The stimulation of circular economy in the Dutch construction industry

How procurement processes can realize a transition arena that is required in order to stimulate the transition to a circular economy

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Introduction

This master thesis is part of the master Civil Engineering and Management from the university of Twente and is conducted in the department of Construction management and engineering. The transition to a circular economy is one of the major challenging that the construction industry faces in the coming years or decades. Having a contribution to this transition by doing this research and participating in events realized that I did this research with a lot of commitment and enthusiasm.

At the start of the research, the goal was set to analyze five cases in which circular procurement was applied to determine the elements of procurement process that are relevant to stimulate the transition to a circular economy. However, it was not possible to find five cases which steered the research methodology towards interviews and changed the research objective to a more abstract level in which the goal was to determine how procurement processes can be used to realize a transition arena. This change from case study to interviews has the results that this research focusses on a macro level of procurement instead of certain elements of procurement processes.

During the research, I had the opportunity to participate in multiple events and to participate in the group “Lef om samentewerken” from de Bouwcampus for the project InnovA58 which provided valuable insights and gave me additional motivation. The concept of circular economy is definitely in an early stage of development but it provides opportunities to realize a sustainable future for generations to come. Society has to be more aware of the materials that we use and how we use these materials. We should step away from consuming and turn-over to using a service and realizing value. If we do this in a collaborative effort, the construction can make the transition to a sustainable future.

I would like to thank Niels Ahsmann, my daily supervisor at KplusV, who always had time to provide feