentioned in CF as this ensures the client awards the contract to the design that has most effectively implemented

DfD. This is especially important if the contractor is just responsible for the design and construction (and/ or maintenance), but the client is responsible for the ultimate disassembly of the building.

However, in the case study, in selecting the offers, the mention was made about the importance of asking for a deconstruction plan in the offers during the case study. This is one of the important principles mentioned under the 'construction and deconstruction' phase.

Another observation in the case study was the importance of a partnership between the client and the contractor for a project on DfD. The client suggested asking for a quality management plan in the offers to improve co-operation and communication. However, there was no such recommendation made in CF. The reason could be that the CF was made taking into consideration only the technical aspects of DfD and therefore, it did not consider the role of the relationship between the client and the contractor for a project on DfD.

While assessing the offers, in the CF, a suggestion was made for the usage of a BIM-based tool to assess the principles of DfD. Akinade et al. (2015) presented a BIM-based tool that provides an absolute number on the extent to which a building can be deconstructed. This model assesses the design for the application of the principles of DfD. However, in the case study, the client did not use a BIM-based tool, and they did check for the overall effectiveness of DfD. They assessed only for the material principle of DfD. The reason for this again could be attributed to the contractor being made responsible for the removal phase of the building. However, it would be important that the client assessed the offers based on the other principles of DfD as well to award the design that has most effectively implemented DfD. However, an interesting observation in the case study is that the client rewarded the contractor for having a future plan of reuse and also on the credibility of the plan. When the lifetime of the building is known, this stimulates the contractor to think about how they plan to use the components in the future. This gives a better assurance that the demountable building will be reused stimulating CE.

For the assessment of the costs, Guy & Ciarimboli (2005) mentioned the importance of considering the upfront, operating, and back end costs for DfD during the design stage so that a decision is made in the view of the future use and future costs of the building. The same was found in the case study, where the client recommended the usage of life cycle costs for the assessment of the costs of the offers. They considered the costs associated from the design phase until the removal phase of the building. The client made the last payment when the contractor removed the building. This last payment stimulates the contractor to implement DfD in the design and also not to demolish the building at the end. However, the future value of the materials and components was not considered during the assessment of the costs. Though this is difficult to quantify, and this makes the calculations complex, this ensures the future value of the building is considered during the design stage.

5.2 REFLECTION ON THE CASES STUDIED

After the comparison was made in the previous section, it is important to discuss to what extent the cases were reflective of a DfD based procurement process. Both the cases chosen for this research were temporary in nature and formulated the ambition as design for future reuse. They did not consider the aspect of the adaptability and only focused on obtaining a building that can ultimately be dismantled after the initial period of usage. Both the ambition and the awarding criteria focused only on obtaining a completely demountable building that can be reused in the future. The implementation of the DfD principle is most effective when a building is designed for flexibility, and beyond that, it's designed for future reuse. Therefore, though DfD as a concept was implemented in the project, it was

not effectively implemented. An observation can be made that the cases are partially reflective of DfD based procurement process as they only reflect the implementation of the DfD principle for eventual dismantlement and do not focus on adaptability.

Also, the strategies they adopted in the cases like a DBMR contract, making the contractor the owner of the building, assessing the future plan of reuse can be adopted only for a temporary building with a pre-determined lifetime. Therefore, the cases studied are mainly reflective of a DfD based procurement process for a building with a pre-determined lifetime. These strategies might be difficult to apply for a building whose lifetime is unknown during the procurement process.

Another observation from the case studies is that though both the cases are from the same client, both of them were procured by two completely different teams. Also, this was the first time both the teams were implementing DfD in their cases. Further, when the case study was conducted, the projects had completed only the design and the construction phases of the life cycle of the building. The projects are yet to be disassembled. Therefore, the client is yet to understand how effective their implementation of DfD has been. Thereby, the strategies they suggested for better implementation in the future have been made from the perspective of only the design and the construction phase of a demountable building. This again implies that the cases were not completely reflective of DfD based procurement process.

Considering the above three points, a conclusion can be made that the cases were only partially reflective of DfD based procurement process.

5.3 CONCEPTUAL IMPLICATIONS

Based on the discussion in section 5.1 and 5.2, the implications for the conceptual framework will be discussed in this section leading to the refinement of the conceptual framework. The conceptual framework will be refined to include only the key activities or the decisions that are responsible for the implementation of DfD in the procurement process. This is to ensure a critical reflection occurs on all the activities and decisions that were conceptualized from the literature study, and a focus is brought only on the activities (or decisions) that play a key role.

In the need formulation phase, selection of the contractor phase, and the selection of the offer phase, the empirical findings were partially reflective of findings conceptualized from the literature review. However, there were some findings that were found from the empirical cases which were not present in the conceptual framework. They are:

In the need formulation phase, the client making an ambition to make the contractor the owner of the building to encourage the contractor financially to design for future reuse. However, this activity might not individually stimulate the implementation of DfD. This also requires ambition to be formulated for designing for future reuse. Therefore, this activity does not significantly contribute to the implementation of the DfD principle. It can only be implemented as an addition to other activities for facilitating the implementation of DfD. Also, this activity can be implemented only when the lifetime of the project is determined. Thereby, this activity will not be added to the framework.

Secondly, in the need formulation phase, a new finding was the client choosing a DBMR integrated contract. Though this contract involved the expertise of the contractor in the design stage to implement the construction techniques that support DfD in the design, this cannot be regarded as the most suitable type of contract for a project on DfD. There are other types of integrated contracts and also contracts like an alliance model, design team or innovation partnership that also involve the

contractor in the design phase. They could be better than the DBMR contract for DfD implementation. Also, the DBMR contract can be applied only when the lifetime of the project is pre-determined. Thereby, no change will be made to the conceptual framework regarding the choice of the type of contract. However, in this research, the conceptualization is being made for an integrated contract which already implies the involvement of the contractor in the design phase. Also, no conclusion could be made on the type of integrated contract that would be most suitable for DfD implementation or if there is any other type of contract that would be better than the integrated contract. Hence, this decision regarding the choice of the type of contract will be removed from the framework.

In the selection of the offer phase, a new finding found was the recommendation to ask for a quality management plan for better co-operation between the contractor and the client. This strategy is currently important as DfD implementation is not mainstream yet, and there might be some uncertainties involved in the project on DfD. However, this might not hold true once the client and the contractor have executed a certain number of projects on DfD. Therefore, due to this aspect being valid for a certain period of time, this aspect will not be added to the conceptual framework.

Finally, in the selection of the offers, the new finding found in the cases was to assess the future plan of reuse and its credibility when the lifetime of the building is pre-determined. This activity will also not be added to the conceptual framework as, though it is a good solution for CE, it is not the best way forward. Indeed, using materials that can be reused in the future helps for DfD implementation but having a future plan of reuse might not be the best strategy involved. For instance, a contractor makes a plan to sell it to a person situated 100 km from the building after five years. However, later, after five years, if there is a need for those materials somewhere closer than 100 km, transporting it 100 km would not be the best strategy for achieving circular ambitions. Also, in the case study, the client mentioned that assessing the credibility was not foolproof as all the tenderers scored the same on the credibility part.

Another important observation from the case study is that the main findings that (in general) significantly contributed to the implementation of the DfD principle were only from the need formulation phase, selection of the contractor phase, and the selection of the offer phase. These were: formulation of an ambition on DfD, awarding the contract based on DfD principles, the importance of the design team in the entire process (both in the client's team and in the consortium), a tool for assessment of the principles of DfD, and assessment of the life cycle costs. An inference can be drawn that the findings for the specifications phase (the type of specifications), tendering procedure phase (the type of tendering procedure), or the market consultation phase that were formulated in the CF do not alone contribute to the implementation of DfD in the procurement process. They can be applied as an addition for facilitating the implementation. Therefore, the findings of these phases do not significantly contribute to the implementation of the DfD principle. These activities will be removed from the framework.

With regards to the recommendation of setting only selection criteria for the contractor (from the conceptual framework) and also finding in the case study that the client would not set requirements for the contractor implies that this is not of the main activities needed for implementing DfD. Therefore, this activity will be removed from the framework.

The updated framework has been depicted in Figure 13. The activities that were previously existing in the CF and were found to be similar (or partially similar) to the empirical findings have been marked in yellow.

An observation can be made that only the recommendation to include the deconstruction professionals and the assessment of the offers using BIM-based tools in not coloured in yellow.

However, this is not removed from the framework due to the significant role they play in effective implementation of DfD during the design phase.

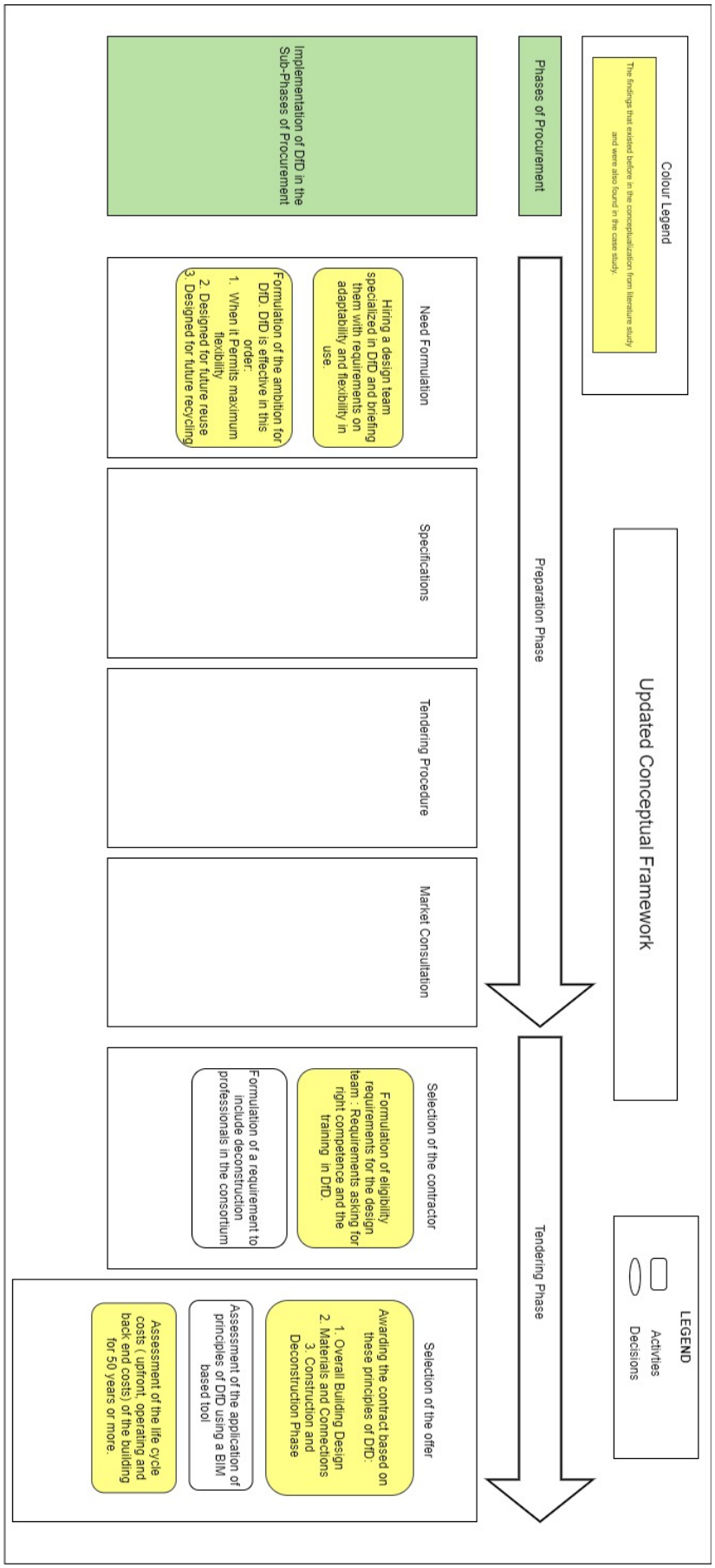

Figure 13: Updated Conceptual Framework (own illustration)

5.4 DFD AND CHANGE IN THE PROCUREMENT PROCESS

In the CF, a proposition was made that implementing DfD does not bring any changes in the type or number of phases that are usually conducted for a general procurement process. A proposition that adding DfD does not result in any addition of a new phase or significant changes to already existing phases. This proposition is confirmed in the case study, where implementing DfD did not bring in a significant change in the procurement process. Also, the client mentioned in the interviews that the process followed for both the cases was just the same as any other project. The only change in the first case was having an awarding criterion on DfD, and in the second case, was having a sustainable partnership. In all, only the activities and decisions taken in each phase were in line with the principle of DfD. This is reflected in the final conceptualization of DfD based procurement process. The main findings for DfD implementation are only from the need formulation phase, selection of the contractor phase and the selection of the offer phase. In addition, only certain activities related to DfD need to be implemented in them not bringing any major modification in these phases. Therefore, a conclusion can be made that implementing DfD in the public procurement process does not result in the fundamental change in the way the procurement process is conducted.

6 CONCLUSION

In this chapter, firstly, the main research question will be answered in section 6.1. Later in section 6.2, the limitations of this research will be explained, and recommendations for future research will be made based on these limitations. Later, in section 6.3, other recommendations for future research will be made. Finally, in section 6.4, some recommendations for practice will be made.

6.1 ANSWER TO THE MAIN RESEARCH QUESTION

The main research question formulated for this research was: ***"How should the implementation of the DfD principle be conceptualized in the public procurement process of buildings in the Netherlands?"***

To answer this question, initially, a literature study was conducted to conceptualize the implementation of the DfD principle in the procurement process. Later, two case studies were conducted to understand how public clients have implemented DfD in their procurement process. Based on the case study results, the conceptualization of DfD based procurement process (that was made from the literature study) was refined. The final conceptualization has been depicted in Figure A.

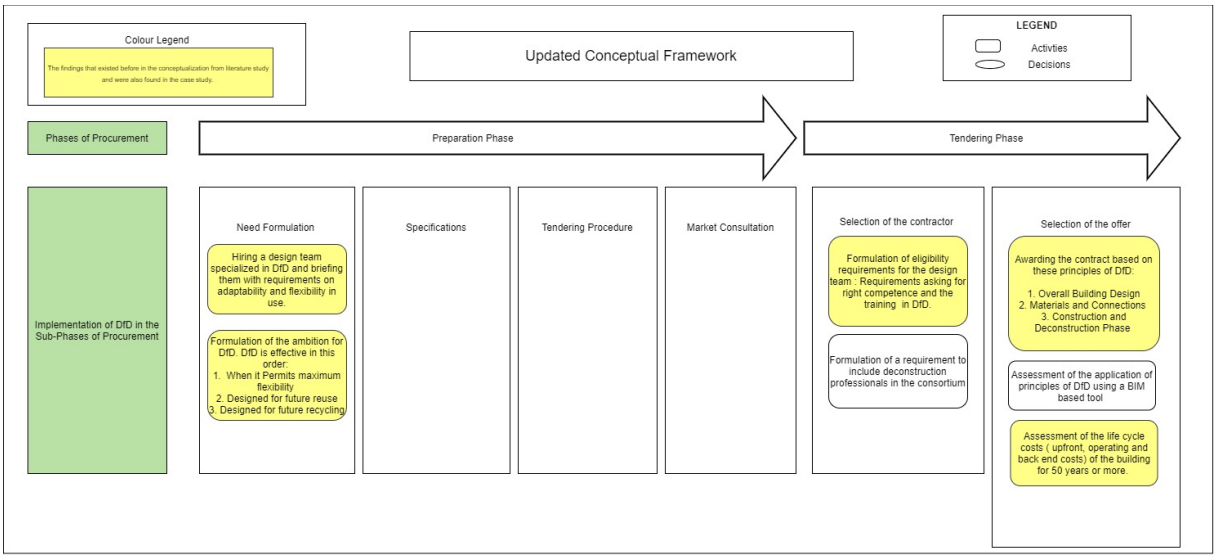

Figure A: Final conceptualization (own illustration)

Based on this final conceptualization, the key activities that are responsible for DfD implementation are:

In the need formulation phase, the public client needs to hire a design team that is specialized in DfD and sustainable design. Later, the public client needs to brief them on the critical requirements for upgrading, adaptability and flexibility in use. The design team can demonstrate the best practices of DfD to the client, and investigate what strategy of DfD would be suitable for the project (based on building type and client needs). Based on the same, the design team needs to set the ambition for DfD. While formulating the ambition for DfD, the design team needs to keep in mind that DfD is most effective when it offers maximum flexibility in spatial configuration. Beyond that, they need to plan for future reuse, and when that is not possible, they need to resort to designing for future recycling.

Later, in the selection of the contractor phase, the client needs to set eligibility requirements for the design team. It is imperative that the design team has the right competence, will and training to work on a project with Dfd. They need to be trained in the design process for designing demountable buildings, knowledge of the code for acceptable DfD, design documentation for DfD, use of BIM-based software and other tools for DfD, design for effective material handling and design for safe disassembly.

Also, in the selection of the contractor phase, the client needs to set a requirement to include the deconstruction professionals in the consortium. This is to ensure that deconstruction professionals are involved early in the project from the design stage. This involvement of the deconstruction professionals helps the design team in identifying the construction techniques that support DfD and effectively implement the DfD principle in the design.

Finally, in the selection of the offer phase, the client needs to award the contract based on "overall building design", "materials and connections" and "construction and deconstruction phase" principles of DfD. These principles offer as a design guide for DfD and indicate how effectively the DfD principle has been implemented in the design. This ensures the contract is awarded to the offer that has most effectively implemented the DfD principle. These offers can be assessed using BIM-based tools that assess the design for the application of these principles of DfD and provide an absolute number on DfD implementation.

Also, in the selection of the offer phase, another important activity is the assessment of the cost of the offers. The client needs to assess the offers using life cycle costs. This implies the client checks the upfront, operating and back end costs in the view of its future use and future costs of the buildings. This could be assessed for a period of 50 years or more.

The main conclusion from this study was that implementing DfD in the public procurement process does not bring a fundamental change in how a general public procurement process is conducted. This implies that implementation of DfD did not bring in any addition of a new phase or bring significant changes in the already existing phases. Only, some of the activities that are conducted in the need formulation phase, selection of the contractor phase and the selection of the offer phase need to be made in line with DfD.

6.2 LIMITATIONS OF THE RESEARCH AND RECOMMENDATIONS FOR FUTURE RESEARCH

The main limitations will be explained in this section. Based on these limitations, recommendations will be made for further research.

Firstly, this research could study only two cases due to time constraint. Therefore, this research could refine the conceptualization based on only these two cases. In addition to this, both cases were from the same client. The procurement process model adopted by different public clients might slightly differ from each other. *Therefore, it is recommended to conduct similar research with more number of cases and cases from different clients to provide an approach that can be generalized for the public procurement process as a whole.*

Another limitation was that both the cases studied were temporary in nature. Due to this reason, in both cases, the client asked for design for future reuse. They did not consider the multiple functions of the building and ask for adaptability or flexibility (which is when DfD is most effective). Also, the strategies they adopted like a DBMR contract or making the contractor the owner of the building is only possible for a temporary building. Therefore, this research could study the implementation of DfD

mainly for temporary buildings and not for a permanent building (buildings that exist for a long period of time). *Therefore, it is recommended to conduct similar research on cases where the DfD principle has been implemented in a permanent building.*

This research studied the implementation of DfD only for the integrated model of collaboration between the client and the contractor. The reason for this was that both the cases that were accessible to the researcher followed an integrated method. Therefore, only the integrated model of the procurement process was studied from the initial phase of this research. This research does not conceptualize the implementation of DfD for the traditional way of contracting, which is also often used by public clients. Besides, this research did not differentiate between the different models of the integrated contract (DB, DBM, DBFM, DBFMO). It studied the approach for the integrated contract as a whole. *Therefore, similar research can be conducted to conceptualize the implementation of DfD for the traditional way of contracting. Also, similar research can be conducted to find out the influence of different models of an integrated way of contracting on DfD (DB, DBM, DBMO, DBFMO, Alliance, Innovative Partnership).*

This research could not provide a choice for a tendering procedure that is suitable for the implementation of DfD. In both cases, the competitive dialogue (CD) procedure was chosen, and in both cases, the client mentioned that competitive dialogue is suitable for the implementation of DfD. However, the reason given in both the cases indicated that CD was suitable for open questions and did not have much of a relation to the implementation of DfD. Therefore, this research could not conclude about the choice of a tendering procedure that is suitable for the implementation of DfD. Also, there are other procedures like Design Competition or Innovation Procedure that could be more suitable for DfD. *Therefore, the research could be conducted to study the suitability of different tendering procedures for the implementation of DfD.*

Finally, both the cases studied had only completed the design and the construction phase of the demountable building. The cases are yet to undergo the disassembly and reassembly phase. Therefore, the implication of how these phases affect the procurement process could not be studied. For instance, no comment was made about the importance of deconstruction professional in a project on DfD as that phase has not yet been reached. Also, nothing about the importance of strategies that need to be considered to enable easy modifications and adaptations to the building (during the maintenance phase) was also mentioned. *Therefore, similar research can be conducted with cases that have completed the disassembly phase.*

6.3 Other Recommendations for future research

The implementation of DfD in infrastructure also plays a key role in transitioning to CE. The research could be conducted on how to conceptualize the implementation of DfD in the procurement process of infrastructure.

Since there are not many tools available, a tool can be developed to assess the offers on different principles of DfD and provide an absolute answer for the effectiveness of DfD.

In the second case study, it was mentioned that the contract management part is also very important for stimulating CE. Since this research considered the procurement process only up to awarding the contract, the contract management part could not be studied. Therefore, the research could also be done on how DfD can be implemented in the contract management part of the procurement process.

In both cases, the clients mentioned that the implementation of DfD and transition to CE mainly depends on the suppliers and the manufacturers. Therefore, the research could also be conducted on how the manufacturers and the suppliers can be influenced to change their business model for stimulating DfD and CE.

Finally, it was found that it is difficult to quantify the future value of the materials or the components used in the buildings due to uncertainty involved in it. Therefore, a model could be developed that quantifies the depreciation that occurs for the value of materials or components over a period of time.

6.4 RECOMMENDATIONS FOR PRACTICE

The main observation from the case study was that the client associated the application of DfD for a temporary building. They felt the need to implement DfD only when they are doing temporary projects whose lifetime is determined. However, DfD is most effective when it is designed for flexibility in design. This ensures they have an option to upgrade and make changes to the building throughout the maintenance phase. This can reduce renovations that are frequently made to buildings these days. *Therefore, the main recommendation is that the client considers the critical requirements for upgrading, adaptability and flexibility for every project they work on and implement DfD in them.*

Another reason that could hinder the client from implementing DfD is the perception that the implementation of DfD could hinder the client from achieving the architectural ambitions. Both the cases studied have proved that the implementation of DfD has not much of a relation to the architectural appeal of the building. Both the cases were architecturally sound. Especially, the temporary courthouse, it is a judiciary building and the image of the building also played a significant role. *Therefore, the recommendation for the client is to not hinder from implementing DfD in their buildings with the perception that it would inhibit the architectural ambitions as they do not have much of a relation. Further, the client can also set two awarding criteria, one on architectural ambitions and the other on DfD to ensure the building is designed keeping both the aspects in mind.*

Also, the client should not hinder from implementing DfD in their projects considering the aspect of cost. Both the cases studied implied that implementing DfD did not lead to a considerable rise in the cost of the project. Also, when the client considers the life cycle costs, especially the costs that are spent on the renovation of the building while making their design, the implementation of DfD will prove to be beneficial. *The recommendation for the client is to not hinder from implementing DfD because of the costs and also to consider the life cycle costs (mainly the costs involved in renovation and up-gradation of the building during the maintenance phase) to understand the benefit of implementing DfD in the design.*

Both the cases studied showed the importance of the role of partnership between the client and the contractor. This is mainly required as DfD is not a mainstream topic yet. The suppliers and manufacturers not ready to change the business model yet. This could lead to certain uncertainties in the project. In order to deal with this, the client needs to have co-operation, good communication and partnership with the client. *Therefore, it is recommended that the client asks for a quality management plan from the contractor in the offer where the contractor works out a plan for the partnership between the client and the contractor.*

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8 APPENDIX A: PUBLIC PROCUREMENT

8.1 PUBLIC PROCUREMENT

The procurement process by the public bodies is regulated by the directives set out by the European Union. These directives contain mandatory rules that must be incorporated and implemented in the national laws by the respective member states. The three directives that contain the rules on procurement are Directive 2014/ 24/EU (on public contracts procurement), Directive 2014/25/ EU (on procurement by entities operating in energy, water and transport services) and Directive 2014/23/EU (on awarding the concession contracts) (Chao-Duivis et al., 2017). The EU Directive provides principles in Article 18(1) of the 2014/ 24/EU that must be mandatorily followed by every public body for procurement (Chao-Duivis et al., 2017; Morledge, R., & Smith, 2013). The principles are:

1. Principle of equal treatment and non-discrimination (Article 1.8, Aanbestedingswet 2012)- This principle enforces the public clients to treat all the tenderers equally without discrimination

2. Principle of transparency (Article 1.9, Aanbestedingswet 2012)- This principle allows the tenderers to verify the actions of the public bodies. The tenderers can monitor and scrutinise the decisions taken by the public bodies

3. Principle of proportionality (Article 1.10, Aanbestedingswet 2012)- This principle ensures the requirements set up by the contracting authorities (public bodies) are proportional to the contract that is being awarded.

The principle of equality always takes the precedence whenever there is a clash between the different principles (Chao-Duivis et al., 2017)

In the Netherlands, the European Directive (2014/24/EU) is implemented in the Public Procurement Act 2012 (Aanbestedingswet (AW) 2012), and this act provides the national framework for procurement. The Public Procurement Act 2012 contains the principles of European Procurement Law and the implementation of the European directives. The Procurement Act also contains the Works Procurement Regulations 2016 (ARW 2016), the Proportionality Guide and the European Single Procurement Document (ESPD). The Works Procurement Regulations 2016 describes the tendering procedures that need to be used for the procurement of the works. The Proportionality Guide explains the principle of proportionality in detail, and the ESPD is the Dutch version of the standard format of the European Single Procurement Document which is prescribed by European Union(Chao-Duivis et al., 2017; Piano, 2019b)

8.2 TENDERING PROCEDURES

The procedure followed for the various tendering procedures is mentioned below:

8.2.1 Open Procedure

The tendering procedure that needs to be followed for the open procedure is (Article 2.26 of the AW):

1. announcement of the contract notice

2. check whether the tenderer falls within the exclusion grounds set by the contracting authority

3. assess whether the non-excluded tenderers fulfil the suitability requirements set by the contracting authority

4. evaluate whether the tenderers conform with the technical specifications, requirements and the standards chosen by the contracting authorities
5. evaluate the tenders that are valid based on the awarding criteria set by the contracting authority
6. create an official report of the assignment
7. communicate and announcement of the contract award to the tenderers.

8.2.2 Restricted Procedure

The tendering procedure that needs to be followed for the restricted procedure is (Article 2.27 of the AW):
1. announcement of the contract notice
2. check whether the tenderer falls within the exclusion grounds set by the contracting authority
3. check whether the non-excluded tenderers fulfill the suitability requirements set by the contracting authority
4. assess the non-excluded tenderers and the successful candidates based on the selection criteria set by the contracting authority.
5. invite the selected tenderers to submit their tenders.
6. evaluate whether the tenderers conform with the technical specifications, requirements and the standards chosen by the contracting authorities
7. evaluate the tenders that are valid based on the awarding criteria set by the contracting authority
8. create an official report of the assignment
9. communicate and announcement of the contract award to the tenderers.

8.2.3 Competitive Dialogue

The competitive dialogue can be used by the contracting authorities during these conditions (Article 2.28 of the AW):
2. when the needs of the contracting authority cannot be fulfilled without the adaptation of the readily available solutions
3. the project involves innovative solutions
4. when a contract cannot be awarded without prior negotiation due to certain circumstances pertaining to the complexity, legal and financial conditions or due to the risks associated with the project.
5. the technical specifications cannot be prepared by the contracting authority based on the available standards or common technical specifications or European technical assessments.
6. when unacceptable tenders have been submitted during an open or a restricted procedure.

The tendering procedure that needs to be followed for the competitive dialogue procedure is (Article 2.29 of the AW 2016):
2. announcement of the contract notice
3. check whether the tenderer falls within the exclusion grounds set by the contracting authority.

4. check whether the non-excluded tenderers fulfill the suitability requirements set by the contracting authority

5. assess the non-excluded tenderers and the successful candidates based on the selection criteria set by the contracting authority.

6. invite the selected tenderers to take part in the dialogue.

7. conduct a dialogue with the selected tenderers to determine the methods that are best suited to achieve the needs of the contracting authority and to determine which solutions meet the needs of the contracting authority.

8. invite the tenderers in the dialogue to submit their bid.

9. check whether the tenders submitted are in line with the solutions discussed during the dialogue.

10. evaluate the tenders that are valid based on the awarding criteria set by the contracting authority and award based on economically most advantageous tender method to the tender that has the best value for money.

11. create an official report of the assignment, communicate and announcement of the contract award to the tenderers

9 APPENDIX B: QUESTIONS FOR THE CASE STUDY INTERVIEWS

9.1 INTERVIEW QUESTIONS (CLIENTS)

9.1.1 Circular Economy

1. What according to you is the meaning of circular economy (in general)?
2. Why was the DfD principle chosen for the project?
3. What is the motivation to implement DfD (and circular economy)?

9.1.2 Procurement

1. How did you (will you) choose a contractor who has (will have) the best approach to apply DfD in your project?

2. How did (would) you stimulate the market to implement DfD in their offers in your project?
• What type of requirements or awarding criteria could ensure a better DfD implementation?

3. How did (would) you determine the best offer made for DfD in your project? (or how do you intend to measure and assess DfD)

4. If awarding criteria is mentioned in question 2, what should be the ratio of price and quality for a DfD project?

5. How do you think the approach followed for your project was different from the other projects (without circular principles)?

Sub questions:

- In terms of the type of tendering procedure
- In terms of the type of specification
- In terms of having a market consultation

6. What were the best practices or what want well in the case with respect to implementation of DfD (in the procurement process)?

7. What problems did you face, or will you face in incorporating DfD in the projects?

9.2 INTERVIEW QUESTIONS (CONTRACTORS)

9.2.1 Circular Economy

1. What according to you is the meaning of circular economy (in general)?
3. Why was the DfD principle chosen for the project?

4. What is the motivation to implement DfD (and circular economy)?

9.2.2 Procurement

1. How should the client select the contractor with the best approach for executing a DfD project?

2. How can the market be stimulated to implement DfD in their offers?
• What type of requirements or awarding criteria could ensure a better DfD implementation?

3. How should the client determine the best offer made for DfD in the project? (or how should the client measure and assess for DfD in the offers?)

4. If awarding criteria is mentioned in question 2, what should be the ratio of price and quality for a DfD project?

5. How should the approach followed for a project with DfD principle be different from a normal project?

Sub questions:

• In terms of the type of tendering procedure
• In terms of the type of specification
• In terms of having a market consultation

6. What were the best practices or what want well in the case with respect to implementation of DfD (in the procurement process)?

7. What problems did you face, or will you face in incorporating DfD in the projects?

10 APPENDIX C: TEMPORARY COURT HOUSE

10.1 DETAILS ABOUT THE OFFER SUBMITTED BY DPCP

The contractor came up with an idea of a building that can be completely demounted and shifted to another place. In the interviews, the contractor mentioned that they already had this idea before, and they were waiting for a client to ask for it. Another factor that triggered them to come up with this idea is that the client was asking for a building that was not just temporary but also architecturally good (Appendix 7).

When the interviewees from the contractor's side were questioned about their motivation for a circular economy, one of them replied saying that their motivation was to construct a building that was more efficient and intelligent, and it fit the hype of circular economy well (Appendix 6). The other interviewee honestly mentioned that he had no motivation for circular economy, it was that time where the building industry was performing poorly, and they wanted projects to continue their operation (Appendix 7).

The contractor mentioned that they liked how the client did not have strict rules or secondary guidelines and how they kept the question simple and open. The contractors were supposed to prove that their design had the minimum waste. When the contractors started working on their tender, they decided that their objective was to spend one euro less than the ceiling price but provide the best quality and they a put a lot of effort on the awarding criteria to win the tender (Appendix 7).

The contractors first looked at using secondary components for the building to score more points, but they were not available at the right time, or they were not of right dimensions. The contractors also mentioned that the suppliers were not ready to give information and assurance on specifications, quality and fire safety of the secondary components. The suppliers questioned the contractors on why they were using secondary components when they could provide them with new components for the building. The contractors mentioned that they felt like they were rowing upstream when they were dealing with the suppliers. They could use secondary materials for the doors and the sill of the building (Appendix 6, Appendix 7).

So, the contractor had to use new materials or components for the rest of the building. To minimize wastage, they had to guarantee the reuse of the components after 5 years. The contractor mentioned that there were no companies that function on the business model of taking back the components of 5 years. So, the contractor created a non-profit foundation with important people in the Netherlands to spread their vision of creating the building as a product. The contractor also went to the Municipality of Leiden to get a letter from them saying that they believe in their concept and that they would provide space for their building after 5 years. They also got an intention letter from an investor who said would consider buying it from after 5 years. So, they had an intention letter from parties but not an actual contract. The contractors refused to give the first right to the Municipality as they felt that it would not be flexible, they told the client that they could have a contract with a person with Groningen or Italy for reuse after 5 years but that was not efficient as later they could probably find someone who is ready to reuse it next door (Appendix 7).

The contractors faced another challenge with the suppliers after deciding on the usage of new components. The suppliers were not ready to change the design the components to make them demountable; the suppliers told the contractor why they were trying to make it demountable when

they were ready to give the contractors new components after 5 years. To solve this problem, the client had to themselves cast the components on the site (Appendix 7).

When the client was asked what made the consortium win the contract, the clients mentioned that the other parties also had letters for reusing it but only for some parts of the building whereas the consortium DPCP had an idea for selling the entire building after 5 years. The contractor also paid 1 million Euros money back to the client to be an owner of the building. This made them the consortium DPCP win the offer (Appendix 3). The client mentioned that the idea of giving the building back to the contractor financially stimulate the contractor and they also felt that they got the building for a discount (Appendix 5).

10.2 Calculation Model

5. Proven reuse versus potential use

There are two different ways to reduce waste (see HS2)
- At the front (pick products from recycling)
- At the back (indicate future cycle for a product).

The products that are already recycled to the front, it is proved that the environmental burden decreases as a credible source indicated.
Products that will be reused on the back, which can not provide evidence yet. Since these plans for reuse. In order not to give the same value to the uncertainty of plans and the security of a product already in use, the plans will be honored differently. The following rules are applied for reuse:

1. Products from recycling (front) if indicates where the product comes from, which building, usage, etc. within 50 km State:. Depreciation is taken over by a factor of 1.0 (eg floor has been used for 30 years , it is still 30/50th counted environmental burden, thus 100% - (60% x 1.0) = 40%), distances> 50 km is subtracted the environmental impact of transport
2. Products that will be (at the back) recycled afterwards: if a credible detailed plan is presented, the following factors shall be used:
    1. Detailed plan with contracts entered: Factor 1.0
    2. Detailed plan, without contracts: factor 0.80
3. Products that will be (at the back) recycled afterwards: if a credible plan is presented, the following factors shall be used:
    1. Credible plan: factor 0.60
    2. Credible ideas: factor 0.50

An example of how the calculation was made for secondary concrete component. The Column where Euro sign is used the shadow price.

Concrete floor floor from recycling (front)
Building stood in the Bijlmer (<50 km), built in 1984, dismantled in 2014 and reused in 2015. Proven 30 year useful life of the expected 50 years. Type of floor: wide slab floor.

Concrete floor floor / reuse (front)				
wide slab floor span 5,40 m	€	9.97		per m 2
amortization environmental 30/50 th	€	5.98	€ 9.97 * 30/50	used 30 years from 50 years of life
residual pollution	€	3.99	€ 9.97 - € 5.98	when used in temporary court
5 years using temporary court	€	1.00	€ 9.97 * 5/50	depreciation during use court
remainder attributable environmental burden	€	2.99	€ 3.99 - € 1.00	floor is processed into rubble granulate
attributable remainder	€	0.60	€ 2.99 - € 2.99 * 0.8	floor is reused after the end / 0.8 detailed plan without contract
attributable remainder	€	1.20	€ 2.99 - € 2.99 * 0.6	floor is reused after the end / plan 0,6
attributable remainder	€	1.50	€ 2.99 - € 2.99 * 0.5	floor is reused after the end / idea 0.5

If the floor on the front side comes out of the re-use and at the back on the basis of a credible idea can again be re-used, environmental burden is left for the floor of 1,50 € / m 2. If this floor scrapped at the end, and processed into rubble granulate, then there will be 2.99 € / m 2 floor over remain on environmental impact.

11 APPENDIX D: CONFIRMATION MEETING FOR THE TEMPORARY COURTHOUSE CASE

This chapter provides a detailed explanation of the confirmation meeting that was conducted for this research. In section 11.1, the methodology followed for the confirmation meeting is explained, and in section 11.2, the findings of case 1 that were presented during the meeting are presented. Finally, in section 11.3, the feedback given during the meeting is explained.

11.1 THE METHODOLOGY FOLLOWED FOR THE MEETING

As mentioned before, the individual report for this case was written by combining the results from the interviews and the documents. After writing the individual case report, a confirmation meeting was held to confirm and verify the findings of the case. This meeting was conducted at Rijksvastgoedbedrijf, with a total of five candidates. Out of the five candidates, three of them were previously interviewed for case 1, one of them for case 2 and the last one was an additional expert on the circular economy. The additional expert was involved to know his opinion on the case findings. The detailed information about the roles they played in the cases is mentioned in section 3.6.

The meeting was conducted for an hour in the RvB office at Hague. The results of the case were presented on the screen, and the candidates could provide their feedback anytime during the presentation.

11.2 FINDINGS OF CASE 1 PRESENTED DURING THE MEETING

The results that were presented for case 1 have been shown in the tables below. The results were presented in this following format: for each phase, the approach followed for the DfD implementation was mentioned and also certain comments that were made during the interviews on that phase.

Phase	Approach	Comments
Need Formulation	Ambition of the project was as "Prevention of waste and maximization of residual value after the usage" A DBMR contract chosen for the project. The design also had to represent authority. Focus on load bearing structure, façade and the roof Prevention of waste in two ways: 1. In the front 2. Or at the back Key success factor also included as prevention of waste.	No usage of the word circular economy. Client told that by including it in the ambition document, you can convey to the market that its an important subject. Choice for an integrated contract brought the chain partners apply as a consortium. Key success factor made the contractor focus on it.

Phase	Approach	Comments
Specifications	To save on time, the preliminary design was given. The question was still open and the contractors could come up with any type of solution or strategy.	The client was surprised by the solution of the contractor. They got a better solution than expected Clients preferred a functional approach. Contractors said performance specifications help them innovate.
Ownership	The client is the owner for 5 years and then the ownership is transferred.	Both the client and the contractor are satisfied with this way of working.

Phase	Approach	Comments
Tendering Procedure	Competitive dialogue was chosen for the project	CD suitable for boosting the ambitions. So, suitable for these projects. The problem, goal and the solution can be discussed better. Contractor said it helps them understand what the question is what is behind the paper.
Market Consultation	A consultation was held with TU Delft professors to decide on the qualitative criteria and for the measurement of the offers. Market research was conducted by the procurement advisor.	TU Delft professors gave assurance that market could do this. The client that were more than one contractor in the market who could do this after the market research.

Phase	Approach	Comments
Selection of contractor	No relation to DfD in eligibility or grounds of exclusion. The selection criteria asked for the extent to which the candidate had worked on creative solutions with an innovative approach.	Afraid that we would not have enough companies apply, If the circular economy theme is very important, selection can be based on vision on circular economy. Construction of demountable building has been existing since a long time. Selection requirements can be made for the design team. Contractor said that selection can be based on problem solving or creativity.

Phase	Approach	Comments
Selection of the offer	Minimum requirement was use of only those materials that belonged to best environmental classes 1, 2 or 3. Awarding criteria mentioned as minimization of waste. The future reuse of the materials has also been focused by asking for their action plan.	If you sure about the strategy, then directly ask for it. If not, go for the criteria, but you should know how to assess the offers. One of the client mentioned "Awarding criteria is the only way out"
		For construction, reuse is a feasible as the steel frame has not been changed. For façade, recycling is required. Since, it was the first time, the clients chose for the awarding criteria. For their next project on demountability, it was made a minimum requirement.
The Offer	The solution was a permanent disassemble building. Using all new materials, an intention letter from Mun of Leiden, creation of a stitching. Contractor already had the solution, was looking for the client.	Contractor liked that the question was simple. Ask for a plan on how the contractors can disassemble the building. Market is opportunistic, they will just do the minimum and stop. Awarding criteria stimulates the market more.

Phase	Approach	Comments
Ratio of quality/price	15%. A ceiling price was set and the competition was encouraged on quality.	The price of all the parties was similar, so the award was given on quality. The winning party also gave a discount of 1 million euros. Life Cycle costs were considered. Penalty for the contractor if he does not remove the building. No cost rise because of demountability. Do not compare the offers using absolute circularity tools.
Measurement and Assessment	A modified MPG method was developed. The method considered the impact caused by the materials in the front and at the back (credibility).	Could check any type of solution. Can be used only when the lifetime of the building is known.

11.3 Feedback from the session

The candidates confirmed the findings presented for Case 1 and approved that the findings were representative of how case 1 was conducted. They also found the method followed for the reporting informative and logical to follow. The candidates did not mention anything about any aspect missing from the reporting of the cases. The expert on the circular economy did not have any comments on the findings presented for this case.

Also, before the findings for case 1 were presented, the model that was constructed for the general procurement process was presented (*Figure 4*). This model displays the different phases that are conducted for the public procurement process. The candidates approved of this model as to it was representative of the way procurement process is conducted at RvB.

12 APPENDIX E: CONFIRMATION MEETING FOR THE GREEN HOUSE

This chapter provides a detailed explanation of the confirmation meeting that was conducted for this research. In section , the methodology followed for the confirmation meeting is explained, and in section , the findings of case 2 that were presented during the meeting are presented. Finally, in section , the feedback given during the meeting for this case is explained.

12.1 FINDINGS OF CASE 2 PRESENTED DURING THE MEETING

The results that were presented for case 2 have been shown in the tables below. The results were presented in this following format: for each phase, the approach followed for the DfD implementation was mentioned and also certain comments that were made during the interviews on that phase.

Phase	Approach	Comment
Need Formulation	The ambition document had no mention about DfD. The ambition document mentioned that focus of the project was not just on the content of the project but it was also on the relationship	You can stimulate the private party by not asking for demands but by working together, it's a win-win situation. Do not look at the contractor as an opponent. Circularity can be stimulated by technical requirements or awarding requirements and by focusing on the process.
Specifications	The requirement for the pavilion was just a one liner: "The materials, or the entire pavilion must be reused after 15 years (the period of use)."	The requirement triggered them but the contractor did what he did because he was our partner. The contractor had the freedom to choose the function.

Phase	Approach	Comments
Type of contract	The contract type was DBFMO.	Quality and circularity is intrinsic in integrated contract.
Ownership	The client is the owner of the building for 15 years and then the ownership is transferred to the contractor.	The client and the contractor were satisfied with this way of working.
Tendering Procedure	Competitive Dialogue was chosen. 50 percent of the time was spent on sustainable partnership and hospitality.	Client and contractor both told CD is extremely important. Circularity was not an item during CD. Most efficient way for the client to achieve better goals. Especially important when the client does not know what they want.

Phase	Approach	Comment
Market consultation	No market consultation was held with respect to DfD.	The consortium held a market consultation to check what is possible in DfD.
Selection of the contractor	Eligibity requirements and selection criteria had nothing related to DfD. But one of the selection criteria was sustainable partnership, project references where clients interests, co-operation and supply chain management	The contractors can selected based on their vision. The contractor need to convince they have the knowledge or that they are eager to learn. If required, prescribe to work with the leaders without mentioning the name. The construction of demountable building is not complicated.

Phase	Approach	Comment
Selection of offer	Awarding criteria not related to usage of materials or circularity. Sustainable partnership was one of the awarding criteria. The contractor was not chosen based on DfD.	SP was given a weight of 15 percent. The sub-criteria were interfaces and interaction, interest for co-operation, respect and trust, pro-activeness, conflict management and quality management.
	The contractor won because they had a good idea as to what they could do with that. Others had a lot of volume and it was vague.	The contractor was a clear idea but it wasn't worked out, they got enthusiastic in time. What the client asked inspired them but did not inspire enough, it was their motivation also to do something good for the environment.

Phase	Approach	Comment
Ratio of price and quality	The ratio was 50/ 50. A ceiling price was set.	Ceiling price encourages the contractors to compete on quality.
Measurement and Assessment	Evaluation was not based on DfD. An assessment team was set to evaluate sustainable partnership.	Contractor set his own performance requirements. Contractor used Building Circularity Index to compare different solutions.

12.2 Feedback from the meeting

The candidates confirmed the findings presented for Case 2 and approved that the findings were representative of how case 2 was conducted. They also found the method followed for the reporting informative and logical to follow. The candidates did not mention anything about any aspect missing

from the reporting of the cases. However, the candidates made a comment about sustainable partnership. The agreed about partnership being important for DfD project, especially when a building is being made using secondary materials. Finding available materials and products that fit the technical standard, the architectural ambitions, the budget and the planning requires partnership. They said that though it is possible to award a contract on this aspect, it is difficult to make it measurable. Therefore, they usually ask for a quality management plan where the communication and cooperation with the client has to worked out by the contractor.

The expert on circular economy also made a comment on the one-line specification on DfD. He said that it was quite remarkable that the contractor made an effort to use old materials in the building as this requirement could have encouraged them to use all new materials since new materials are more easily reusable after 15 years than old materials.

13 APPENDIX 1-12

13.1 APPENDIX 1

Circular Economy

1. What was your role in the project?

I was the project manager for the new court house.

2. What according to you is the meaning of circular meaning?

When you are not spoiling the new materials that you are using or using the materials that have already been used in another building.

3. What is the motivation to apply circular economy?

We needed to have a building for only 5 years. We did not want to create a lot of waste for something that we only use for 5 years. It's for avoiding waste and also in communication it is hard to explain that you are making a completely new building for just 5 years. It was both these reasons.

4. Why did you go for this principle of circular economy?

We did not choose the solution. We had an open invitation. The market came up with this solution. We did not have a preference when we started.

Due to the high quality of the building, it is rather difficult to use other (previously used) materials. In the solution that won the competition, parts of it was already reused before. So, it was a mix of both new and already used components.

Procurement

1. How did you know which contractor has the best approach to DfD?

We went for mixed EMVI. It is not only about circularity. It's on what is important for the project. In this case, the green building or green solution was important. Because, it was 5 years and we wanted to have good explanation to everybody that we are doing like this. In other projects, it can be something else, a mix. Most of the projects have a mix of different criteria that you want to meet. So, it is not one for one most circular solution. That's not how we do it.

We had a complex document containing requirements they had to meet for the building. Then we had gunning's criteria to check their offers. A part of it was for the price and a part of it was for the quality.

2. How did you know the contractor was fit for performing this project as this concept was new?

In the selection phase, we had some criteria they had to meet. We had a couple of companies applying. We had three of them that were doing okay. So, we went to the next phase with the three. Then we had a dialogue with them to talk about the project and the kind of solutions. They could ask questions and they showed us stuff and we talked about it and at the end, they had a prepare a bid. We judged the bid and then we got the winner. We did it in two or three months. We were surprised by how in less time, the contractors could make a proposal for us.

3. When you look for a contractor, would you look for a contractor having an experience with DfD to do the project?

It depends on what kind of building. We can't say in general.

4. How do you stimulate the market to implement DfD in the offers?

We did it in this project through the awarding criteria and we made an ambition document. If you talk about it, then the market knows that this is an important subject for procurement. As a client, you can give the attention to what you think is important and the market always reacts on that because they want to win. If you tell them all the time that you think that this is important for the building, whoever responds on that, takes a lot of effort to win on these criteria.

You have to be clear about the ambition upfront.

5. How did you assess the offers when you used the subjective criteria?

We had to do with the people who had the knowledge to do it.

6. What do you think should be the ratio of quality and price?

It depends on the project. There is no answer on this question. In this case, price was also important as it was only for 5 years. Price is always important. The solution that won the contract, they had the best price because they had this concept of using the whole building somewhere else. They were able to give the highest value at the end. That's why they had the best financial offer. The one who uses the best model for reusing is the cheapest one as well as they are able to gain money with what is left at the end. They have a lower price in the beginning. It's kind of a mixture, that's how you do it good, you get a good balanced offer on quality and price. (P/Q)

7. The total life cycle costs were looked at right?

Yes.

8. Legally, did you have any problem?

We say it belongs to the contractor. But legally, it's ours, it's on our grounds. (Legal)

9. Have they already made contracts as to where they will use it at the end?

They had a proposal to do so. It is difficult even now because we didn't fix as 5 years. We said 4 years and we can make it 4 times 6 months longer. Then, it is very difficult for the company to sell the building if you don't know when exactly the building's life will end. It makes it now for them difficult to use the deal they thought it would be 4 years ago. It's not going to happen what they thought it would be. I am sure. So, they have to look for something else. (future circularity)

The contract they submitted for something like an intention contract. And if they really had the contract, they got extra points. The surer the case was at the end, they more the number of points they get. Otherwise, they say something and….

It is still a problem for the company, they have to come back to get their product. But it costs them a lot of time and some money to demount the building. The best for them is when they can get it out of our place and directly take it to the new spot. Otherwise, they have to leave it somewhere and wait. Their business case at the end, it will be hard for them.

10. Were all these costs considered?

I don't know if they considered it. I don't think so. It doesn't affect us, but it will affect their business case. It is more difficult, it takes more time and more money to take it out. You have to do it and learn. (Future circularity)

11. How do you think the approach followed for this project different from another project?

For my role as project manager, it was not different from other project, for the process. We always do it more or less on the same lines. The criteria were different, but the process was the same.

12. Could you tell more about the dialogue sessions?

We started with a meeting with all the people involved. Then we had individual sessions. We discussed about techniques, functionality of the court house, circularity. The meaning of dialogue is to discuss what we want, and they talk about solutions. (CD)

13. Did having a dialogue session help in executing the project?

It is quite necessary to do so. Yes, very much. We get far better solutions. (CD)

14. Did you have a market consultation before you went for the tendering process?

We had a session with TU Delft to think about how we could do it. We knew couple of companies that are capable and interested in these kinds of projects.

15. What were the best practices followed in this project?

We really got a new concept as a solution. That was the best result.

You need to have an open mind and be clear about what you want to achieve. Be open in the solution and think about good criteria to make the good match.

16. What problems did you face in incorporating DfD?

No problems. The problem now for the project is now for the winner to get the building out. So, they have to finish the process. Otherwise, if it ends in a demolition. It was a success in the beginning, and it goes down. So, it was a success and you can call it a successful project only after 4 or 5 years of using. Success is really there if they transfer the building for good use in another setting. At the end, you can evaluate if it was success or not. It has to be completed to be called a success.

They have to give the ground back to us without the building. If they are not using it in the way they mentioned when they won the contract, they have to pay a penalty to us. We hope we are not going to do that.

17. Let's say, you were to do another similar project in the future, what would you think are the most important thing clients need to keep in mind?

I should pay more attention to the last phase of the project. Because we were really in kind of in a hurry. My real project was only the new courthouse project. Most of the attention went there. We did not really think about the end phase and we did not have dialogue about the same. When I do it again, I will give more interest and time to the end of the life cycle of the building.

18. Why wasn't the principle of circular economy applied to the main building?

Because the ambition for both the buildings was not the same.

13.2 APPENDIX 2

1. Could you tell me about your role in the project?

I am the project manager. My job is to let all the people do their work and I monitor the price, quality and the planning. I also supervised the tender. That was the main job in the first phase of the project. A new building was needed for the courthouse. On the same place, the temporary court house is standing. The fixed buildings, they have to stay there but there was not enough room to have the courts there. Also, to have lunch and to have some rooms for office. So, the architect, he had an idea to build a temporary building. But how do you sell that to the outside world that it is temporary. You spend a lot of money next to the new building. So, we brainstormed with each other "How can we sell the building?" Then we came up with the idea to have recycling project on the front and on the back. Some professor from TU Delft made a model where the tenders can put in their information. To calculate how it works at the bottom "Who is the most economical tender?". That helps to give a weight in who is the best to do the work. Now, we have the contractor who has built it. He sees the building as a project. That means that he will give the building a new home on another place. After the court does not need it any more, we can remove the building and they will take it to another place. So, in the contract we have made a notice that they have to give the building another life. Not just the doors, the windows, the floors but the whole building. So, they can build a school with it.

2. What according to you in the meaning of circular economy?

We need it I think to not waste a lot of materials. Now, it costs a lot of money when you have to demolish the buildings. It is a lot of money and if you are thinking in the front of the project how you will do it. Then you can find companies who think in the front of constructing the buildings that can be recycled and can be placed in another project. The project of the temporary court is an example of how you can do it. But you can also, if there are companies who take projects back and give it to other companies who will build a new building. Thus, you can recycle things. We need to move to a system where the loop is closed. But what is very difficult is that the companies who are making components like floors and doors, they don't want to do that because they will out of business. If they have a lot of old doors, they don't have make new doors. So, it's very difficult to make a system with companies who will contribute to that system. So, it's very difficult. But because the temporary court house was temporary, it stays there for 5 years. It's a perfect example how you can put it up and give it another life. I hope it will be a success. Now, we have discussions with the municipality because they will develop the place there surrounding the government. May they will build houses there. They will think about of keeping the temporary court house there. Maybe they can make school of it. I hope it is taken away and given another life.

3. What is the motivation to implement circular economy?

Not to create waste. It's better for the environment. You do not have produce new components.

4. What principle of circular economy was chosen for the project?

Give a building a second life. We had hoped that we can get a company who can reuse the components. But they see it as the whole building to give it another life. It was better than we had hoped.

5. Why did you choose this principle?

That was not a choice for us. It was chosen the contractor. It was their idea how they prevent waste. The model helps us weigh which company is better than the other, so we can choose the best. So, we did not choose how we wanted to do it. That was the idea of the companies. But we told in the front that we want to prevent waste in the front. So, we want to have used products to build the building and, in the end, give the components another life. So, the model helped us figure out which is the best option. It was not our idea to see the building as a whole product. That was the idea of the contractor. But our team stimulated them to come up with this idea.

6. Did you use secondary materials in the building?

We have doors from detention cells. We wanted to use floors from a building in Den Hague, that was very difficult. The supplier of the floors has problem with that. It was very difficult the floors. So, we had to build them new. It was the cell doors we used in the front. The other things are all new. The suppliers did not see any business to using old floors because it's their business to produce new doors. That is a huge problem in the whole recycling industry.

Procurement

1. How did you the choose the contractor who had the best approach to the implementation of DfD?

We used the model. We told that in the procurement that they have to use the projects in the front or in the back. We said to the contractors we want that you think about how you can use the used projects in the front and in the back. The model where they could fill in with which projects they used in the front and on the back, that tells who the best contractor will be.

We provided a preliminary draft because the land on which it was to be built was very limited. So, we consulted with the court about which functions had to be in the building and the architect made the preliminary design. In the courthouse, visitors are not allowed to cross judges etc. so process in building is very important. Because of these processes we created this basis, and told the companies they could change parts, and to come up with ideas. Well, companies came with ideas from very different directions. We scored this with the sheet from the TU, focussing on both the used materials as decommissioning.

Awarding criteria were drawn up for recyclable, plan and maintenance. Each of them had weights. The usage of materials also was also a part of it. That is how you got the number of points. Just like a normal award would work.

2. For the contractor, was it compulsory to have experience before on these types of projects?

No. Because we are afraid that we don't get enough companies. The only thing we had as selection criteria was that only that they had have a building built with different process. Actually, before that they had to have already created building of sufficient size. Because afraid too few companies otherwise. Not many companies have enough experience. Risk because of planning otherwise as we might not have found enough number of contractors having an experience.

3. How did you stimulate the market to implement DfD (CE) in their offers?

They have another department, which stimulates circular economy, Bert Alberts. How the market can be stimulated.

He thought about the forumlier with TU Delft in the project.

4. How did you determine the best offer made?

The awarding criteria had some points and the contractor with the highest number of points won the award. The quality was higher than the price. 60 quality and 40 price. We looked at the architecture, process of the court, the circular economy was very important.

5. How was the approach followed for the project different from the other projects?

It was not the different. The process was the same. The only thing that is different is that it is a temporary building. The process we took was the same. There was no difference. It was only the gunnings criteria.

We had three dialogue. CD was a part of the tender. Because the other project was done normally. So, we invest in having a dialogue with the contractors to explain what our meaning and our expectations for the project from them was. (CD)

The only time we were all together when we were looking at the building. But when we had a dialogue, it was always individually. (CD)

You make an agenda and what the subjects are of discussion. How the contractors see circularity. What is their idea to go with circularity? How do they want to do it in the project? Then we can tell if it's possible or not possible. Thus, in the project, the maintenance was a very important subject of the dialogue because there is a new building and there are buildings that stayed, and they had to couple both. The installations of the old building have to function with the new building. The contractor is responsible for the installation during the exploitation phase. For us, it was very important subject that we wanted to discuss with the parties. (CD)

6. What type of specifications did you go for?

That is the preliminary design said how high and how big the building had to be because the space we had was limited. They think about used projects in the front and the back. Take materials from used projects or use the materials in the new project. They only had to select materials and engineer the installations. They only had to choose if it would be grey or white, the outside of the building is clothes. That is the input from the contractor. But the preliminary design how big the design, the doors and other things were from the architect.

7. Would you want to do it the same way for the next project?

We did that because our architect was in consultation with someone in the court and he was so far with making the design, that we say we will give it in the tender. We give the draft in the tender to save time. Otherwise the contractors have to do the same process again. If you do another project, it is dependent on the other factors. If you make a draft in the front or you will make them do it. I cannot tell you now. We make the decision based on the project.

8. Did you do a market consultation?

The incoop department of RvB did that. We decided that we have the middle, not the big companies but the companies who are in between who could do it. The big companies have their own ways and own systems and they are not innovative. The small companies are more flexible. It was a conscious choice to go for smaller companies.

9. What problems did you face?

The problem is that to fit in the new installations with the old building.

The time was a little bit problem. We have a problem in the consortium in working together. The collaboration was a problem in the consortium because we choose integrated contract. The way of integrated contract, not all parties knew how that process works. Many expert interviews to realise the right installations. Other parties thought she would help in design, but they didn't. and there were problems because of this.

10. If you were to do another project, what are factors important?

Lessons: important: beforehand: ambition and guideline -> before you have thought what we want, how do we create circularity -> in ambition and guideline. Describe well and communicate to the market. Many ways to create circularity but need to discuss how far to go and what do we want.

Existing building vs new, many options, think well beforehand! The contractors can bring in circularity in many ways, but you should discuss beforehand with your team how far you will go with respect to circularity and What you want now.

They did it with the forms with the selection procedure but not sure if it works elsewhere.

You must have a dialogue to make it clear what your meanings are and if it possible to do the project. You can't build it without them, and you need to speak to them.

13.3 APPENDIX 3

1. What was your role in the project?

I was the sustainability advisor. We knew that temporary court house would be there for 5 to 6 years. We came with up the idea to minimize the amount of the waste. So, we had to think about how to measure it and we wanted the contract parties (consortium) to come with up all different kinds of solutions. So, they could come up with a bio-based kind of solution, a solution that's gives the minimum waste for the life time of 5 to 6 years or they can come up with an idea of disassembly and reassembly. All kinds of solutions should be possible. I am not sure if you are aware of MPG (Milieuprestatie gebouw) method. So, it's a way to calculate the environmental impact by using materials. Usually, if you make that kind of calculation, we do it for life time of 50 years and not for 5 years. So, we adjusted that way of the calculation. (measurement and ambition)

2. What according to you is the meaning of circular economy

It's to minimize the waste. Waste equals food.

3. What principle of circular economy did you go for and why did you exactly choose that for the project?

We did not choose the principle. We wanted a way to measure it where they could make anything possible. To leave the solution the contractor.

We came up with the idea that consortium is the owner of the building.

4. What is the actual motivation to implement circular economy?

It was to minimize waste and environmental impact.

5. Do you see a difference between sustainability and circularity?

Not really! There are many ways to explain sustainability and there are many ways to explain circularity. But, in a way it's about the same principles. And if we talk about circular economy, we very often limit it to materials. We can do it for water, energy etc.

6. Sustainability was there before, also right? Why do you think the term has become so popular now?

May be because it is easy to visualize. Waste equals food is very simple concept and very easy to explain. Anybody can understand. And with sustainability, it was doing things less bad instead of doing it good. But also, C2C is also a way of circular economy. They started with the story of stop doing things less bad but do something good. So, C2C was something in the middle.

PROCUREMENT

1. How would you choose the contractor who has the best approach to DfD implementation?

That depends on the height of the assignment. So, are we allowed to go only to three parties? If that's possible, then we can select the best parties. For example, I had last year a demolition project and then I could go to three parties. I did some research about who advertises about the circular economy. The best and the most and what their practices were.

2. Do you think the past experience with circularity matters?

Them having an expertise with circular demolition? Yes, that's possible. Of course, there are different possibilities. You can also ask the parties to write about their vision. Then do a pre selection. But then, sustainability or circular economy must be so important in the project, that we have to think that we have to do a pre-selection on basis of this theme. But if we think, architecture or functionality is more important, then this will not work.

3. How do you stimulate the market to implement DfD in their offers?

There are different ways. We can either make hard demands (minimum requirements). So, we have knowledge about what is possible in the market. We cannot make our demands so high that only one party can follow. So, we need to look who is at the top and who is at the bottom. And we have to go in-between and stimulate with the best parties with the minimum of three may be. There has to be competition. Otherwise there will be problem.

4. So, the best way is to give minimum requirements?

Not necessarily the best, that's a good way. I think we have to think more and determine a strategy. If we want a building that you can disassemble and reassemble. You just have to ask for it. Don't let it depend on the parties that make the design. One does, and one doesn't.

This depends on the situation. I am not saying that you should ask for a building that you can disassemble and reassemble every time. You just need to think about what your strategy should be.

For example, I was working on the project for an office that does research for the government. They were in that location for 100 years. They are very specialized. You can't put them in any building. Now they are moving, you cannot put them in any plot. They will be there for 100 years or more. So, it does not make sense to ask for building that can be demountable. It is not logical.

5. What kind of requirements you asked for in this project? How did you stimulate them?

We made it very simple with the adjusted MPG method. Normally, when you take out materials out of the ground, you transport them and make it a product in the factory. Then, you transport it again and assemble it into the building. All the environmental impact is made during that period and not during the life time of the building, hardly. So, all impact is in the front. But, mathematically, what you can say is if a building has a lifetime of about 50 years. That environmental impact, you can spread it for those 50 years. (measurement)

If you take a concrete floor, it has an environmental impact. If somebody is harvesting a floor from a donor building and in the donor building, if it had a life time of 25 years. 50 percent of the environmental impact is already completed. Then we can take 50 percent of the environmental impact to the new building. So, it is lower environmental impact. (measurement)

6. Is it not complicated because you need a lot of data?

No, it was very easy. Also, because, for this project we concentrated on the construction and skin. So, façade and roof. And it is not complicated as you can put just the tons of concrete. Environmental impact of construction and skin is 70 percent of the total building. So, if you bring a new material, you have to calculate the full environmental impact of the material. If you take it out of donor building, you only consider the rest. The difference between 50 years and the lifetime is already been served. And, what they had to do is make a promise for what they would do with the product after 5 or 7 years. So, if they said they are going to sell the whole building and they already had a signed contract, then they would get full points for reduction in the environmental impact with a credibility of one. If they had a promise almost ready, they would get 80 percent of the points and if they had just an idea what to do with it, they got 50 percent of the points. So, the credibility of the promise was also evaluated. (Measurement)

7. Did you put them as awarding criteria or the hard demands?

This was in the awarding criteria. We had only one hard demand. They had to use only those materials that belonged to best environmental classes 1, 2 or 3. So, it was not possible to make a very lousy building with a high environmental impact and after 5 or 6 years demolish it. (minimum requirement)

8. What was the criteria?

To minimize the amount of waste caused by this project.

9. Can you find a balance between the architecture and circularity?

The parties have to find the balance. These are two different criteria and these parties have to make a decision on how they translate architecture to all those other demands. Not just circularity. We have a make a transition to bio-based, if you look at the governmental buildings, it mainly has technical materials. What will they do if we are moving more towards bio-based economy? What will they do for architecture, that's an interesting question?

10. What was the ratio of price and quality? What would you choose for your next similar project?

I am not sure, anymore. And, it depends on the project. It can't be generalized. It also depends on what minimum specifications that you write. What's in the criteria and what's in the demands. What other important elements are in the project. How does circular economy weigh in comparison to other demands?

11. The awarding criteria or the requirements, which stimulates the market better?

If you want creativity and you don't know what you want. You have to go for criteria. Also, if you want to be surprised. If you have a strategy and you have thought about it really well, you can also make demands and make a mix of those things.

If you are unsure, you can ask the market for the solutions. But then you need to think on how you can assess these different kinds of solutions.

12. Could the mathematical model be applied to any solution the market would come up with?

The normal MPG, it's not possible, so, if you want to make it a straw, then you can calculate what the environmental impact. IF you make it out of concrete, then you can calculate it for concrete. This worked because the period was for 5 years. If you have a normal project, you cannot do it like this. Then you can say that MPG is a linear way of calculating. Also, the standard method does not take into account that a product came from a donor building or that it has a future after your project. So, that's why we came up with an alternative method. The standard method is a linear way of calculating.

13. How did you measure the process part?

It's not 100 percent water proof. I think almost parties scored about the same in the credibility. There was a difference, the winning party said we sell our whole building. They said they will go from Amsterdam to Leiden. They had a contract. They got 0.8 times the credibility. Other parties, they were not selling the whole building. They got points for parts of the building.

We had an excel. They had to write all the products used in construction and skin in that excel. And then the kilos. The MPG factor number. Then they had to write down what the future of the building was. That was multiplied with the credibility number.

14. Was it too technical for everyone to understand in the project?

It was crazy. Because, we figured out something completely new. We got zero questions. There was even one party who improved the method.

15. How do you think the approach followed for this project different from the other projects?

It started as a normal project. Because we had not time for sustainability. There was no money because it was temporary. It should be at low costs and very fast. Nobody wanted to listen to the sustainability advisor. But they were willing to discuss the topic. And we had an evening at the university of Delft with the professors working on circular economy and sustainability. We did not come with a solution during that conversation. But when we left, in the bus, we suddenly got the idea we should not be the owner of the building. Then, we got the idea of DBMR contract. If you make them the owner, they have to decide how to get most of the value out of the project when we are finished with it. That was the core of the idea.

16. What discussions did you have during the dialogue sessions?

On this topic, not much, I think. So, it was more about the functionality and architecture. For circularity, they had to just fill out the form and a number comes out. That's it. There were no questions about this method. What was nice is that all the three parties had different approach. So, that's what we hoped for. Anything should be possible. The winner was that party that could take all of the building into little parts. There was one who made modular concept. They wanted to make prefab modules in UK and ship it to the Netherlands, not to the smallest elements. The last one was also in components,

they had a concrete solution. They had a naked architecture, minimizing on the amount of materials used.

17. Was the preliminary design already given?

We were in such a hurry. The architect designed the functional schemes, the floor plans. Some improved the floor plans. They of course had to get into discussion with Fokke and the court. But they were allowed to do some changes. So, that worked. (Specs)

18. Which specifications stimulates circular economy?

Any answer could be right now. It depends on the other criteria. If you give a lot of points to functionality, flexibility and a lot of space. You can see that the designs from the parties are too big. The spaces are too big and there is too much material. If you design it yourself, you can optimize those things. But I can think of examples for the other way around.

19. Did you have a market consultation before doing the project?

Not for circular economy, I think. Because we dint think of MPG method ourselves, within the RvB. But, a professor from TU Delft, who happen to be also in that session. He is the godfather of MPG.

20. Can we have a method to measure to all type of offers if we go for functional specifications?

You can use that method for any building. Usually, now according to the Dutch law, you have to make an MPG for all residential buildings and offices bigger than 100 m2. But you make an MPG for the whole building. If we look at our company, we are mostly doing renovations and not building new. What I want to do is to make minimum requirements for the layers of building (Stuart Brand). He makes a decomposition of the building into layers such as site, skin, structure, services etc. If I do a renovation, I want to make an MPG requirement for walls, floors, ceilings, installations. But I don't have requirements for construction and skin may be. So, I want to give it more detail. Not making the requirements for the building as a whole where you can use it only for new. I want to develop a method that you can ask MPG for parts of the building. That's the next step.

21. What were the best practices from this case?

This project is unique as it's just for 4 to 5 years. The method cannot be copied for ordinary projects. But, this method of calculating can also be used on renovation projects. I am working on a project in the Hague, the architect was not sure about how we were going to do the renovation. A bigger renovation, transformation or are we demolishing the building and building a new place. I was asked which the better option was from circular economy perspective and a colleague of mine who is working on energy was also asked the same question. Of course, if you do nothing, if you renovate in a minimum way, you score great for circular economy. If you demolish, you waste a lot of materials and make a new building with a lot of materials. But you cannot answer this way, then I came up with the idea that we should compare based on CO2 based on using energy and also using materials. Then there was a difference, demolition and building new was 100 times better if we consider for 50 years and then doing the small renovation. Because energy is far more important in terms of CO2. But it is project specific and depends on how old the materials are, what new materials will used, what is the energy level now and what will it be. There are a lot of considerations. I used the same MPG method from the Temporary Amsterdam Court House.

22. How did you convert it to Co2?

MPG is built from LCA. LCA is the environmental impact from a product. In LCA, there are a lot of environmental impact themes, one among them is Co2. Every product has a different Co2 percentage. But I took kind of an average. I took 50 percent. This was because CO2 is just one of the themes.

23. How problems did you face with respect to incorporation of DfD?

If you want to reuse the used materials. All of the construction in the Netherlands should try using that. But there isn't enough secondary material available.

Another problem for the public clients is that we cannot say if you have to bring concrete to that company because he is the best. You cannot say we are going to make cardboard walls because we know it has the lowest impact. We cannot ask the market a question only where one party can deliver. If I am a private party, I can go with the best. Our way should be to get rid of the ones left behind. So, we have to study who are the best parties and make minimum requirements that needs 3 parties or more who can do it. So, only with the criteria we can award it to the best contractor.

24. Why can't you a build a demountable building as a permanent building?

You can have that, but you cannot use the same calculation method. You cannot say minimum waste during the life time of the building as you do not know the life time. Here we can define in 5 to 6 years.

You can assume a period. Usually, in this method, the period considered is 50 years. If I look around, lot of big renovations are taking place in 25 years. Some of the buildings are demolished after 20 or 25 years already. What is interesting is that nobody wants to invest upfront in disassembly possibilities. But if total cost of ownership is taken into account, it is profitable.

13.4 APPENDIX 4

1. What was your role in the project?

I was involved as a procurement advisor for this project.

2. What according to you is the meaning of circular economy?

The normal life cycle of a building is for 50 years. Circular economy is using the basis of the construction for those complete 50 years. Make it flexible inside the building.

The second-best idea is what we did for Temporary Court House in Amsterdam. Make it reusable on another place. How do we change its usage? How can we use it for another purpose after its usage? Giving it another life.

3. What principle of circular economy was used in the project?

We can demolish the building and use the materials elsewhere. Better is to give the building a second life. If that is not possible, then the materials can be reused. With the temporary court house, all the construction parts are fit together with bolts, so we can use all the parts in another place to make a new construction. Of course, we need to transport them, and transportation is not good for the environment. This produces a lot of CO2.

4. What was the motivation to use circular economy for this project?

Questions from outside, newspapers, politics. So that was the driver. The goal was to use less money and cause less impact to the environment as the courthouse is temporary in nature. (AM)

Procurement

1. How can DfD be incorporated in the procurement process?

To make it a part of our specifications. To make it a part of the tender and the best idea will win the tender. In this case, we asked for an idea that causes smallest impact on the environment. The solution could be usage of bio-based materials. It was up to the contractors to come with a solution. The solution that we got now was also given by the contractors.

2. How did you choose the contractors who had the best approach to implementation of DfD?

The process was done in two phases. First phase was selection of the contractor based on skills. We asked for project references from the past. In the second part, the offers were assessed. The first phase is to check if they are well equipped for this case. We asked for projects with a similar question in the past.

3. Did this limit some contractors from entering the process?

Yes, we got more than 3 parties from the market. So, we selected 3 and we had a small competitive dialogue with the 3 of them to verify if they understood the question and to optimize their solution. The dialogue is to make them understand your question well. (CD)

4. How did you find out if there are people ready to do this kind of a project in the market?

Looking it online, I found some contractors who did temporary housing in the south of the Netherlands. They had made some temporary houses for students in villages. We knew that there are contractors who could this kind of a project and we knew that there were more than one.

5. If you were to do another project, would you do it in a similar way or what would you do better?

Temporary Building is a unique project. We hardly do any projects that last for a period of 5 years. For a circular project in general, have an open question. State what the problem is and what the goal you are trying to achieve and ask the market to come up with the solutions. It is also necessary to have the dialogue to discuss the problem and the goal and verify if the market has understood the question.

6. Do you think dialogue is necessary then?

Yes, if you have an open question. If you want the market to design for a functional question, then it is necessary to check if they have understood your question. This is not possible by just asking for questions on the paper and then asking them to decide.

7. How do you think market can be stimulated to implement DfD in their offer?

You have to ask the question for a circular project. Circularity is a solution. Our question is lowest impact on the environment. And if circularity is the solution, its fine. May be there are other solutions to get a lower impact. A solution can be called circular, but they might not the best solution when you look at upper levels of the 3R principle.

8. What type of specifications are more suitable for a circular project?

You have the best result with the functional specifications. Because, I give the market a chance to come up with their own solutions. Let's say, we describe the solution but how sure are we that this is the

best solution. If I have a functional question, I get competitive solutions from the market and then I can choose the best solution. The functional specifications give a chance to the market to use their ideas and their innovation. (Specs)

9. You already mentioned competitive dialogue, if you were to do another project would you go for a competitive dialogue?

Competitive dialogue is a very good procedure to discuss and make the solutions better. They can check if the understand the question of the client and also optimize their solutions later. The dialogue can be used to discuss the problem, the goal and the solutions from the contractors to achieve this goal. (CD)

10. Did you do a market consultation for this project?

No. We were sure that they were contractors who could do this in the market.

11. Let's say, you were to do another project. Do you think it is necessary to do a market consultation?

It depends on the question. If you are not sure if the market is capable of doing it, then a market consultation would be necessary.

12. How should the market consultation be done?

There are different parties in one room, and they are in competition. They will never ask questions. If they ask some questions, they are scared that other parties will find out about their idea. They will ask these questions only during the dialogue because they trust us that we will not give away the solutions to others. Only a market consultation is not the effective way to discuss the problem we have and their solutions. (Also, a problem)

13. You had asked for project references to select them to the next round right?

Yes, we had a dialogue with only three parties at the end. As this cost a lot of money for us and even for the contractors. Open Procedure is not suitable as it costs us a lot of time to evaluate these solutions. The project references were asked a criterion and not as a minimum requirement and the contractors with the best references were taken forward.

14. Do you think you can implement circularity through grounds of exclusion?

We check which contractors have good experience with respect to the question and the selected the best ones. By doing this, we will get the best solutions and the contractors who have less experience, maybe they will never give us the best solution, so its lost time.

15. How would you prefer putting DfD in the offers?

In the case, we had put in the awarding criteria as we wanted competition. The best offer based on the criteria was awarded the contract. We said to the contractors we have a problem and we have a goal to achieve, give us the best solutions. So, I have to award the best solution and therefore, we put in the awarding criteria.

In these kinds of projects, the awarding criteria is the only way to go.

16. What should be ratio of price and quality?

The focus should firstly be on quality but a balance between quality and price must be brought about. In our case, only 15 percent was quality and rest were based on price. But the awarding criteria were

very well defined. They put a lot of effort in deciding the criteria. For the price, we had maximum price and most of the contractors were around that price. So, the question was never about the price and it was decided based on quality though the quality was only 15 percent.

17. What type of awarding criteria is necessary?

In this project, we used the lowest impact on the environment. The materials and the CO2. The university of Delft helped us make the assessment framework.

18. How did you ensure circularity in the future?

In the tender, we asked the contractors to give as much security as possible to ensure the reuse of the components. The winner did not only have an idea on how to construct it but also idea on price for the building when they take it away. So, the contractor is involved financially in the process and if he does not reuse it, he has a bad project. The second one in the project also had a very good technical idea but he did not give us a price for the components. So, he was not financially involved.

The price that was asked for entire 5 years. It was a DBMR contract.

19. What were the best practices in this case that could be followed?

Best practice: One contractor for all the phases. This gives the best guarantee that it will be reused or less impact as possible. There is a business from the contractor to reuse this building. It's his business to make the building that can be reused. So, I had the best product. It's his building.

20. Legally, did you not have a problem?

During the period we use the building, we are the owner of the building. But at the moment when the contract ends, we have a rule that the building is from that moment is owned by the contractor. Because we are the government, the contractor has no risk. After 5 years, there is a rule which states that we are no longer the owner. He has paid us 1 million to be owner of the building. So, he has bad business if he does not use the building later.

21. How did you ensure you got a consortium in the project?

We have a contract with only with our contractor and he has a contract with other chain partners. A DBMR contract has brought them together. (integrated contract)

22. What problems did you face, or will you face in the procurement process due to the incorporation?

Problem in the procurement process is that I can't make up my mind if the market has business in this project. Will there be business for the market parties. Since, we are government, we don't have a business and we are not making profits. I need to make up my mind if there is a profit for a company for this type of project.

23. Do you think it's hard to make some profit from a DfD project?

I think we found the right party who makes a profit from the question we asked. Reusing the elements from building to make a new building, that was the business from our contractor. Our question and their business matched. That's the best thing I can have in a project. From procurement, I am not sure I will find the right match.

The questions are whether there is a company that could make business from the question.

The contractors already had this idea, but the clients were not asking for the same. They were happy we asked an open question.

Ask a good question. Give a good definition of your question. What is your problem and what is your goal? These days we spend a lot of time on what is the question and our goal and when is the user happy.

The three ambitions were lowest impact on the environment, process of the court should be good during the transformation from the old building, lowest impact in terms of disturbance and noise caused to the surrounding people.

13.5 APPENDIX 5

1. What was your role in the project?

I am an architect. I investigated on how we could keep a court house functional while simultaneously erecting a new one on the same plot. We developed the idea of a temporary court house, we made a functional layout of the temporary court house. Eventually, we proposed do to something with circular economy. As a matter of fact, we did not use the word circular economy then. Just say if you are going to erect the building of 6500 m2 with a lot of high technical demands in terms of security, safety, functionality and the representation. We thought we should something with idea that we have a building only exits for 5 years and before it becomes obsolete. We organized an evening with TU delft actually. We had a session with some professors to know if it's feasible to do something with demountability or circular approach of tendering. From there, we developed the qualitative criteria for tendering and the measuring tool for minimization of waste. We wanted to make the intermediate step of the temporary court with minimal impact as possible in terms of finance and in terms of materials. We dint use the term circular economy.

2. What according to you is the meaning of circular economy?

In general, it is that you don't use raw resources and the design of the building is done in such a way that at the end of life cycle, it can be reentered in the production cycle with minimum of loss and minimum of energy.

3. How did you define circular economy for the project?

We did not say circular, but we said we want to minimize the impact in terms of materials. And we knew that the time frame for the temporary court house is just 5 years. In a way in the procurement, we said we don't mind whatever the strategy is. As long as it's minimization of the material impact. So, we said you can make a bio-degradable building that collapses in 5 and a half years or you can make a Hitec building that you can demount and reuse in another location for 100 years to come. We could compare all the solutions. It should be a part of the bio loop or the tech loop.

4. Why did you choose for this principle of circular economy?

Two things we did. One is that we said when we procured, we need this building for 5 years and afterwards, you get it back. So, we made financial impulse for profitable next use. We gave an impulse to the contractors to design in such a way that they could may be another profit on another location. We said that the only important thing is the minimization of the material impact in the 5 years. So, we looked for a tool to make all these different strategies bio-degradable materials or Hitec, comparable. So, in the end, what we asked them to do, to make a list of materials they would use. And we had a list

from national institute of bio economy NIBA. They have the natural time spent of a construction material. For example, a concrete slab normally has a technical time span of 50 years. Make a list of all the materials that you use and give the normal time span of that use and we compare that with the time span of 5 years we would use. If you use a concrete floor slab, we normally use it for 50 years. You use it only for 5 years in the court house. So, we say you have wasted 45 years of concrete slab. So, in order to reduce the waste of 45 years, you have to have a strategy as to what you will do with the slab in the next life time. If you found another slab that was already used in a building for 25 years and then brought to the temporary court, then you have 25 plus 5 (30) instead of 50. Then, you have another strategy for demountability and usage of it at another place for 20 years, then there is no waste. Essentially, we did this for all construction materials and the façade materials, not in interior materials. Because it's easy and they together are about 60 to 70 percent of impact of the entire building.

5. Did all of them make a Hitech building?

All of them came up with demountable strategy. The technical demands were too high for bio-based building. In a way, what I learnt is that it is very easy to make a demountable building. We have done this for decades. So, it's not very revolutionary. In the end, they made a steel frame. There was little innovation in the concrete floors. They made a method to bolt the floor. Normally, they glue it to the steel frame. The concrete slab is such a cheap product that you cannot compete with it. Any other means, such as wood or steel structures, easier to mount. They are much more expensive that the concrete slabs. The solution they had was a steel frame with concrete floor. Wooden frame for the façade. In a way, old fashioned way of construction. I think the big innovation here was not in the construction method. We created a financial impulse for the developer to find another spot to reuse. Within 2 years, the new court house is ready. Then we know if we have succeeded. Could be that they will still demolish it and not use it. We have a feeling that we got the building for the discount. So, we got the building for a discount. They are confident that they can make money on another location.

6. So, the technology is not something new right?

We looked for the possibilities for use of reused concrete slabs. It made it complicated not because of the lack of availability. There are no companies that want to guarantee the strength and fire safety or all the certificates we need to have a trust in the design. It is very hard to get this in second hand materials. So, I think the big challenge for circular building is not in the design itself. It's in the supply and demand on building products. Now, it's not there. For small projects, you can go to Marktplaats and you can see what is available right now and you can buy it. For buildings with a certain size, the design period is too long, so you have to trust that the design choices that you make now, you can buy them in 2 or 3 years. So, this time lapse is something not solved in the circular building economy. In the end, the building materials that were used in the temporary court house were all the new materials. So, they are suitable for reuse in the next generation. But they were not actually a part of circular economy.

My personal opinion is that for construction, reuse is very likeable option. Because one is that steel profile hasn't changed in 60 years. The technical development is fairly slow. That means that the steel beams that I use today, I probably want to use the same kind of beams in 10 to 15 years. The dimensions really don't change. The construction in general, it needs to fire proof and it needs to be strong enough. So, there is not so many demands for construction. I have high confidence in the reuse of the construction products. When it comes to the façade elements, I am highly skeptical because I think that technical developments on facades go much faster. For example, glass, they are innovating at a fast rate. Who wants glass that is 20 years old? So, its tainted in the wrong color, doesn't have the

right transparency, there is no energy efficiency. In a way, 20-year-old glass is obsolete. Nobody will want a new building with a 20-year-old glass. Then there is fashion. So, there is design proposals. Who can predict what people will like in 20 years? The things that we design now, people will probably not like in 20 years. My personal opinion is recycling is a much better strategy for façade elements.

7. What is the motivation to implement circular economy?

We have used 75 percent of the world land is used by humans. We need to reduce our consumption. When it comes to bio-depletion, destroying the forests, the open air mine fields, all the poison that is used to take stuff out of the earth. There are many reasons to reduce the cradle to grave approach.

Procurement

1. How do you think DfD can be stimulated or incorporated in the procurement process?

I think one way is simply make it mandatory. Speaking for the real estate agency, I think in any procurement that we do now, there must be a thought on circular procurement. The debate can be on what exactly is circular procurement. You cannot go into the tender without touching the topic. So, another thing is of course in mandatories, pricing of the environmental impact of any project that you do. That is a financial impulse. You need to pay for the Co2, land use. We are talking about third party effects. So, in an economy, you and I have an economic transaction. The third party which is not a part of the economic transaction, is victim in a way. The pricing of the third-party victimization should be a part of legislation that is to come. I am not really a stimulant guy. You should just say do it. Then they will do it. If people are challenged, they will succeed.

2. How do you choose a contractor who will have the best approach to the DfD implementation?

With the temporary court house, we were not sure if it was possible, so we made a qualitative competition element. We challenged them to come up with the solution. And then another project that I did for Kosovo chambers in the Hague. We needed the temporary extension of the office space. Because it came afterwards, I saw there were so many competitors in the temporary Court House who could make a demountable building. So, then we made it mandatory. We said this extension must be demountable with lesser loss than 20 percent. It dints become gunning's criteria, it became a minimum requirement. I think when it comes to designing for future circular usage, you could make that mandatory. We dint find any negative price consequences. So, with the temporary court house, we even got a bargain because we gave the building back. With the Kosovo, we don't give the building back because we are unsure of the period of usage. But we dint see any cost rise. So, in a way for the same prices as a normal office building, we can get a demountable building.

3. How do you choose a contractor who is suitable for this project?

We do integrated tendering right. The selection criteria for the participants is addressing not only the contractor but also the designer. My point of view, making a building demountable is not a spectacular specialty. On the forehand, you know contractors who will not be able to do it. It is more of a design strategy than a building challenge. So, in terms of selecting the contractor, I would not necessarily say, that they should have experience with that. There are other things that are more important than that method. For the design team, you can focus on people who have an experience with it. The designers need to have some feeling with it. Even in the case, erecting the building was not very complicated. It is bolting instead of gluing. That's it. The architectural firm was very excited about it, they took it even further and they adopted this challenge. They needed little stimulants to do this. I think the challenge; can you motivate the participants financially? The consortium that won the tender, they really see a business case in circular economy. As an architectural firm, they see it. But also, as a developer, they

see this possibility. They really think they can do something with the court house in another location. For them, it was an obligation, but it was part of their DNA. So, we got lucky with that. The ultimate challenge is not with the contractor or the designer. It's with the product manufactures for the building economy. That is where the real revolution has to take place. The chicos, steel producers, concrete slab producers, these are the ones whose business is cradle to grave ultimately. They are dominant in the construction industry. As an architect, you select products from the markets and implement it in the building. So, I think the real revolution is with the manufacturers. It's not with the architects or the constructors. They can still have their business case as of now, they erect the building or design the buildings. They just have to be able to select different materials. The availability of real circular components is limited.

4. As per the ambition document, you were looking at it from the material level or they came up with the component level?

So, in the end what we say is we didn't put materials to waste. We say if you put good usage to the materials, we are happy. We did not even make a Co2 equivalent thing. We could make Aluminum. In a way, we said it's a shame if materials go to waste.

5. Can this approach can be used in future as well?

The calculations that we proposed, they were very effective as we did not want to put forward the design strategy. We wanted to make bio-degradable building for only 5 years, Hitech building for 100 years or a building completely made with secondary materials comparable. We dint have a design preference. So that made it complicated. In the tender, you have to compare bio-degradable building with a Hitech building. We could do this because we were really sure we would use it for 5 years. And then the new court house is ready, they move out. And the municipality wants to erect a tower there. So, they don't want a court house to stay there. This is an exceptional situation Most of the times, we have a building, you will say barely 10 to 15, 20 years at most. Nobody will put a date on him. You do not know how long you will use it. The design strategy for such a building is much easier. You will always go for a demountable or reusable building. You will never go for a bio-degradable building with a risk that it falls apart when you still want to use it. The tender procedure that you used for the courthouse was very successful for the courthouse. It may be too complicated for other projects. As what I said for Kosovo chambers, we simply said you need to make it demountable. It was much easier, it was mandatory. It was a not a part of the awarding criteria. It was simply a thing that they had to prove. For proving, we look at material passports and detailing and assess whether there would be a lot of demolishment in order to demount the building. On this part, you can make your life easier. Simply, ask for demountability and may be at a certain point, there should be a measurement of land use, CO2 equivalent for materials. So, right now, if you ask for demountability, you can still get a new building. Slowly, 10 15 years, we would want to make it mandatory that no new materials are inserted. Tool for that part must be developed. I am not sure if it's already there.

6. When you say demountability, the word temporary comes in. Why can't demountability associated with a permanent building as well?

Now for all buildings, we do this. Because in the end, the offices, especially, we are finding it hard to maintain for long time. So, most offices after 25 years, they are worn out. I have ideas about why. For any office tendering, you should ask for demountable building. You can debate on what level of demountability. Then what becomes important you have an idea of reuse or recycle. So, I think you should always accept the possibility of recycling. There you should make a differentiation between reuse or recycling.

7. How do you ensure the future reuse of materials?

In this case, we stimulated it financially by giving the building back to them, mandatory. They can either demolish it or put it to reuse somewhere else. There with the financial stimulus, to do something with it is with the contract. I think that it is the biggest stimulant that we put in. In the tender, we made it an awarding criterion. They were focused on it. The last payment comes only when they have removed the building. So, there is penalty on that side as well. The financial impulse is the largest stimulant. This is also specific for the temporary court house because we know it has limited functional usage on this site. For other projects, I find it more difficult to put an end date to the usage. How are you going to stimulate the contractor if you cannot tell at what time or in which state he will get the building? So, I think it is a responsibility we should take it ourselves.

8. How do you think should be the ratio of price or quality for these projects?

For a temporary court house, we got a discount. The value for the contractor was partially returned to us in the tender procedure, so it was cheaper. They paid us for 1 million for the building. The number is fictional. We estimated the costs of the building as 15 million. Two other contractors priced it at 15 million and this one at 13.5 million.

It's hard to say in general. Per project, you have to decide. This is separate from the discussion on circular economy. There is always a price quality ratio and it differs per assignment. My experience was that making it demountable did not make it noticeably higher. So, it is not a factor in a way.

9. How do you think the approach that you followed for the project was different from the other project?

I think the reason we have this interview is because we were the first to give so much focus to it. It was also possible to create this focus because I already made the floor plans. So, a lot of awarding criteria that we normally have use to ensure a good architect on the layout of the building was already out because I made the layout the building. So, the fact that we gave a lot of solution into the tender made it easier to award the circular approach.

10. It was not completely functional specifications. What type of specifications would you prefer?

I think in the end, this is not the approach you can always do. In terms of awarding criteria, you cannot have too many. You have only three four topics that you can award on. Because if you have ten, anybody can some of these and eliminate themselves. So, I think if you want to make it important, you should make it important. I think here, we made it really important. But then again as I said, for the next project, you can also make it a mandatory requirement. That's even more heavy. Then they have to do it.

I do not think that technical or functional specifications really matters. Again, I don't think that erecting a demountable building is a spectacular foot. So, I think the focus should be on how to create a world in which there are many manufacturers that supply you with circular products. So, on our part, where we tender in the design and the construction part is not really where the challenge is. The type of specifications does not really matter.

11. Which type of tendering procedure do you think suits a circular approach?

Competitive dialogue helps in pumping up the ambitions. So, if it's an ambition, it helps. Again, it refers to the last question, it is not related. For the real circular economy to rise, we need to focus on other people.

12. What is your opinion on having market consultation before doing circular building?

We did a university consultation. So, we went to the professors at the TU and asked what's in the road. They gave the confidence that we could do it. We dint really do a market consultation. But of course, we knew that the building market was buzzing with circular economy and Cradle to Cradle. So, we knew that there were a lot of people looking for projects to showcase their ability to do it. We knew that there are many architects promoting themselves with environmental sensitivity and a lot of manufacturers with cradle to cradle carpet. We knew that the market was ready. The courthouse got a lot of attention because in a way there were a lot of people talking about circular economy but so little projects to showcase it. So, the courthouse had a lot of attention for that. For the fact that we finally had the project with the stamp of circular project.

13. Do you think a balance can be achieved with architecture and circularity?

Yeah. Again, there a lot of questions where you presuppose there is a challenge, where I don't see it. I think you know when people talk about material passports and a lot of times, the underlying ideas is that we have existing buildings and they are up for demolishment. In three years, they will demolish this and this building. From their material passport, I can see what's there, I can then use these elements for my design. I am very skeptical about this idea. In a way, it is difficult as now in our economy, there is unlimited supply of products. And so, I can wait with my purchase. So, I can make a design decision here. I have pre-design, I have final design and technical design. I procure and then I have execution design and then three, four years later I buy the façade elements, aluminum façade elements that I foresaw. So, this is how we work now. If we are solely focusing on secondary materials, we have a situation where we have limited amount of availability of products. So, when I make a design choice, I need to immediately purchase or reserve. And then there is an existing building and I already make a down payment on the façade elements that are already there in this building because I want to reuse them. Where the procurement or the tendering will in another 2 or 3 years. This is the time gap I cannot grasp. What I believe is in a way is that manufacturers need raw metal for their steel beams. For that they don't really care where their raw metal comes from. It can be either from a demolished building or from a mine in Indonesia. For them, they just need the metal. They can melt it and make it into something new. So, it's much easier to see that they will harvest the building and put it use for their product catalog. I as an architect can still trust that these products are available. The challenge is that when you go for recycling, energy is consumed. So, the good thing about actual reuse is that you can use it directly. I am a positive thinker and I feel energy is something that we can solve. We have wind energy, solar energy. If we can make our economy on renewable energy. It's not so interesting anymore to have this reuse if I can have the recycle. Then I make special choices and still have technical developments. Even the building regulations is not allowing direct reuse as of now. For example, glass. We will end up where the construction companies will harvest the steel beams from old buildings, the façade manufacturers will harvest and recycle materials from demolished buildings and put it into new products.

If you really price land depletion and really price Co2 equivalent of the products of the building. In the end, it will become an economic model to simply harvest it from a demolished building.

14. What were the best practices with respect to implementation of DfD?

They also focused on the reduce concept. They made the façade from cloth. It's a mm thick whereas masonry is 15 cm. They were very innovative here. Also, because now, for another location you need another color, the waste is minimal because you renewed the cloth. The material that has gone to waste is minimal.

Most innovative concept where the contractor is made the owner of the building is the best practice with respect to procurement.

15. What were the problems that you encountered that (or will encounter) with respect to implementation of DfD?

I think the big challenge is the sheer size of building production. So, I think we build much more than we demolish. The idea that we will have a completely closed loop for me is hard to visualize.

13.6 APPENDIX 6

1. What was your role in the project?

I am the director of cepezed projects. Cepezed projects is the project developer related to the architectural firm. We do more than architecture. We also have the initiative of the projects and we also co-ordinate the building process. We are not the standard architects. We also did bit more in the beginning of the process, after the design is made in the execution of the project. Together with Martijn, we had a joint venture. In the joint venture, we participated in the tender. We as cepezed firm, we did the whole design of the project and coordinated with all the design parties.

2. What according to you is the meaning of circular economy?

What we use as an idea of circular economy is very much related to sustainability. Designing buildings and building systems that can easily adapt to future developments and in that way, they retain their value much more than the traditional systems. Circular economy for us can be circles of 1 hour or 1 minute but can also be a circle of 1000 years. Doesn't matter how big the circle is as long as it is the circle. For us in the building industry, there is a focus on building circles lifetime of about 10 years because of the financial system. What we would like to do is make buildings that have longer lifecycles and it's very much focused on what we do. Focused on making buildings as a product that can last longer than the traditional buildings because they are adaptable and flexible. After the first use is over, they get demolished. Does not have any value anymore. We would like to make buildings that keep their value and can be used for 2 3, 6 or 7 times either by demolishing it entirely as in the case of a demountable building or by just adapting the interior of the building and the structure. Our definition of circularity is very much related to the definition of sustainability by the Brundtland commission of UN. Everything you do, you should think how much I am caring for the future. Giving the future generation opportunities and not restrictions. Most of the buildings that we make in the Netherlands and the world is making restrictions for the future. So, that's the basic thing that we are busy with in the building industry.

3. Do you see a difference between both the terms?

Sustainability is a much broader definition. The end is if everything is circular, then you don't have to worry about sustainability. Then everything is also sustainable. It is very difficult to have a sharp definition of both. I also do not find it interesting. There are many groups trying to have a definition as to what is circularity and what is sustainability. You can talk about it for years and years. At the end, it all comes down to intelligent design. Just to have some sort of effectiveness and efficiency in the design and the making process which is very comparable to what nature does. The whole idea that nature does not know any ways to. That is something we should incorporate in our industry. IF we do not have

waste anymore, then everything is automatically circular. We would like to deal with circularity on an abstract level, on a higher level. Entire buildings and entire infrastructure and cities to make that more flexible and adaptable.

4. Why did you choose the principle of the disassembly?

If you make a building that you can disassemble, it is automatically a building that is flexible because you can also disassemble parts of it. You can disassemble the entire building and put it elsewhere. You can disassemble a part of it and attach something to it. If you design the building by thinking on how I can take it apart, then just by simply thinking about that, you have much more flexible than a traditional building.

5. You chose to use new materials and using it elsewhere after the life cycle. You could have used secondary material, right? Why did choose to use new materials?

We used a few of them but not very much. Not so much materials but components. We would like to use used components. They are just not available. If they are, then they are of not the right size or available at the right time. If you are making a building and you order second hand flooring systems somewhere, but you don't know on which date it is coming, then you have a problem. So, that's also a part of the problem. If materials are available, then you don't know exactly when they will be available. May be there will a building demolished next year and certain products will come out of it. Will they be available in February, March or April? So, for us that was a risk. The date that the courthouse should be open and also RvB also have appointments with the courthouse that the building should be ready. So, that's kind of flexibility is hard to be put into the design and the construction process. What we saw is that if we take the new products and we design them in a way that can disassembled, it can be easier. If everybody is doing that, in 20 or 30 years we will have a much more flexible environment. That's some kind of Utopian vision that we have. More buildings should be easily dismountable, so that you can plan reuse of the buildings much better, you can value the materials and say well, this panel I can take it out and it is good as new. We probably might have paint it or dust it and it's as good as new. So, the value is almost the same as the new product. If you go to charge virgin materials higher, then the used materials might be cheaper. Then the used materials will used more. A lot of people say that we need to have that kind of system before we make circular buildings, then you can wait forever because you have to start making circular products and then the system will hopefully find a way to some kind of market place for the elements.

6. Are there enough sub-contractors who are dealing with used materials this in the market?

There are few who are actually working on harvesting used materials and building products. In certain areas, it's already common. If you have historic building elements in the building, like old doors or old fire places or there are lots of sites where you can order them. Historical building materials, there is already a market place for that which is flourishing, and you can make a lot of money with it. But with the new building materials, it's not so common. Few are doing it but. We used some of the old materials in the courthouse. The doors and the sill are from an old police office in Amsterdam. We used some of it but not much because it's not available.

7. What is your motivation to make DfD buildings?

General, the motivation is not so much to make sustainable buildings but to make intelligent and efficient buildings. That's something we are doing for 45 years now. At this moment it is called circularity, our buildings fit very well with the hype of circularity. But it is not that we say, oh circularity, we need to make circular buildings. We make buildings in a way that we do and yes, it's circular.

Because we already make buildings that are designed like kit of parts, just like building systems where most of it pre-fabricated and only assemble on site. So, no welding or no painting or at least as least a possible. So, the material that comes to the site is just with a few screws. You can screw it onto the building, and you assemble the building on site. If you think about the building process that way, the next step to already dismount it or to redevelop your building to different function, it is very much easy. Lot of our buildings already, they started as an office building, later it become a laboratory and later a school. Every time it is rearranged from inside to make it possible, the structure of the building remains the same. The court house is now a court house, in 5 years it can be housing, laboratory or school. And that's what our buildings always have. And now we call it circular buildings. Its bit of a hype. But, the thing behind the hype is thinking about efficient material use which we have to do because materials. A lot of materials that we use in the building are not so rare, the cement, the concrete and gravel, that's not so rare. I am not scared we will run out of sand in the world, there is a lot of sand in the desserts. But it's just not smarted the way certain buildings are made in the concrete, they are poured on site and the moment, concrete is dry, there is no flexibility anymore. It is much more thinking about that kind of building systems that are more efficient and intelligent than the buildings that are made now. It's more like a product industry, if you say how a coffee machine is made or a car is made, a lot of effort in designing the product and really thinking about how you will build it, testing it and then making the prototype, then actually making the product and then you have a product you have certain guarantees on it, certain life time and you can recycle elements of it. In the building industry it's hardly ever done, you start with building techniques, there is not a lot of design effort is made in building. It is really very low, and it must be much higher. If you compare it with telephone, you first spend millions and billions of it on designing and then you get billions on them. In the building industry, it is not common way of working, but then, if you see all the buildings, 9 out of 10 buildings are more or less the same. They have a different color, one is from brick, one is from steel. It is not that buildings are so different that you cannot think of intelligent systems that can make it efficient. One of 10 buildings you can make it very special and very different. We are not propagating to make all buildings same. You can have lot of differentiation within the buildings just by making the structure more intelligent and flexible.

Procurement

1. How do you think the client should select the contractor with the best approach to DfD?

The way it was done at the court house: I found it as an intelligent way of asking a question. There were not very strict rules or secondary guidelines. The question was just "Make a design and convince that it is sustainable or circular "The word circularity did not come into the picture, there was no talking about circularity. Just to minimize waste, that was the basic question. We need to have a temporary building, we are going to spend a lot of money on the building. But after 5 to 6 years we don't need it anymore. So, just convince us that your design has the least waste or spoilage. That was basically the question they asked. The three parties went of designing all different buildings. The question can be very simple. It not like you have to have a big framework first as to what is circular economy, how can you score certain circular elements. You can leave it up to the parties that have to make the design and that have to make the bidding. To come with an intelligent solution to very simple question. In the building industry, a lot of people on the site of builders, contractors, developers and the architect, always say the client has to ask the right question. If they don't ask the right question, we cannot give the right answer because you don't ask the right question. We think that it's very stupid to blame the clients for not asking the right question. The clients, they can have a very simple question, we have so much money and we have so much square meters and it want it then. Just give me the best solution for it and convince we your solution is the best. That would be the smartest way to do procurement.

But we have to have systems that can used to compare with each other. That's not so efficient most of the time. The problem is that you don't always get the best solution. You get a solution that ticks the right boxes, that is not always the best solution. It is very difficult, as a govt you are spending public money. You need to ensure that you at least you are thinking about how you are spending it. Everybody can make mistakes, if some projects are not very good, you learn about it. You learn from it. That's also something you must be able to make mistakes in procurement. You should not be afraid of leaving something open and letting the market come with answers. I think that was very well done with courthouse. Because the courthouse was, it began with a project that was, the main courthouse was the big project. Then they had a problem, like temporary court house also. So, it was a side project. As I understood it. I think also there was more space for RvB to fill it in. Because it was not a very important big project. They could be more open in asking the question. Then you see that if you are asking more open question to the right parties then you get more intelligent answer. Because it was not the answer they expected. They thought we won't make temporary building which we would be made of temporary materials and we came with a permanent building which is temporary court house, but the building is permanent. We will use it forever but only for 5 years as court house. So that was a very different way of thinking, we were the only of the three who did that. It gave a better answer to question. It is not an answer they expected. You should give the space to let the market give a more intelligent answer. There are also some simple procurement questions that you can ask to stimulate the market and think about circularity, one of the things that we always say, if you have a project, do not go for measuring the absolute circularity. If you want to build a certain office building and you ask five parties to make a design, make sure that you can compare those 5 with each other and not have some absolute circularity scores on the buildings, that is not possible yet. But to compare with those projects with each other, it's not so difficult. (Measurement) That's much easier to compare among circularity than to compare one office building in Rotterdam with a hospital in Groningen.

There is no objective measure for circularity, so that's impossible to ask. You should not wait for the objective measurement because that will take forever. So, you have to experiment. And through experiments, you will make certain buildings that are more circular than the other. Then you will know that you need to go in that direction. But, it's not an absolute science. The techniques are going to change rapidly in the coming years, so, should not have too strictly defined circularity. Then you will miss new developments. One of things we recommend is, if you ask for a building, then ask also for a plan to dismantle the building, may be after 5 or 10 or 100 years. That's a very simple question. Everybody who is participating in the tender, if they get that question, they have to automatically think about how they will dismantle the building. It's not that they have to do it, you have to make them think about how it can be done. Maybe they will make a building that is not dismountable building at all, but that's also a good solution if it's a very strong building that will be there for 1000's of years. That's also in a way very circular and sustainable. You have to make people think about how they can undo their work. That's very counter intuitive. Because we as architects, we want to make buildings with a lot of materials. We should also think how we can undo the buildings.

2. How would you want the clients to select you in the first phase?

Mostly on past performance but also on ideas on the assignment. If you want a swimming pool built, then you don't know when you get the best swimming pool if it's designed by someone who has already made 100's of swimming pools. But to make swimming pool, you need to have certain technical knowledge on what kind of problems you will have with a problem. If you have someone who has never made a swimming pool, then it's not good. You have to select the parties who know what they don't know and know what they have to know. To select the team that has all the knowledge together. So, it's partly past performance. Using past performance, you will build a courthouse if they have

already built a courthouse. Not just functionality, more on the process and complexity of the building. So, you should not select just on the function, more on the process and the function.

3. Wont asking for circular projects as a reference, will you not hinder innovative parties from entering the process?

You will define what circularity is. For this project, it was intelligent in the question they asked. There was an already a design made by Fokke. We also had the focus on circularity and efficiency of the main structure. Not all the chairs and tables, we could leave that out. I found that as an intelligent way of selecting on very quickly the parties that can have the best solution. Not focus on too much details. Just have the main ideas. The main ideas should be good. In the dialogue, we can do it better and better.

There are not so many people with circular projects. That narrows it very much down. I would prefer to select parties on intelligence on their vision on the problem. So, that's what I meant by past performance. If you have someone who solved very difficult problems in a very intelligent ways in the past. But these had nothing to do with circularity. But its creative and thinking about new ways of problem solving. You need to ask questions about efficiency, circularity and sustainability, they will also come up with a good answer. Or with a surprising answer. But if you just only selected based on how many courthouses they have built where none of them have built in an intelligent and efficient way, it makes no sense and better not choose on that criteria.

4. How can the market be stimulated to implement DfD in the offers?

It would be best to make the criteria relative. Don't focus too much on very strict criteria that makes something circular or not. Nobody knows that exactly. Ask very simple open questions and see what kind of answers you get. It's difficult because you have to have in procurement, criteria and this one scores 5 and this one scores 3. If you just ask for plan for disassembly, that's very easy question. If someone gives one line, it can't be done, it's the future. Then you know well, they dint think about it. It's very common in procurement to ask a strategy plan. For example, if you have to build something in the inner city, it's very common to ask how that will do, if a contractor goes to look at the site, and then says there's a canal and we use some boats. Then, they have to write some sort of plan, it is difficult plot but there is water and we know how to get it by boats. It's very common to ask for a plan like that. The plan on how you will approach the project. That's also not absolute. If someone says by boat, someone says by truck, you cannot check it in absolute way. But you can say you checked for the boat, you are more intelligent in problem solving. That might be favorable party. That's the same you can do by asking for a plan for disassembly. Look how smart the answer is and then you have to convinced that they can do it. A building that you can disassemble is what we think is always more circular than the building that is difficulty to disassemble because circularity begins with to have a chance to have different parts separated (not glued). Components can be taken apart without being damaged. That's fundamental. If you are not thinking about that then you never get a circular building. Or you should make a building that will stay there for 1000's of years. Also, if you build a demountable building and if everybody likes it and it becomes a monument, it has to strong enough to stay there for 100's of years. We should not make a building that is of poor quality that will take itself apart.

5. What do you think should be ratio of price and quality in these kinds of projects?

If you stimulate life cycle costs, that means that investment in quality is an investment for the long term and this makes the building cheaper at the end. So, what we recommend is for people to say we have a building and we have 10 million available and give us the best building that is available. Not say we want this building, let me know how cheap you can make it. Then you know you will always get less

than what you pay for it. You have some kind of minimal price or a maximum price, everything you went under was that was appreciated. You could score points with that. You should focus on spending the money that you have on as much as quality that you can get. That is a better way of approaching than I want to spend less money on the project. The incentive should be higher quality for the same price and the minimum quality for the lowest price. As a client, you don't want someone working for you who is not making any money. If that's the case, he will make a shit building and you do not where he is going to make the money, probably you will know 10 years, 20 years or later. (p/q)

6. How do you think the approach followed for this project was different from the other projects?

Well, it was the first project where already a preliminary design was given. So, we could start very fast on calculating what it should cost and that is not something we see a lot.

The dialogue session is common especially with RvB and not so much with other clients. That's what we like because you can have the dialogue with the client and show yourself where you have intelligent solutions. You can also see what the real question, the client is asking. What is behind the things he asked on the paper, that's very important. I think it's not easy for RvB to do it that way. It costs them a lot of time and money. But I think you get the best solution. If you have a building that costs 20 30 million, then spending a few 100 thousand on the process, that's very well spent. Then again you should not ask too much of the parties of the market because there is an effort made by the market parties. It will cost us 100 thousand to participate in the process. If you lose it once, its fine and if you keep losing, it's not fun anymore. So, you should not ask too much and ask the things as a client you can make an intelligent choice. Most of the time, if you have three parties, they can all do it. So, there is no bad choice. They need to select the one they feel will bring the most creativity in the process, the one who can be more transparent than others, the one who does not have any hidden incentives. That is difficult to select the parties on these criteria. It can be done with a lot of experience. (CD)

7. What type of specifications would you prefer for a DfD project?

In this case, the preliminary design was given but it was still very much open, it was only a 3-dimensional program and there was no material or technique in it. To define the outcome that you want and not how you can fill it in. You can say I want a building for 100 people which should be between this and this temperature or you can tell you need a building of that height and width. You should be able to describe the performance, what you want the building to do in the period that you are using it and then let the market come up with the solution how they think that is the best product for the question that you have during the 10 or 15 years that you will use the building. (Specs)

8. What is your opinion on the clients having the market consultation?

We do also a lot of market consultations, we don't know what exactly they want with it. It's very difficult for us to see how useful it is.

Market consultation with everyone in the big room with all the market parties is not very useful, nobody will say anything. Everybody is looking who is here and who is my competitor. Also, we have currently market consultation in Utrecht where it is one on one, that is better.

9. Can you still participate in the process later?

That is always the difficulty. In RvB, some project teams are very scared of talking one on one with people. That's very much depends on the people. Also, with the courthouse, within the dialogue somebody said we cannot answer it right now, if we do, we have to tell the other parties also. Then we said leave it and we will think about it ourselves. You have to be open about it and you should not

be too afraid of having a dialogue, you will never get everything. There is a certain risk. If you don't document the dialogue in the right way. Then there might be some people who will not agree with how you are doing it. That's a problem of the clients, there is no one answer to it. I do not think having a market consultation one on one is a problem when you share the outcome with everyone. That's the only way to get real information.

10. Do you think you can balance both architecture and circularity?

I do not think there is any relation between circularity and ugly or beautiful, bad or good buildings. You should not be hindered by that. You should not ask "If we ask for something circular, we get an ugly building". The aesthetics has nothing to do with circularity and this is a bit of problem with circularity. A lot of them think that if you have circular buildings, it should look second hand. That is not the case.

As of now, we don't have to worry at the material level if it belongs to biological cycle or technical cycle unless and until it is demountable. In the future, when the market is more intelligent, we can think if this is better or the other one is better. We don't have to solve all the problems at once.

11. What were the best practices in the case?

We learnt a lot from this project. We can have a plan that can be more adaptable or have components that can be better disassembled. You are constantly learning. But the main thing is that you have to do it and not think about I have to learn it first and then do it. Do it an intelligent way, maybe you have a conclusion that was okay, we learnt a lot from it, next time we will do it differently, if you start looking for the perfect way of circular building before you make a circular building, then you will never start. That is bit of problem in the industry. We do not know what circular buildings are, we will not do anything about it. Doing it a bit more intelligent than they did it yesterday.

A lot of materials can be taken out, but we will not be reused. Something to think about in the next project.

This is good example of how you should do it. What they really thought about in this project is what is the key success factor, what do we really want to achieve and that was avoiding waste and spoilage. And that was the main incentive for everybody. What I would recommend is: that was an incentive that was good for us and good for them as well. We both had the same goal and if you have the same goal, you have the best results. Then you speak the same language, you can be transparent about things. We were not into making the cheapest building for the highest price, then we know we are not going to profit. We have to make a very good building that has a lot of value for us when the courthouse leaves. That automatically makes the courthouse a high-quality building. That was an incentive that was good for RVB and for us. We will know in the few years if it will be successfully redeveloped.

You have parallel incentives, that is very important. Normal project, you say 10 million and you have to build this building for me and then you always know you will get just the lowest quality that is just acceptable for the client, so that he doesn't go to courthouse and in this project, it was different. I would recommend you always look for common goal. That can be very abstract. The whole system that we used here for verification and validation of the whole process was based on 5 key success factors that we defined together with client. One of them was least waste possible, another one is building it on time, so every decision you make, will it endanger the delivery dates or not, also the quality of the materials that is used, does it fit the atmosphere of the courthouse. Also, one of them was the people around the courthouse not being hindered. So, few of those success factors we defined in the beginning, that was very useful. Every decision you make from us and also the decision made by

the client, you can put up a scale of 5. Do all of them have 5 or one less, may be. But all of them should be line with all those goals. I would recommend you do that.

12. What problems did you face with respect to incorporation of DfD in the procurement process?

We would love to have more second-hand materials in the building. That's is one of the problems that we faced. We tackled the problem just by using new materials. Another thing is, this is a temporary building and the building permit, if you make a temporary building, but in our philosophy, it is not a temporary building, it is just a temporary courthouse and a permanent building. Do you make a permanent building permit also? but we did that. The quality is higher than temporary building, we did that because we could ask for permanent building permit. That's better for us for the future to reuse. That all kind of legal stuff. The problems that we had to solve, we solved more or less. Because the permits on the site is still temporary, but the quality for a permanent building. We need to get in a dialogue with the municipality how we can solve it if we want to put the building in the near future there. But, to rebuild in Amsterdam, do we have to ask for entire new building, only for the location? That kind of problems we haven't solved it yet. Everybody wants it to be a success, so we are confident we will solve it, but it's still not officially solved. We might have solved for this project but if someone wants to use the same mechanism, then it should be put into legal. The rules should change.

13.7 APPENDIX 7

1. What according to you is the meaning of circular economy?

It is difficult because everybody is using it in their own advance to spoil the real purpose of circular economy. The reason I like it is to look further than your own project or your own benefit or to look more general in the project. For instance, I can make money to build 100 m tower over there, but I also have to consider what will happen with the environment when the people are not living there anymore. For me circularity is look further than your own benefits and then you have to invest in doing it smart, doing it differently and also invest money because it's more expensive to do it. If you are doing it, you are making it easy for our children or people after us. In the big picture, it's about thinking about the new steps of things.

2. How would you define it with respect to the project?

We were triggered about the tender because they looked for a building which is nice, it has look good as a court, it will have a lot of journalists in the front of the building. It has look architecturally good. So, that's difficult if you look at the temporary building because they needed a temporary building. And with cepezed we were also looking at different ways of building and rebuilding or changing the building itself or even replace the building itself or move the building. Five years ago, we looked at the tender and we had done a different project with them in Leiden. It was also about different steel structures, how to connect them. When you have the building you have a difficulty, you can be very flexible with the building or the building itself. Within the building is difficult because you have big insultations and you have the steel structure. When you have a steel structure and big insulation coming, you have a different height, then it is difficult to change the laboratory from left side to the right side. The project we did them was in Leiden and it was a pharmaceutical building. They wanted to have flexibility within the building. When the tender for courthouse came, it was strange because they wanted a nice building and a temporary building. So, it doesn't match. Then, we talked to each other and let's do it. We came up with the idea, actually cepezed was working on the idea from a long time already to remove or replace or the move the whole building. You can take it apart and rebuild it

somewhere else and then we just did it. I just liked the idea. That's why we started. There are different phases of tendering. I believe there were 11 people who started, 7 complied with the demands and from the 7. There were 3 chosen for the next phase. Suddenly, we were left with the last three. Then we said, we have to do it and we want to win. Then, that's why we made a team, at each step you have to think not the normal way. Because you have to know, and you have to consider the person on the other side of the table does not have the same idea. He will just make the canopy, glass or the pavement but we wanted to look at the whole picture.

3. Why did you choose for the principal of disassembly?

I think because cepezed was already thinking about a project like that for a couple of years. And from the last project we did together, we also talked about making the connections as simple as possible to consider taking it apart again. It was sort of a similar structure. When you go in a tender, you also consider what other companies are taking part. We knew, you can make it by using wood and you have to say that with wood structure. You have to be responsible for the maximum life span of the materials that you are using. That was the main question I believe. So, you can do it with materials which were already used and reuse it. You could also do with new materials and then make sure they were reused again. But there were companies that make small boxes, with all the boxes together you have a new building. That was also one way of doing it, it was not looking good as courthouse. We did not consider them as an opponent.

4. Why did you not go for a solution where you could have reused old components?

There were other companies who were doing it. Also, because cepezed already had an idea of taking apart the whole building. We liked the idea and we thought when we do that, we do it totally different. When we do the tender, we want to do it our own way and we are not going for the cheapest, that was our main goal. We do it for the best. We do like what we want to do and we don't let the opponents let ourselves crazy to divert us from our goals. We had a goal and we said I think nobody is doing this and we want to do that.

5. What was your motivation to go for circular economy?

The main thing was it was not in a good period of the economy, we needed projects. I can have a story but we needed the projects. This was one way of doing it. We also liked the idea. It was not that we have to help the environment. It was that we have to pay the people here and run the company. That was our main goal, we liked the project and we said well, we can do this and let's do it and we need the project. The whole idea of circular economy, it fit well, and we said well, the solution suits us. We are right company to do it. The RvB told us that why we won, the reason is it is nice to have a different company from BAM, Dura Vermeer. That was nice. I also told Louise, nice that you mentioned it, please consider that what we are going to do is isn't done yet. And nobody does it. We are facing problems and sub-contractors who don't have the same idea. Please give us the space to fix the problems and consider that we cannot solve all the problems that we are facing. We have to focus on, sometimes we solved the problems normally and sometimes, we can go with circular thought in mind, but not always. The answer is we needed the project and we liked the project and the idea of circularity. We are thinking that we can win with the idea.

Procurement

1. How were the contractors selected for the project in the first phase?

You have different levels of how you can score and how you can get points. What we did and we do it with every tender, just check can we win or not and what do we have to do. One thing is difficult that

we have to make sure or guarantee that lifespan of the materials. Not all the materials, but only with the façade and structural part of the building. That was difficult. We were saying that we make a quote and we said all the materials which are used right now. A lot of people are saying we have to reuse the materials of the old building. We were saying, and I am saying that when they build those buildings, they hadn't thought about using the materials later. Just forget all the old buildings and the new buildings which are doing, use materials in a way that you can reuse it. Don't reuse a material which is not good. It is better that you take a loss for instance, for environment but make good materials right now that you can guarantee you can use later. Because for instance, the kanaalplaten, we were thinking reusing the old, but when I asked the question, can you guarantee? When I take it out of my building? All the parts that are in a different building, you have to also make sure they are transported wisely and installed wisely in a way you don't damage the slab. They have to be still good. Sometimes when you transport them, you can damage them. There a lot of old materials but nobody tells what the quality, what are its specifications and I have to guarantee RvB. So, you have different problems and the thing we wanted to do, we want use materials and think also about the next phase to take it apart in a way you can still guarantee the specifications and the quality of the material itself. That's the whole problem.

There was no sub-contractor of the kanaalplaten did not want to do it. After the project, he wanted to give us new kanaalplaten. We told we don't want new kanaalplaten, we want to reuse this. That's the problem with all the sub-contractors. It feels like you are rowing upstream. They say well, they don't like it because there is such amount of material and production in the whole economy, they don't like it that you reuse it. So, we did it ourselves.

We also needed Louise and Inge, we needed them as well. For the façade, it is being built using sandwich construction and then façade with glass, some of it has to be bullet proof, some of it with the sunlight, some with noise reduction. Then we made one standard façade, for bullet we put something in front, for sun as well and for bullet as well. For some, they did not want to be seen. We did something at the back as well. The main façade has to be cheap and effective.

We made a part of the façade and put it next to us under the sun to see how it is developing and to look at the quality. Because we go to Inge and Louise, you want a façade and you also want a guarantee that is good, you want a certificate that it is good. But we cannot give you, because this façade hasn't been built yet. We cannot give you yet and you have to understand that because we make a new project. That was the way of thinking of the client and they considered that as well.

They have to think differently. We had certificates of different parts of the façade but we did not have a façade for the entire part. So, they had to understand if the parts were okay, the whole façade needs to be fine.

The first phase, they selected on the vision. You know how they selected. With the other tenders right now, vision, just a small document where you can explain what your vision is, why you like the project and why you think you are perfect for the project. Perhaps, some information about other clients that they can contact. So, that you can get some reference and some information about the company. That is what I think is enough. Perhaps, the vision also needs to be specific to the project For instance, if its project in a small space in the middle of the city , you have to also tell them how do you think about that and how do you want to work with that. I think that's also needs to be asked. Vision about the project itself and also about specific about the problems of the project.

2. Wont asking for circular economy projects as reference will limit parties?

For example, for schools, you can only build school if you have two references of school in the last two years. I always fight with clients and call them and tell. Well, a school is not different, and we have done a lot of hospitals. So, I think reference projects is good but in a wide spectrum.

Still, its also always the case that, telling them that you can do it. And do it good as well. Its two different things. That's why they like reference projects but I think if you for instance have a project that has been never done before. What here was the case as well. Here was the case, you had to give some other projects but not for the whole problem. You can give it for instance, we gave the project for Sadair and we get a 10. You can score 1 to 10 and we scored 10. That's why we were selected as well. But we had to, with the tender procedure, you can check it in the document, they say well, we want for instance a project you have done in the past that you can say you worked together with cepezed. That was one thing. That's why you make sure you worked before with each other, but it can be a school or whatever. They don't ask you to give a reference projects for temporary court house built in a circular way. Then they stop innovation. Like you mentioned. You can do what you can do, if you ask a specific project on a specific thing. For instance, that you worked together. For instance, you had the responsibility of the whole project, for also the insulation. For instance, we used the project Savier to let them see that we made flexibility within the project, not to move th whole building but within the building kept it flexible. That's I think, you can ask other projects and not stop from innovation.

3. How do you think market can be stimulated to implement DfD in their offers?

The only way the market and the economy, its very simple, they are opportunistic. If they do it, they have a bigger chance for winning. They made it really clear that you have to be circular in a way, you have to guarantee the life span of the materials and the higher is the more points you get. SO, that's why, We looked at the tender, things you can score points on the awarding criteria. We looked at it and said, well, when we do this like this, we can get some points. We looked at the design and our projects and our whole way of working, we said we have to work like this. That's the right way of doing it. That you make awarding criteria, that are good for the client and for the market, they have to do it, otherwise they don't win. If you publish those criteria in the early stage when we start a tender, we are looking at can we win, and can we do it. And we need that information. And if we feel we will get 100 points and on the other one 0, we won't do it. So, I think, to stimulate the circularity, it's not, I don't believe that some people are but not all people and not enough people are doing it because they like, because they want to win. That's the honest answer. (offers)

4. What is your opinion on giving minimum requirements?

If you say this is the minimum requirements, they will just do that because they have to save money. I don't believe in it because people are opportunistic to do that. SO, you have to make sort of an incentive to do it. That's also a different example. But, if you are, when we do a building contract, only a building contract, the client also wants to have a penalty when we are too late. And then I say, well okay, you want that, and I understand it. I can only look. I think the penalty is good, but I also want a bonus when I do it quicker. I think that's nice and fair also. I think that what I like about the temporary court house, Inge and Louise respected the way we worked. I liked that. We were always honest, and they were honest as well. We put our problems on the table and we were saying well, this is our problem, we know it, its our problem and its not your problem and we know it, we want to know that you know it and we want to solve it like this and then you can help each other. I like that they were also open minded on the things we were working on and also the problems. For instance, the insulation was a big issue, but also because in the end, the building is built by people and the people who are coming to court house, they don't think that they are going to the most circular building, it will be a

temporary building for 5 years. He is not thinking that, he is going to work. Every person coming to the court house, we started a conversation with them and then said, well, this is the project, this is the vision of the project and this is how we want to do it. So, we have to give some more information to every person who is coming on the site. If you make this bad, perhaps its good for 5 years but we want it to be good for 50 years. That was difficulty during the construction.

5. What should be the ratio of price and quality?

We had a vision that we don't focus on price. So, when the budget was I believe was 15 million and we said, well, our offer will be 14, 99999, so one euro below and we put as much quality in the project. So, our vision was one euro below the ceiling. We knew we weren't the cheapest, but we wanted to be the best. So, we put a lot of effort in the awarding criteria. One way, the difficulty was for us, because we weren't using old materials, we have to guarantee the lifespan of the new materials that we were using. So, we had to guarantee we will reuse the building which we cannot guarantee. Because there aren't companies that are saying well I will take the building in 5 years and then you can put it there. That is your tenant. The world doesn't work that way yet. It was very difficult. We told that to the client, we said our vision is this and one thing is really nice, Menno came up with it. We have the commercial Patek Philphe, where a father is sitting next to the son, and it says, you don't really own a patek Phillipe, you just take care of it for the next generation. That was really strong .That's the same with our building, we still have to guarantee it. But if we did guarantee it, we can guarantee it, we can get 100 points, maximum points because we can guarantee it for the whole life span for fifty years. For example, the kanaalplatten, its standing there for 20 years and I am using it for 5 years, so 20 plus 5 is 25. So instead of 50, we can guarantee 50 percent of the life of the kanaalplats. For us, it was new so, it was zero here, then 5 years for temporary court house and then different users or different building. But it is still 50 years, if we can guarantee it, it was perfect. But what we did, we cannot guarantee it because there were no persons who do that, but we can guarantee the way of working. So, what we guaranteed is we can take it apart, we tried to let the client understand that our vision is good and that we cannot give the new tenant after 5 years. We cannot. We also mentioned that other parties for instance, when they want to reuse the wooden structure for schools, our opponents did, they cannot guarantee that as well because there was no school after 5 years where they wanted to use it, the school did not exist yet. So, what we did, we made a stichting, that is sort of a company with different people from TU Delft, uncle Breenman which was at that time the head of Bouwen nederland, also involved in politics, very famous in the Netherlands. He was our ambassador and he also believed in the concept, so we made the father of the idea of our vision, we put it in a company, in the stichting. Just to make it more important and let the client see that we are taking it seriously. Then I went to the municipality of Leiden and I also explained to him and I said well, in 5 years we have a building and we need some space but do you believe in the concept and can you write a letter that you believe in the concept and can you write a letter that you consider in 5 years that you can provide space for the whole building.

It's a non-profit organization, we put it in an NGO and we said well, we have an NGO who wants to spread the idea of the vision. The RvB cannot involve, after the tender, they can. So, we just said the idea of gebouw as product, a building as a product. That was the name of the NGO. That was one way of showing the client that we can guarantee it, its not some idea we just came up with it. Its being widely spread, also, there are a lot of people who are involved, important people and also people who can make it work. Also, the letter of municipality and the investor who said in 5 years I want to consider buying the building and move it to Leiden in some years. It was not a guarantee, there was no party, actually Leiden wanted to have first right and we refused it. We put this in a letter to client, because we say you want t guarantee, but you also want circular economy and circular project. If we make a

contract, to Leiden, then in 5 years, we put it here and that's not flexible as well. We go as far as an intention and not a guarantee. We can make a contract with a person in Groningen or Italy, but probably the guy next door wants it, that's more efficient and better for the environment. The thing you ask is not good. They went with the idea. (future reuse)

6. Legally, was there no problem?

No, actually everybody is asking us, menno and I, they did the drawings and we did the construction. In the end, we are both the owners. They are saying who is the owner, but are you getting rent right now, what happens when it burns right now. The case was with the tender, 15 million was the money, NPV, and it involves us they pay it before they use it. They paid the whole 15 million in advance. It was divided in the amount of the money of the building and the amount of the money for maintenance. 12 million as upfront and some amount each year for 5 years for maintenance. The total NPV was 15 million. During the tender procedure, they made a hike to 15.5 because there was some question about maintenance, it was more expensive that it was thought. The thing is that we get paid for the first part, each year for maintenance and in the end a small amount, after we remove the building. So, our responsibility is to take away the building. The last amount is the penalty.

I have a responsibility and I am honest, so we will remove it. There are also different ideas about that. I strongly believe that, you can take away the building and you don't have to do it. For instance, the municipality does not know yet what to do there. They do not have a vision as to what to do there.

7. How do you think the approach followed for this project was different from the normal project?

The thing that you have a ceiling and you can maximize the scoring criteria was different and I liked that.

Also, the problems we got during the project, you have the face the risk, new things that you have to make and build, you have to let the client see and know that you are innovative. I liked it about the open mind of the client.

CD is needed. Also, in a way, what we did is for instance, we had three meetings and with different topics. We can also ask questions, so, actually it was really specified what we need to give the client at the end. So, we had to give certain set of information that they can check on the criteria. They save they have to make 5 drawings with a scale of 1:100 of the sitting zale. They told specifically what they want. They had an agenda for the meetings with different topics. They also had advisors whom they got for the meeting. The thing is you need to have a discussion. We as a consortium what we did we were not sitting there and looking nicely to each other, we are going to do that and this and that. We made the next steps and drawings how we want to do it, we explained and presented it to them. In front, a week or two before, we were also asking them to bring certain advisors on certain topics we wanted to discuss. We took action like this. That way, we triggered them to give comment on our own way of working, we like that, they also liked it. Because the meetings were interesting and the quality of the content of the meeting is good. Normally, when you go to a meeting and when you have not done your homework,, you are just talking to each other and making promises to each other. Now, we can talk about the content we present them, they can also say this is wrong or right and you can do it like this or you can do it like that. We can discuss also the problems with them. For instance, we presented the problem of façade. We asked them the question "We cannot give the certificate for the whole thing?". For an innovative project, you need to have the discussion and both the parties need to do their home work, specifically the consortium and they have to take action and present their idea. (CD)

8. Which type of specifications do you prefer for the project?

It depends on the use of the building. For this it was a very short time, they made the initial design. We had to only check it and change it a bit. For instance, the other court house, they started form scratch. I liked it that they made an initial design and they gave sort of a head start, but for the specifications. Only thing I want to know is what specifications they need. Also, in terms of why and just saying this needs to be anti-glazing, I want to know why. Then I can design the façade. I need specifications written in a way that I can know why. I need to know the context.

9. Your opinion about market consultation for DfD projects?

I think that's good. The thing about market consultation is that it is difficult. You have to know the person on the other side of the table because if you are asking people will you do this, what do you think of that, they can promise you anything, you do not know the value of it. But if, what I like about for instance, RvB, they do a lot of projects in a different way. When they evaluate each project, also this project they did, they get a lot of information in the right context. And that they can use that information as a market knowledge. They have a sort of a shit load of information that they can use, they also know the context. So, if I am telling Louise what I think about certain things in this project, she understands better than when we dint know each other, we did not a project yet. She asked me a question and I said sure I will do that for you. I only say that I want to have the project. That's the thing I don't like about market consultation because they can tell anything. If you take your information from different projects with parties you worked with and you have a specific project done, you do not have use the whole information or evaluation for this project. If it's the same project, we can do it, if its not circular. If you want to have talks during the tender, the dialogue, you can use information about different evaluations on projects where you used dialogues. It doesn't have to be circular project or innovative project. For the persons you know, you get a better and quality information in the right context what they think about the dialogue. Market consultation is good but you can take information from other projects and reshape the tendering procedure. That's what we do with sub-contractors.

You have a vision and with each project, you do an evaluation, what about dialogue, what about innovations and project, what about the criteria you give and then you can reshape it a bit, also with some market information. Then you have a steadier course. You decide on better information. Perhaps market consolation with people you know rather than with people you don't know, as you -know the context of the way they work. We have different sub-contractors, I know I will get different from both of them due to the difference in their way of working. I need to know that to interpret their answers.

10. What problems did you face?

I think its always the same problem that you have to investigate what you want and what your vision is. The sub-contractors are not ready to take the components back. I think the procedure we followed, we will follow the same for another project. Then again, wewill have similar problems, some people can work with it and sometimes some materials cannot be reused because the market is not ready for it.

13.8 APPENDIX 8

1. What was your role in the project?

I was the responsible person for the realization, preparation of the project as a whole. It started with discussing with the community and NS, the terms on which we could start the procurement. It was

2012 when we started, the procurement only stared in November 2013. In the meantime, we made a contract of how the plot of Knoop could be filled in. Because there were no conditions to start with except the existing building, that was not exactly what we had in mind to just renovate it, we wanted to redevelop it.

2. Meaning of circular economy?

It's the only way to look at the future I think. Because if we keep exhausting the earth as we do .This year we took a part of this years production of the earth in August, even the year before. This cant last.

We have to find different ways to make buildings as an example. More in general, different ways to live without exhausting the world. So, it means a lot for building, but it means a lot for other terrains also. Food production and food consumption. Do we have to eat meat?

3. Why did you choose the principle?

I did not choose it. The choices were made by our partner. The contractor is not exactly the right word because our partner is more complex than just a contractor. It's a consortium that was led by tender manager Rogier Joosten. He took up the glove and asked himself what I could do to make the pavilion worthwhile more than just the fulfill the obligations that are there in the contract. The obligations were in the contract did nit go so far as he did. He challenged himself knowing what is going on in the world and knowing the pavilion will be there only for 15 years. He challenged himself how do we develop this pavilion and make the concept of exploitation in line with this. This is not our doing, its his doing.

The requirement was 15 years while it was the trigger to think differently about the investments you make. Circularity is then, rather logic to take into consideration what do you do with the pavilion when its not needed anymore. Well, you can just demolish or do better things with it. That's what he asked himself and that's not our doing, that's his doing.

4. What was the motivation to go for it, I know its their doing, but you put the requirement?

No, I did not really. Circularity was not even an item when we started the procurement.

5. The requirement was that they had to reuse it after 15 years?

No, we just made it clear after 15 years, it should be taken away by then. That's all.

Instead of just demolishing it. The investment is almost worth nothing when you do that.

You just have some material that can be reused, well, if you don't make it demountable, what can you do with it. Demolition is the only way out normally. He thought it through and made up his mind, well, he thought a better way to develop the pavilion. Its as simple as that.

Procurement

1. How do you think circularity or DfD could be incorporated in the procurement process?

Well, to be honest. Circularity is an understanding that is so broad and so underdeveloped that we must ask ourselves, what do we mean with circularity. And more specific, what do we mean when we talk about this with respect to building and exploiting. Cause both are equally important I think. If you don't have a clear vision what you mean by that, its hard to translate that into the way organize the procurement process. In arhnem, the next project of ours, we emphasized this lack of knowledge about circularity but first of all seeking a partner.

Well, you can look at your contract partner as someone who is an opponent of you or someone you need to reach your goal. I don't want to look at them as an opponent, it is a choice I made in the Utrecht. It is an important choice I think when you don't really know what you want. With respect to circularity that is the case. When you don't know that exactly, that's means you have to go through a process in which you need a partner to discover the possibilities that are best suiting the goal of circular economy, in this specific project. So, partnership is most important. When you select the right partner, you reach a goal that you don't really know the content of in advance. You can't make yourself a clear image of what you will reach at the end of the road, that is not important, its is important that you have a partner who will help you discover the right way with respect to circular economy to develop a building and exploit the building, its most important.

I don't think we would be wise in describing rigidly what we understand as the right way to incorporate circular economy in the project, you don't know that. We need each other. We don't know what's in the contractor mind when he asks him the same question, what is the right way to incorporate circularity in my project, in my way of building. We don't know what's going on his head about that. We have an idea, but we dint know that because we are not a contractor. We can try to understand in advance his considerations about this, but its impossible and every contractor is different. So, you would be very unwise to think you know what this specific contractor that you will make a contract with has the potential to help you.

2. How would you define the SP? What according to you is the meaning?

It is also developing through years. Our understanding of the term. In Arnhem, for example I would like to avoid having suppliers in the project. I would rather have the supplier change their attitude and be a partner also. Because the supplier delivers the goods and he is away after that. HE has no commitment to the project other than the delivery as his contracted and a bit of guarantee afterwards. That's not What I am looking for. For example, if I need furniture, I can describe it the best way I can in advance, we have a chair for the and they must be of this size and then you get what you have asked. What if you discover that it is not as simple. The chairs and table are in a room that is bit too noisy that you don't need only a table and a chair but also some surrounding material to use it more comfortably. If that is the discovery you make after the first supply, then you have to ask yourselves how do we solve the problem, if the supplier is gone, then it's a problem. If the supplier is your partner, then he will think about the development of needs with you.

In this specific example, the supplier can take back the table and use it elsewhere because he is a specialist in this field, I am just the user. What do I do with it if I don't need it anymore. What can I do with the material that I do not use anymore, I can try to sell it the supplier knows best what to do with it. He can take the value of what is taken in into consideration, when he is delivering the chair and table, he can replace. I really need partners. Also, there, not just the main contractor, my only partner, partnership with suppliers also. I do not like the term suppliers at all.

3. Since you added SP as an awarding criterion, what factors did you use to assess?

We developed criteria. Before we did that, parallel we had lengthy dialogues about SP in the tendering phase. As lengthy as the design of the building, so, 50 percent of our time was used to discuss SP and hospitality.

4. Once you had the dialogue, how did you measure it?

We had several criteria. You had a list of criteria. Criteria and sub-criteria and 2 teams, one for the building and one for SP and hospitality. Two different teams and do different chairman, they made the judgement.

5. How would you want to know if a contractor is fit for performing this job?

We did in Utrecht was with an interview, a lengthy interview. 2 hours with each team. Each team would send two key people, they could choose it themselves.

We had a set of questions that we formulated very specifically in the tender phase. In the tender phase, you have to treat everyone equally and you cannot just have a free conversation. Have a clear set of questions that is followed exactly to have equal treatment for every party.

6. Would you want to follow the same procedure?

No, because DBMFO was the way we had the procurement, this cant be done anymore. We want to but we cant because we have a organizations in the government that do the cleaning, the security. In Utrecht it was all a part of the task that the contractor could do, the consortium could do. It is not the case anymore. DBMFO, you have the operations, operations is then only catering and nothing else, that's too thin. So you cant do this anymore. Exploitation is mainly the job of the government now. We cant ask the same question anymore because of this development.

In Arnhem, we prepared an assessment, an assessment of the team that wants to compete with the other team and were together with our team.

An assessment. Well, you five assessments with a team from the government and a team of the competitors and the process, the human process.

A previous project reference is a start, but an assessment goes deeper than that, how people behave in certain conditions and this assessment will be developed by some external parties that knows how to do it. We wont do it ourselves because we don't know how to do it.

It is important for the partnership. You have five parties that want to compete and then each party has a team that is put together with our team and observed by an assessment team. This is in the second phase.

In the first phase, just give us information about previous projects that are important with respect to the goals of the project that is in hand.

7. If the goal is demountability, is it important to ask for previous project references?

That's important. If you have a party that has never thought through what circularity can mean in the project. So in Arnhem, it will be probably something like a DBMC. C will be circularity.

Well, think through what circularity is in this project, we developed criteria about that and we have an external party that helps us with that and these criteria will be specified before the start of the procurement phase. Well, when they know these criteria, they can respond with reference projects and a way to compete with others.

8. Wont you limit some innovative parties this way?

I don't know. Of course its not just that you have thought only important that you have made projects like this is important to show that you are the right partner to make progress with this aspect.

The professionals and the experts in the team can do it.

9. How can you stimulate them to implement it in their offers?

To make it a part of the criteria. That's most important that you make it nice to have and you wont get it probably, if you make it a must have, you will be more sure about getting it.

10. Criteria or the hard requirements, which one would it be?

Not hard requirements. We don't prescribe the means by which they can fill in the word circularity, they can choose their own way. Because I don't think we have explored enough what circularity can be, its not proven, we will be surprised probably if we let it more open.

11. How would you want to determine the best offer made?

The external party we hired made a way to calculate. They effect of the project on the circularity. The building circularity index. It's a way to discern which is the best party. Because Its is not just that, it is more than that. It is not just a tool that helps us. We all draw pictures than the outcome of the tool.

Something like the rest value after first use.

We did not do it in this project. Circularity was not an item. We started in 2012 and completed in 2103. Circularity was not very popular.

12. How would you want to ensure that the contractor would use it in the future?

Demountability is not the only thing that is important. Because if you make something that is so beautiful that it will never be demounted, why should it be demounted. Adaptability is very important. Take a monument, is it demountable. Is it important that it is demountable? It's a different kind of durability. It can be never taken down but not intentionally.

Its possible in office also without demountability, I don't want to do say that demountability is unimportant. Because if you have a rigid structure when you can take the walls away, it is difficult to make another use of it than the first use of it. It is important of have logical thinking about it. But main thing is the building as a whole is of such a high quality that nobody thinks about taking it away because it is to dear for everybody to even consider that. There are offices that are successful in this aspect as well. The material will be in the same place and can be used forever, that's the best use you can make.

There are different ways of looking at circularity.

Not just technical but also aesthetical and also social. If we succeed in making a future monument, that will be the best. Because everybody values it more and it has a high residual value after first use.

Sometimes aren't so easy to do a building that is technically perfect but has no real value. And even then, the costs of attempting it can be low.

13. What is the ratio of quality and price?

In Utrecht, SP with hospitality was 45 percent. Set a fixed price and strive for the highest quality within that price. Know how much it would cost, if you know that's the right price, then ask for the highest quality.

It is not always easy to no the cost. In the market, we have now the way prices develop are sometimes unexpected and other way around, it is also possible. When the market is low, the prices are also rather low. That's the problem for quality sometimes too, if they make a price too low and rest of the process, you have a problem. Firstly, you have a partner that is driven by the wish to repair his conventional

shortcomings, so that's a difficult conversation you have. You are not served by having procurement won the person having the lowest proce, you will get into difficulty afterwards. It is best to have a reasonable price rather than going for the lower price.

14. How was the approach followed for this project different from another project?

Partnership is not an item, not explicitly atleast. Of course everyone wants to collaborate but its different from partnership.

If I ask to you to collobarte with me, it is something different from asking from " Will you be my partner?".

You make explicit that you need the other party to fulfill the common goal and the goal must be common otherwise you have a problem. Even if the interests are not fully aligned, the goal can be common. You try to align as much as possible, but in some situation, you will know you will have a different interest from you partner.

The first thing you want ask yourselves, are you prepared to take other interests into consideration along with yours. It is very very difficult to do when you are not a partner.

15. What is your opinion on having a dialogue?

Very important. If you don't know what the outcome must be. The only way you can discover the best outcome is to put together the knowledge you have, you and your partner about certain aspects of questions. When you have a good convo about it, then you get better results. The chances of being satisfied without having a dialogue is very difficult.

In DBMFO, it is a very long relationship.

16. In terms of specifications?

Functional specifications also have their limitation. In Utrecht, we had around 800 to 1000 functional specifications, pages of specs. How can you be sure your partner can really understand what's written there, he cant? If even he does his utmost, he will have limited understanding of what you intended.

You can solve this by being a partner. By not asking for a product that is ready to build but to ask a sketch, that will be the basis for good discussion on how it can be worked out. How can your partner what you intend the best, what helps the best, not just what you write down, best thing is discuss all the things that are unclear that you write down and I think in my experience, limitations of written documents in this respect can be really make clear what you want, such a complex product, limitaions are big. Its not that I plead for not writing down anything but to keep it simple and small, so that the costs of subscribing are not as high as they were. In utrecth, they were sky high, every partner needed 2 to 3 million to have an application that is valid. An offer that is checked by the banks that is valid, it is very elaborate offer. We give them one million when they loose.

17. Circularity and functional specs? Any relationship?

With func spec, you can make only things you can describe completely, you know what the outcome will be. If its not difficult to describe what you want to get, in other respects, circularity, what do you want, what do you ask when you ask for circularity, it has so many aspects.

You cant go for functional specs. Not even tech specs. Just go for ambitions and goal, highly abstract and ask them for translation that is fit for this special conditions.

Its an adventure you will start, you don't know what you will get. Many people will be unsure when this is the case. You can think of it as risky but when you think of opportunities. To really get what you want, is it what you think what you want.

Specifically with respect to circularity, what can circularity mean. Its so diffused and its very important also. It would be unwise to exercise it, you know what circularity is exactly about. If you concentrate on materials, you make it without taking in consideration other aspects. For example, if they are making a monument, its fine to use a huge volume of materials. What if in these buildings you have very less material, you are proud of, byt if its taken down by 20 years, what have you achieved then.

18. What is your opinion about market consultation?

It is very important because you have to think through with the market parties what circularity is and what you expect from them is important to take it into consideration in the procurement process.

One of one is very difficult because who do you choose to talk to. It is not in line with equal treatment, it can't be done.

You can do with multiple parties when you have no project in mind. There are many gatherings about circularity with no project in mind. Or use references that were done before that can be inspiration for others. That's is done very often. But that's a part from procurement process.

19. What were the best practices? Other than SP.

To say little bit more about the approach of partnership in this case. Rogeir did what he did because he was our partner. I did not stimulate a circularity approach, he asked himself what's best to do with pavilion now that the office is in full swing being built. His job in the process of orgnaoso9ning good office project officers was done. What he experienced with us was an inspiration to him I think to think aghain what the pavilion should be. We had described some things about this. He asked himself "How can I contribute to the goal that the government has?" and how are they in line with our own goal. How can we set an example that will serve us as a company and the government I am contracting for. The investment we made in the relationship was very important as a basis for his willingness to act as he did with respect to the pavilion. He was just another contractor that I selected in the process, he would taken just the easiest way to fulfill the obolgations that were written down. Now, he challenged himself.

Well, we made it easier to them to have a successful pavilion by not asking a sum of money for the ground that is ours. So its easier to have an exploitation that is okay.

20. What challenges did you face?

It's the same story again. Sorry for repetition. The most difficult is in e technical world to ask attention for relational aspects. Social interaction in a project is as important as technical part. It is underestimated, it is not taken seriously. When you see things about partnership in the procurement document, some lines that are written down about it. Are they taken up in criteria and its always nice to have. People underestimate the difficulty in bringing the right partner. Just like a marriage.

21. Did you ask for references where partnership is important before?

That is not wise, how could they describe themselves on paper. I think an assessment is much better way to do it.

22. Were both these projects procured together?

They were supposed to do it together from first. It is quite unusual also for us because the pavilion doesn't contain functions that we need for government workers. It is extra and not in our normal work. So, I was looked upon rather strangely because I made it a part of the procurement process. Why do you do it because this complicates a lot. If you don't do it, you have a vacant place for 15 years. That's ugly and that doesn't place everyone who has to do with this place. You leave a chance to add a function that makes this location more socially safe and vivid. Its a missed chance if you had not done it. Easiest way is if you had not done it. Many ppl asked me why I did it and complicate what is already there.

It is a part of dbmfo contract not in the way of the office. They do not have to convince how the exploitation phase meets our needs, because we did not have any needs with exploitation. They create their own needs, their own level of performance. The only thing we asked is that they will take in the building functions that will add something in the goals in the abstract level that I just mentioned to you. so if the made a barber shop and not a restaurant, that would be okay too. But all location is such that so many people walk by it, we hope it is a vivid place. We needed to wait on the partner with what proposal you would come.

13.9 APPENDIX 9

1. What is the meaning of the circular economy?

Well, for me circularity is a way of thinking how to bring materials, products, buildings, so, at a higher rate of integration. So, preferable buildings or products, if not materials that products are of made of, in the technical or the bio- circles. It has a few principles, reduce, repair and recycle, rethink.

Basically, you can, put the definition in a very short word 'rethink' every step of the process to make products (buildings) at the end of the use of the product, think very well what are you going to do with it. Then, use of the principle of upcycle, so that at the end of the use of the product, how can you reuse it.

2. What principle of circular economy was used in the project?

We used basically the cradle to cradle idea. So, upcycling and trying to keep the products and materials in the two circles, techno circle for example for metals or the bio-circle. As much as possible. We also used the shadow price.

3. Why did you choose this principle?

It was at that time, new. It was the standard technique. It was the top technique at that time. We also used the old 3R principle.

4. What was your motivation?

I did not even think about this. It was a normal way of thinking.

Well, the 3 R principle and the shadow principle, that were the policy of the company (RvB). C2C was more an ambition but it was also an ambition of the company. This is one of the reasons.

It is also the aim to go further and if possible within the framework of the project, the time, planning and the money, you aim for the best in terms of the environment. That is also the ambition of the company till now.

It was not special in terms of sustainability, it was special in terms of co-operation. I was the consultant for sustainability and comfort, for me, it was my duty to set a good example for this project. To set a high ambition within the framework of the project, the planning, the budget and also the policy of the company.

Procurement

Difference between the projects

You cannot even compare the two wit each other, one of them is building forever and other one is building for a while.

1. Why is design for disassembly associated with temporary buildings?

Because I think up to now, the best we know is design for disassembly, also building forever. It's more difficult because the requirements for other than circularity, for thermal comfort and energy saving, they can be a against design for disassembly. So, what I told you about the air tightness of the façade, you need it for two reasons For, thermal comfort and also for energy saving of the building. Because the more air infiltrates from outside in the building, the more you have to condition the building. So, you need a high air tightness of the façade, but too high requirements for air tightness of the facade implicates that you have to use mortar and using mortar makes it more difficult if not impossible to disassembly every well, the components of the façade. Its just an example.

Building forever has much higher requirements for a lot of aspects, so comfort, security, constructive security of the building. So, the building is strong enough. I don't know, a lot of requirements that can be a problem for easy disassembly of the components of the building.

2. How can circular economy or DfD be incorporated in the procurement process?

There are two aspects. Main aspect that I am thinking about now, one of them is the technical requirements or the awarding criteria and the other one is about the process. How do you organize the process?

For example, which kind of requirements we set on the market for the contractor, what is he going to do with the products at the end of use. By the way, you have a lot of type of contracts. So, its design, traditional contract, design and build, design build and maintain. Its different. Its not a question you can answer very easy because in every type of contract, it's a different way of doing business with each other. If you have few hours, we can talk about all of them. But basically, all of them have certain process, so it's also a matter of rethinking those steps of the process. To think about the stakeholders and what could you achieve. Is it for example, that you want to purchase an installation, or you want to lease within that type pf contract, is it possible to lease instead of purchase. Its not that easy to answer that question. Once again, it can change the way of owning the components that you purchase. Do you really want to be owner of the electrical installations or you can just lease the electrical installation? You can ask for service.

3. How did you choose the contractor?

We did not actually because circularity was not even a word.

We didn't, so there were a few award items and sustainability of one of them. But, it was just for a very little piece of the award and we focused on the energy saving and not on circularity.

We did not select the contractor on the basis of circularity. Energy saving but for a little part. No, we just have chosen, you can't always choose circularity and we chose energy saving.

We however had requirements, ambitions and a lot of things for circularity but it was not for the award. But once chosen, the contractor regardless of the chosen contractor, he had to deal with the requirements of circularity. So, it was not an award, we did not choose him based on circularity, but once chosen, he had to fulfill to meet our requirements in our contract, circularity for cradle to cradle ,3 R. You have output specifications. There were output specs for circularity. It was a compulsory effort for cradle to cradle. 3 R was compulsory. And the shadow price was also compulsory.

4. Did you check if the contractors have these projects before?

There are a few phases in tendering. First is the selection and then is the award. Then you choose one contractor at the award, one wins and then you do business with the contractor on the basis of the technical specifications. In the selection phase, you choose a few contractors who will submit their offer.

They have been chosen on certain selection criteria, one of them was. I am not very good at it. You can better talk to Peter because its his expertise. But you choose them on the basis of the capacity to do such a big project, do they have the knowledge, do they have the capacity with the people, do they have the financial stability. Also, the quality of the projects they had done before and sustainability was one of them There were many selection criteria and sustainability was one of the criteria.

5. How can the contractor be stimulated to implement it in their offers?

We formulated an ambition for the project, ambition document and also the output specifications. It's the requirements.

The contractors that were in the award competition, they studied the award criteria, minimum requirements and the ambitions. Most important one is the awarding criteria. I ask for three people who are graduated in construction, then I want to know within mathematics, which one of them has certain expertise in mathematics, you look for contractors that meet the aspects and capacity and then you choose from 20 contractors (random number), you choose 3 and the three of them they have to go for the award. For the award they have the requirements, ambition and the award criteria. The award criteria is where they get points, the more points they get, they win. They do not focus on all the requirements, but specially on the award criteria.

Minimum requirements vs awarding criteria

Well, it depends on the focus, you have different building, different projects, different focus. For one project, the focus is on circularity and the other project, the focus could be on co-opertaion. Its not what we like, its, what is the best for the certain project. So, you don't have two prijects that are the same. Every project has it specific characteristics and within the nature and characteristics of the project, you look whats the best, awarding criteria for the project. Its almost never one criteria. You have to make a choice, too many award criteria is never okay, you need certain, just few awarding criteria to make it more clear. What is it about in this project.

6. Sustainable partnership was the awarding criteria, how did you measure this?

That is not my expertise. This was done through a jury and a commission of experts in sustainable partnership.

Whenever the award criteria is subjective, architecture for example but also SP. We do this through a jury of experts. People that have a reputation. Professors from the university for an example.

The award for sustainability was energy saving. And it was a very hard criteria with determination method that was uniform. So, its an objective method**.** So circularity was not an award criterium, we did nit choose the contractor on the basis on circularity but on the basis among others, energy saving.

7. What weight was given to sustainable partnership?

It was more than 40 percent, almost the half.

8. What is your idea on price/ quality?

It was an EMAT tender. Within the quality, there were more aspects. I do not know the ratio of price and quality.

9. How do you think the approach followed was different?

The sustainable partnership. It was not used before within this company, I think in the Netherlands, in this company, it first time in the project, the award was based on sustainable partnership.

The SP was the choice of the project manager.

It helped enormously. This had extreme good consequences on all the aspects of the projects, the co-operation and the way we worked together in the projects. The results, the value was very very big and actually the idea of the project manager was that it only what you are asking but also the way to achieve the result (things you require). He wanted the process to be based on good working relationship between the client and the contractor and he persuaded our management that having a good relationship between the contractor and the client, that would bring added value on all other aspects, and he was right. Also, for sustainability and circularity, it brought a lot of added value.

10. What about the dialogue? Is it important for this project to have a dialogue?

Absolutely, its anyway compulsory. It is compulsory. It is the way with how you tender. But the project is too big, and the nature of the project asks for dialogue.

Well, we had a lot of discussions. The discussions were on all kinds of aspects, I was not present at the dialogue was co-operation, for SP. It was not my expertise. I was there for technical part, the quality of the building but also for sustainability.

It is not one dialogue, it is a series of dialogue.

The dialogue is extremely important, through this dialogue, you explain and help the contractors that are in the competition for the award to understand better your requirements, your ambitions, your aims, your purpose. And you also understand what they are thinking. What their vision is and you help them, that's very important to, it's not only assessing and assessing, just making it difficult for them. Trying to help them to understand.

11. Did you have a market consultation before?

Not on sustainability. 75 percent of it had to reused. It was not an award, it was a requirement.

12. Would you do a market consultation in your next project?

For reusing the infrastructure. No, if you have change a bunker into an office building but no this was already an office building. It was an old barrack with the functionality of office. If you change an office to another office, its refurbishment and enlarging.

13. About the circular pavilion, you just put one requirement, right? You got this idea after you awarded them the contract? You negotiated after you awarded the contract?

We did not negotiate anything because it was a minimum requirement. No, the pavilion was not.. I don't know actually, if they talked about the pavilion during the award. We had the requirement that we would like to have something there but it was very light requirement. You ask for something to make the place more lively and it's a temporary construction and I don't actually know if it was compulsory within the contract. So, you have to talk to Peter and ask him if it was compulsory because I don't know. But once you made it, it was the question to reuse the products.

14. Did you ask them to make a contract for reusing it?

There was no specification whatsoever about how you would want to resue it. It was just one liner.

15. Legally, is it not a problem because they have built it on your land?

But it is our building, it will become their building when they take it away after 15 years. For 15 years, its our building.

16. You also mentioned about the differences between the two projects? If you make a permanent building demountable, you will have some issue? Did you observe any other difference?

Its very different. They are two complete two different buildings in all respects. The only word that you can use for both is that they are buildings.

Here they had to reuse 75 percent of it, there they got all new materials? With respect to this did the face any difficulty?

It's a combination, some of the materials for the pavilion are reused materials from the former old barracks of the office building. The façade for example has been reused. There is lot of products inside that are reused products. But not all of them. There are new materials but for new materials they made sure they are able to be reused after 15 years. At the end of life, they can be reused. Also, as materials and not as products. Example, wood. They can reuse the products but then in the end of life when the product, that is made of wood is not reusable anymore, just for whatever reason it can be, you can reuse the material. They are not painted, you can reuse the wood to make another product.

17. What do you think were the best practices other SP?

For the office building, I think that there is a lot of things that you can learn. These projects have a long term. You have to dare to look in the future and dare to ask, to put the requirements. There is always a good equilibrium between asking too much, what is practically not doable and daring to think that the technique will be farther, one step ahead, 6 years later when the building is going to be built from the moment that you formulate the requirements. SO, looking into the future, prospecting the future and the technique in the future. It is very important, for these long-term projects.

Never do it on your own, so,always look for partners. There are policy makers that can help you prospect the future, also look at the innovation and try to talk to innovators. Or the knowledge

institutes, the universities, its always having a good dailouge with a lot of persons that are experts in technique and in policy, in theory of constructions, the professors. Prospecting and looking for help for knowledge, then to talk about the realistic possibilities about near future. Then formulate the requirements. Also, market consultation.

18. What problems did you face because you went for implementing these new SP, c2c, 3R principle? Also, asked them to reuse 75 percent of it.

For the office building, none.

For the pavilion, yes. For the pavilion, the market was not ready yet to deliver the products we needed. So, those circular products, they were simply not available in the market. For the office, yse, we asked for C2C for interior.

Sorry, I said we did not do market consultation. We did two of them. We had one market consultation for C2C. It was within another project, Rijnstraatacht, There was a market consulattion, I was also a member of the market consultation.

The other one was not a consultation. It was a market research. So, you also talk to people. Market consulttauin is that you invite the market. So, you invite the supplier.

The market consultation was absolutely successful. The market consulattipon for c2c was done with all the suppliers that wanted to answer our invitation. So, it was successful and we knew that they can deliver the interior elements that we were asking for. So, that's how our requirements were. We did not c2c for all the products, we asked only for the interior elements. The most C2c products, they were available for those market.

When you set the requirement, a compulsory effort, for c2c for interior elements. So, that was for the office building and the market research , you go on internet, you talk to policy makers about the future and also just calling engineer offices, your professional network. On what could they deliver in the future. The research is how far can you go with the energy saving requirement. Prospecting the future is really important.

For C2C, we also spoke to the Micheal Braungart, at one of the lectures at the university. William Macdonald, it was the presentation he gave.

Problem for circular pavilion

For the circular pavilion, it was really a problem (by the suppliers). Our one liner was a light requirement, but the contractor had the ambition to get maximum out of it. To make circular pavilion and also with a building circularity index, with an assessment framework to measure the circularity. So, he wanted to deliver much more than we asked. He went for it. For him it was very difficult to find the suppliers for products and materials.

19. The integrated contract, opinion?

According to my knowledge, it's a very good contract. Its integrated and the quality is intrinsic in the concept.

It stimulated also circularity. Because it stimulates that you reduce, reuse and you rethink all the phases. It's a trigger within the contract to make things better and to reuse it, make the operation costs lower.

13.10 APPENDIX 10

1. What was your role in the project?

From the pavilion, it's more strukton. The only thing I think was an important task, it was a little start because I am an architect at RvB, we are mostly not designing ourselves but mostly making the conditions for someone for someone else to make it beautiful and functional, of course not for the budget and all that kind of things, but for most of time I was for an architect supposed to set the questions to the market what was important for the project. Of course, a lot was about well the environment and all the site itself and the buildings around so that we have a good design. Most of it was about the design and the program about working together, also a lot. When we make a ask a tender, so the conditions for the tendering and we got 3 three important things, ofcourse I can show you, I have pictures for you. That's the normal thing ah, all the buildings have to, that's what the architect focus on and its about the environment, the building, the use of it, to use it very well, the way you experience it, the way it feels like, how it looks like and ofcourse the future and theres the durability and those kind of things are in this. So, when you put some conditions where they were important or and then with this, they all get when there are several plans coming in, you look at them and check how well they scored in these. And the Knoop was on a spot where also the Utrecht itself also had ideas how it has to be done and there was a plan what were the important things about it and you could see a clear spot where the building should come, there were other spots where in the future other buildings would come but not right at the moment and there was a corner on the side, that wasn't a part of the building, but there has to be done something, but it was an empty corner and did not look well. So, how can we put that question to the market to get something there and what should it be. So, talking about it we asked for a building that could be moved because there was a definite building later on, so that's also the durability(sustainability) effect but also a practical reason. So, there has to be a building, it has at least 400 square meter of maximum of 1000, those normal things you ask for and it would be nice, it cant be demolished and thrown away, it must be able to use it elsewhere or to use the materials elsewhere. But we don't want to waste the materials, so actually that was the only thing we asked for. A building that wasn't a waste, it could be replaced somewhere else. I had a durable idea about it. And we also told the consortium and we don't have a program for it, you can think of anything and you can use it yourself, the profit is for you and whatever you want to do with it, do it. We just want a building there that can be reused.That was really the only thing we asked for at first in the official papers and then we had the selection of the consortium and I think there were three of them and we gave the points on things we asked for. These are things from architectural view and usable use and at the other hand we had how to work together. The SP.

Well, there was a lot of people who were looking at it and then Strukton came out and cepezed and then you have a dailouge before you have chosen, with three different consortium and when you talk about it, you talk about the main buiding, have you got ideas what you want to do with the small building and then, Strukton shared he had a nice use about it and other things also that were very good because the square, the knooplein, it was not asked directly because it should be there when all the building were ready, but we did not ask for immediately making the square. And that was also a very strong point for us, they already made it in the first stage, it looks much more beautiful. And they had other things about, there was a lot about, that was when you say sustainability, there was also, that was building over there and also we had an old building there and the question was to reuse it as much as possible, so that's also sustainable. And it had very low ceilings, so there was a big difficulty to put everything in it for light and all the insulations to make it work. Having still I think we asked for 270 free and it was to 285 or something, so they only had a very small, so that's what also the think where we looked very and ofcourse, there we also asked for about the durabaility of the building that had low maintainence and sun collector on the roof. So, that was about the building, when we had the

dialogue, we had several firms. Strukton got the most points for the way they thought about the little building, so they got the assignment and then during the process, everyone got enthusiastic more and more about what was possible, so we can do this, so it grow in the project, so it wasn't asked for at the first time but because ofcourse Rogier was making a strong effort to make, spo that's his effort,, so all of us we had people of knowledge and everyone got enthusaitic and that's how what it is. SO, when you say what would you do the next time, I think its years ago what I told you now, in the long processes project and nowadays we ask much more in the front of course. No, well, somethings we can keep it open. For instance, rechtbank, that's from the first time that its durable and it it temporary and so we ask more and more for sustainability and also for the use of gas and that its low as possible. So that's, I think that the progressing in time, knowing what the possibilities are, you can ask for more.

And for this project, it worked out perfectly, so its also the way you ask it, that's the nice thing about it when you ask everything on the letter, that you have do this this this, then you do not have good surprises like this. You have to ask minimum but also trigger people who want the assignment, you have to trigger them to do more than what you asked for. Then we have tools to do that because you have to grade them in what they offer, so you can say the more it is, the points you get, the more likely is that you will get the assignment, so that's our way of doing it, We cant ask too much but we can a minimum and try to get more out of it, we can give them more points and then they do it and also now, its also more common that we don't look at the small site itself, building itself, more also the environment around it, so that's rather new. It goes slow but you see it gets better and better.

2. What according to you is the meaning of circular economy?

I think, it's difficult to put in another language. So, it is using the things, the earth gives you as efficiently as possible and be aware. So, that's also an awareness, what you use and what the effects are.

But, the awareness is very important I guess.

3. Did all the three parties come up with different solutions?

They had on the same spot and more or less but the thing was, two of them had made the volume and it was all very vague. You could know they did not know what to do with it. They had a lot of questions about it, so what will the Knoop use this as a conference area, can we put shops in it. They did not really have an idea what they wanted to do with it and on the pictures, a lot of volume with the conference rooms and I don't know about the other one, who had a restaurant in it, some Starbucks in it or something. But you could feel that they did not what to do with it.

4. Was the technique the temporary building itself?

They did have a , but also not that far. That wasn't with the Strukton either, but Strukton had a story that they wanted a make a sustainable building there and they had only their that it could be used somewhere else. They had in principle steel structure, so you can remove it and use it elsewhere. But they had vague plan. They dint get points on that part.

5. What was the motivation to go for the reuse?

Because it was the best of the three, but it was also well thought through and you could feel the vision behind it and that was, then you have the most idea that it is going to work because it had to be a success, we could not allow they are being kind of structure that wasn't, so it was not an important part. So, they had a vision about it, they would put money in it. So, we had the confidence in them, in the plan and in the idea of course. So, that was very good. Everyone got enthusiastic about it in time but also it reflects, there were of course the big building also, we asked for things. But, well, somehow

it was connected, when we can do that, we can do this. That was one, Rogier was also with the big building, so we had, so the advice of him had some influence. That was good.

We realized that they have to be something on that corner and we also realized it as from the government, it wasn't very nice to let something to be built there and after 15 years, so we have sustainability and all those things high. SO, there must be something that we can reuse, that was the most important thing, we can reuse it. Well, ongoing, howdy cat did a lot and a lot talking on about how it can be better, we embraced the idea and we did together. But the honour is for the consortium.

6. How do you think circularity or DfD can be incorporated in the procurement process?

Well, you see there is the law and its going further and further in that. So that's a easy way, so you just have incorporate it. So that's very good and there is an awareness, more and more in society, so its not done to ignore it and the government embraced it. They made appointments when we will be completely circular. So, its well, having the knowledge in the house but also going to people outside to get the knowledge, its an active way, we are searching for knowledge. That's what I want to talk about yesterday, we had a lot of discussions yesterday because it has to do something with the norms we are asking for and that's where also Rodica and I had sometimes little arguments because comfort for instance, they are very strict and the sound must not be, and when you have those very strict rules that we just have, that is not Rodica, that is what we have RvB. But, that also strange how much you can, so when you have more flexible norms, you can achieve more and that was yesterday also the topic. We have to stay a bit away from very strict high norms for a building because there are other things that are more important. Now a days, from the past we have built up how we can work and how we can feel it but the environment was not incorporated in the old days. Now we are aware and we have to incorporate it but we have strict rules that, so that's a part in the very near future we have to adjust make it more flexible.

That's where you constantly see, as I said yesterday we know but it is not that fast.

7. How would you know if the contractor is fit for performing this project?

That's what always is very important about architecture and other techniques, is the dialogues we have before we give them the assignment.

Then its on paper, but we can still ask questions about how they have a vision about this, we ask their vision on the subject we think those are important and then it depends on what they answer. I mean it is a bit boring, when you have seen a lot, when you read it, you can see whether they have a common talk or if they are actually thinking about it. Also, of course, when the 10 we look up on internet, then you already have an idea if they and when they never did anything, its not a reason for not choosing them but then they have to, in what they write about it, they have to convince us they want to learn a lot about it. We always ask for references of course, this is the assignment, how did you look at it and did you something similar or if you did not, how do you want to. Its by what they give us answers, if we have confidence or we don't have confidence.

I am also busy with, this was phase one of the Knoop. There is also phase two, that is also a big thing, we incorporated in what we asked from them. That's will take more than a year because we have talk about the government and Utrecht, it is becoming a part of what we ask and what they write about it.

Yes, the Knoop project also it was similar.

8. How do you stimulate the market to implement DfD in their offers?

By well, the part of it, giving them points. Awarding criteria when they are showing it but also we have to write very clear down what we are looking for and that's we also learn to do that better and better, so because, well, at first it was we dint have the knowledge what we were looking for. But, we are learning and learning, so its what you ask, its very important for what you get. Asking very clearly what you are asking for is very important for what you get. So asking very clearly what you are looking for, whats the minimum and what is rewarded.

9. Minimum vs awarding criteria?

Nono, the minimum requirement, mean absolutely must do but as I told you the norms we have, we can't over ask, we cant say this is what we must have and try to stimulate it, but we want to have and we could put down the norms also higher in time, I mean for instance there are gradations for A,B, C and D and I think, two or three years ago, every building has to be minimum C and now every building has to be minimum B and in time, then we have a minimum of A of ofcourse. So, we also can adjust the norms, what our minimum is, but that's also has to be in bit of balance of costs of course.

10. How did you determine if it is the best offer?

Well, its always, we had a lot of people. We had people, everyone has his discipline and knowledge, I did the architectural part, most of it and Rodica did comfort and sustainability. So, I mostly looked at the architecture and the environment.

11. Was it done for both the projects together?

We had a team, each of them looked at it on their own, but then we discuss together to come up with consensus, we discussed it and what did you find in large, because sometimes it is very good for one but bad for the other. So we need to discuss it and then know what how it is, that's a team work.

Ya, I think, absolutely, for us the main project was the Knoop and they all said they made something there but strukton got the most points for that part but they had other strong points as well. So, in the very sadest way, if they did everything on the building not as good as the other ones, then they would not have won. But they were good in much more things, because at first, they had a clear idea but of course it wasn't worked out because it wasn't a clear idea, but it wasn't the main thing ofcourse, Knoop was the main thing where we judged them on but they got extra points because they got a nice view and it turned out to be perfect. I was very glad and also working together with them, it was very special for this project. And that's what we learned from it, that we have to do it often. It was so important and It was also funny at the start because the building world is not very soft and in this project, in the beginning, we had sessions with well, the soft things, how you work together and be honest and say what you feel, those were "Oh my god, whats this like", its was very different, it was really funny. But it worked so well because you see none, the main thing was that we were honest, we had a lot of differences, we did not hide the things behind what we want, we just said, the contractor said this costs a lot of money, when you want this, then you could discuss that is it worth that. So, it was very open communication. The whole project was like that and even because there were a lot of people, in the first stage, there are most of time other people but the man, bouwmanager on the plot who had all the ropes, he was there from the beginning, so he knew how it worked, how it worked and all of us we took the new people in the same way, so, it worked very good, the whole project. I don't know What peter, he had to deal with more or less money, he was very content

12. You did not ask for it, they come up with the idea, what do you think stimulated them?

Ya, we asked for in a way they could get it, but they were very, Rogier also, said because you asked it that way that we have reuse it, they started thinking how do we do that and then. So, it was, actually was a very little thing, it was very important that we asked it because they started then, then it went further and further. Even in the dialogue, they said, oh, do you mean, that could be nice, so it was going on and on. But then in the next project, we already asked for much more for sustainability.

Ratio for price/quality?

It is becoming much more important at our office and I think, it's a bit, at this time most of the people are realizing how important it is, you also see it in politics, then there is more money you can put in it because everyone thinks it's important and what also is architects normally, most of them aren't, wont tell you sustainability is the most important thing, they want a good building and where people feel good. But during the past 10, 15 years, its being proven that both is possible. I saw a new building by Thomas RAU, very recently. It looked beautiful and it very sustainable. It has been proven over and over you can do it, then there is no border.

The quality is being taken seriously and also raising the quality and making it serious business and not oh yeah, also that. Incorporating it, you will get a nice building. So, its grown up.

Its is difficult to tell the number, whats the quality, is it good comfort, it has to be one package and everything has to be up high. 80 , 90 percent, you looking for the optimum and maximum on all those issues, you just don't want it to split it, you want a whole package and everything has to as good as possible.

13. How was the approach followed different?

Everything was normal except for asking out the partnership. That was new.

14. Would you have any comment on CD?

That's absolutely necessary, absolutely. And from both sides, because, we always get it back from the contractors also, where they just come talk with what you want and what you looking for, they cant give the optimum answer for it. So, we want to know what they can do and they want to know what we really want and how can they give us the maximum. So, dialogue is super super important.

15. Any comment on specifications?

More functional and open. And you want to make it able for to find the best solution and if you are pinning all things down, they aren't as free in thinking of the best solutions, so they have to freedom to make the optimum. And to surprise us, the fun part is when they send in the plans. We say "WOW", that's beautiful.

16. Did you have a market consulatation for this project?

I guess. Absolutely for the pavilion, strukton had, they had to know what is possible for the function. I don't we had it for the office building, because we just, we were our won customers, we needed space. So, it was absolutely, we had discussions with the govt and the municipality because what can be done there, what they want. But not about the market.

17. Do you think it is required?

Mostly not required.

Well, I think it isn't that complicated. I think the construction is very super intelligent or something, NOOO. But its good thinking but the sustainability is from the whole idea, from the inside and the plants grown there, no electricity in the kitchen and reuse of the glass panels from the Knoop. But, it is not super complicated. It can be done.

18. What were the best practices?

Well, I don't know whether there is one thing. I think well, everything you have to be aware what you are asking for, that's important. And therefore, you must know what's possible of course, the main things, not everything, but main thing. You have to be aware of how important it is the way you ask for things and how you can stimulate the market and how much freedom you give to develop it, because we had a free program and they could fill it in themselves, they get the opportunity to make something they can make a profit of and that's also important for them that it is interesting they can fill it in a lot together and try to make profit from, not only from the beautiful thought but also well, the business side of it. So, you have to aware of what you are asking and you have to give freedom to make their own optimum decisions and then its also important that you know how to get people together and develop it even more. So, to give room to develop it and get other specialists helping.

19. Whats problems did you face?

Well, what we heard earlier, the norms we have. And the tension between sometimes safety and well, optimum solutions for circularity and also of course that wasn't the case in this case. It wasn't at all the case at all, but you can imagine sometimes, the use of materials can be very sustainable but the design can be less by using. There is pavilion at Rabo ABN bank, they used existing materials or isolation of genes and that, when you see them, it has some looks and when you choose it sometimes you don't want to look like that, you must be able to choose something else because it isn't nice in that part, so we have to always, that is also with parametric design, I guess they are all tools, they are all possibilities and architect has to make a good total product and sometimes there are not one to one to be incorporated. But that's also RAU is very good at it, that is also quality of the architecture in it. Therefore, I think you have architecture specialized in sustainability and they are also thinking about the looks of it. So, that's always what you think. We have to find a match between sustainability and architecture.

13.11 APPENDIX 11

1. What according to you is the meaning of circular economy (in general)?

Satisfactory fact to maintain and improve prosperity

2. What principle of circular economy was applied in the project?

In the beginning there was only the principle of not being unscrupulous and investigating what was possible within the framework of the business case for a period of maximum 15 years. In the out-put specs for the pavilion we asked: The materials or the entire pavilion must be reused after the period of use.

3. Why was that principle chosen for the project?

Because the exploitation period is a maximum of 15 years. The specs are written between 2012-2015. In that period there was no government policy with regard to circular construction. We did, however, aspire to high quality and focus on a good image to make working for the government attractive in

order to have talented employees in the future. That is why we searched for examples and found, for example, that in California (USA) 30% of the use of materials had to be mandatory in order to obtain a building permit.

4. What is the motivation to implement circular economy?

The pavilion must be able to be used until 2033 and be exploitable. That's why you have to think ahead. In addition, the central government must be a model in the development of real estate. That requires a visionary perspective.

2. Procurement

1. How will you find out if a contractor is suitable for working on a circular project (demountable building)?

By asking to describe a vision and give examples.

1. How would you stimulate the market to implement circular economy in their offers in your project?What type of requirements or awarding criteria could ensure a better circular approach?

If required, prescribe to work with leaders as a consultant to a subcontractor. Without mentioning names, you can describe the expertise that a contractor must have.

2. How did you determine the best offer made for circularity in your project? (or how do you intend to measure and assess circular offers)

I'm not sure yet. Also depends on the type of assignment. In new construction, for example, you are freer to prescribe a methodology and in the case of a renovation, you will focus faster on the use of material. Still a nice challenge but I see chances.

3. If awarding criteria is mentioned in question 2, what should be the ratio of price and quality for a circular project?

I don’t know.

4. How do you think the approach followed for your project was different from the other projects (without circular principles)?

Sub questions:

- In terms of type of tendering procedure / In the tender phase we gave the Candidates a lot of freedom to come up with good proposals.
- In terms of type of specification / Keep it simple and accept also accept if something fails. The time is not yet ripe for that and it can only be realized through extra investments.
- In terms of having a market consultation / I’ve got no experience with markt consultations.

5. What were the best practices or what want well in the case with respect to implementation of circular economy (in the procurement process)?

Restaurant at the Spark building in Amsterdam. ABN AMRO pavilion, Temporary court in Amsterdam.

6. What problems did you face, or will you face in incorporating circular economy in the projects (in the procurement process)?

Sometimes the ambition is too high and a good business case is not (yet) possible. Furthermore, circularity is part of sustainability for me. Every situation is different and that means that we still have a lane to go in order to speak of a circular economy.

13.12 APPENDIX 12

1. What was your role in the project?

I took the initiative to redesign it. I was the quartermaster. I was the putting the energy in the process and I was also the design manager. I was the project manager.

2. What according to you is the meaning of circular economy?

It is based on that you don't use anymore fossil materials. You find out a way of economy or the process without the emission of Co2. Nice thing is that I have already been working on 25 years. Last year I made an excursion to India. We went to Delhi and I worked on the Bahai temple. New temple with concrete slabs. With the whole of the process, even in my study we did not do anything about sustainability. The first 15 years of work was only efficiency and less costs and safety. So, safety was the most innovative thing. Then we started with sustainability. That's the only way of using less energy and less Co2 emissions and it was not about materials. Even the last 5 years, I started myself to think about how we can operate better with the materials. That's only for last 5 years. Before it was only costs, saving costs, safety and less energy. There were no figures about that it has such huge impact. For me, the eyes were open when I studied myself last year and then I started the greenhouse to turn it over the new business model. That wasn't the task of the government.

3. Which and why did you go for this principle of circular economy?

I think we choose the principle of less material, longer life time of the materials. That was the most important things about the materials. And then, the reuse of the materials, long life. If we don't use it in the building, we use it in another building. The last one is the origin of the materials. We tried to find bio-based materials but in this project, we did not use that principle a lot. We did not have the expertise and we did not have the budget.

4. What is the motivation to apply circular economy for this project?

My motivation is to have my own active impact as a living being on this planet for sustainable future, so that was my goal. Contribute to the sustainability. I can do only those projects where I can have really big impact on sustainability. Because it is also the vision about how you can earn some money. It is also future based. If you don't do that, next years you get out of work. You don't get your knowledge about sustainable building.

Procurement

1. How do you think circular economy or implementation of DfD can be stimulated through the public procurement process?

A lot. It is very important question I think public parties has three pillars of influence. One very important one is purchasing, the other more important thing is to think what you are doing, really look at our question you are asking the market and that's not about challenge the market, challenge

yourself. Do you really need it or can you skip some demands? I have already challenged Rodica about that, the demands about the climate. You have to realize that in this type of climate in Holland, your demands are for highest temperature. The insulation has to be very powerful, only for those few days. There you have think about your demands. You ask a lot of materials for that.

Last one is, that worked really well in the Knoop, you can also by stimulate the private party, not by demands, not by contract, but by working together. Then you get like a win win situation, but you can also, its not about challenges, it's about information and sharing the knowledge.

Purchasing- then you ask the party to make a proposition for less materials. But that's also two-way things, because it's very difficult to measure, the purchasing way is very important, but it is very difficult to measure.

2. How should the client select the contractor who has the best approach to implementation of DfD ?

You can challenge them on plan of approach. Plan of approach and experience. Plan of approach of your design process, of your construction process and then you have to challenge the contractor, how is he forcing him to do better. How is he working to make less waste, or to use less materials? And very important, a contractor, if you ask a design team, they have to be influencing the design, the contractor is also influencing about the transportation. So, what is he doing about making the process better with less transportation?

3. Do you think experience is necessary to work on these projects?

It's a combination. If you do not have experience, you need to a very good plan of approach. Because in that plan of approach, you need also a way of finding how you get the knowledge. For me the point is knowledge. Its is experience and knowledge, it's not like a craftsman who is looking to the sky and has a good solution. It is getting more and more specific intellectual knowledge. Good example, I gave a lot of presentations, last time, there was a very nice discussion. Now, I have more knowledge on bio-based, may be on this time, I will construct something with wood. But it was wrong public because the public were steel workers. They said that it is ridiculous. Because wood has a larger footprint than steel. So that makes it difficult. You need knowledge and measurable figures. The green house was such an early process, such an early innovation process, it was very easy to make big steps, if you have to make other steps, really the choice between steel and wood, you need the knowledge.

4. How can the market be stimulated to implement circular economy or DfD in their offers?

Before I forget, I have already told about co-operation and working together. I think most influence is in the process is after the awarding the contract, that's the starting point, don't forget that. Then you have the most beautiful challenges of working together. That's the also very difficult. Normally, in public private ways of working together, you have a lot of lawyers looking with you if you are doing it right, sometimes, difficult to find the best solutions.

That's about working together, that's about sustainable partnership. That's difficult.

5. They can give you either some minimum requirements or do it by awarding criteria? Which is more suitable for stimulating the market?

Minimum demands and rewarding about your success. Its both. If the solution is well known and you want it from every contractor, its better to ask it as a demand. That way you can find out the market you want to stimulate to do better, to do better than the minimum demand, you ask the market.

Also very interesting is to follow the process and it's really about the circularity after awarding the contract. Because my opinion, if you fix the design in the moment of the rewarding, you can improve it easily 20 to 30 percent in the phase after that. It is only a very raw design. Specially, about the materials, it is happening on the phases afterwards. That's difficult. It's a very difficult way of purchasing.

You have fill in the process that you are getting it better, after the contract because a lot is not filled in, exact enough. Even the finishing materials, you have biological cleaning materials and very toxic materials, that's also the phase where you have to make decisions.

6. How would you want to measure?

There are a lot of methods used to measure, those methods help you a lot to make a decision. Circularity index, MPG and LCA. A lot of ways of challenging two alternatives. But if you want to challenge the market, you have to compare two contractors. And they want a very safe and honest way of measuring, that's difficult. The measuring is not black or white. Its not absolute at this moment. And then, you get discussions.

Invest a lot of time and there is progress being made. It is getting better, if you want to challenge the best party, it will still be difficult.

The civil industry, the roads industry has already ways of measurement. There are a lot of things.

7. In circular pavilion, how did you think the client should measure future circularity?

Its not in my knowledge. I would ask a specialist about that.

8. What do you think should be ratio of quality and price for these kinds of projects?

I think generally, its good to have less than half of criteria on price. Less than 50 percent. The other 50 percent is not only about sustainability, its also about usability and also about.. You have a lot of important things, interesting thing is if you are a developer or a client it is to try to measure those things, still in money. If you say, its functionality, its money. Its not money in construction phase, but it is money about lifetime. If you make an office and you pay the service x amount but you make a design you can use it far more better, and may be 30 percent more profit. It is very interesting to ask the market to make a building that is more usable. Because that's money for you. Another thing is that if you are a big organization like the government and you want to have your goals and they have on a higher level ambition to become circular. If you look, you have a vision about how you can fill in that goal, you can also think about money. Its costs you money, you spend money because organization time is also money. It is interesting if you can fill in the goals about circularity like this pavilion. You can compare it with your goal. What is the impact on your goal, if it is large, then you can better spend a lot of money.

Now the interesting thing about my opinion is, about the green house is its always a circular business case. So circular on this moment you can innovate a lot without extra money, so if you have 10 percent extra money, you can enormously make improvement. The starting point is to find the improvement without extra money, to make less, if you make less, it is always cheaper and better for circular economy.

9. Most of them think going for circularity will cost a lot of money, is it true?

That is mostly about on the level of change of materials. If you have to choose between wood or bio-based wood. But a question before you make the decision is if you need the chair. First ask how many

chairs you need, if you need 10 or 6 chairs. If you just need 6 chairs, use the amount you saved on the 4 chairs for better 6 chairs. Bio-Based in construction is around 2 to 4 times expensive. If you have the wood bio-based, it will be 2 to 4 times expensive. But that is improving very fast. That's also a little bit an advice to public parties, don't invest too much money in the material kind of waste.

10. How was the approach followed for this project different from a normal project?

If you listen to my presentation, you will know all the differences.

11. Is the competitive dialogue important for these kinds of projects?

Very important. Very transparent. Not too formally dialogue. You need it. You need and that's the most efficient way for the client to get a better level of goals.

The most important thing is that what you write it down on paper, if they have questions, you can discuss about it. If they are solutions, if they have questions about your demands, it is one of the points that you can improve. If they have suggestions about change your demands, then it is very nice to talk about in the dialogue, then you can say that's a good suggestion, you can use it. Sometimes, you give a lot of information, the contractor it is very difficult to understand everything.

When he says "they", he means the contractors.

12. What is your opinion about having a market consultation?

The two projects I had before, it had intense consultation. Consultation went very well. But you have both prepared. On both the times, a very good client and on both times, we prepared ourselves very well.

13. Opinion about market consultation with your competitors?

The consultation was one-on-one. Not with our competitors. That's nonsense.

14. What do you think were the best practices?

The green house- my strategy. The three pillars and focus on that. Invest in facilitating those three pillars. There is lot of knowledge in the team and its not about one person. You need all the knowledge and you have to stimulate all the people.

For the procurement process

Then my opinion is to ask us the plan of approach. Because my strategy will be a part of the strategy of the plan of approach.

15. What problems did you face?

Nice thing is that I am already working on big project. Its so easy to implement all the new strategies and all the learning points. But that started with starting point of new way of working together. Because I have a lot of ideas, but if the ideas are not implemented by all the engineers, its only my ideas and it will be damaged only the project. The starting point is working together, definite ambition, formulate the vision and facilitate the process on a very intensive way with focus on the goals**.** They are not sustainable goals on a mixture of goals. Constantly (Continuously) take all the people with your way of measurement of goals.

Challenges yes. Problem is that you do not achieve your goal. Challenges that you deliver above your goal. That's about co-operation to each other and implement all the information you get from the eco network. It was one of the pilots of the eco-network. You have to find out about this.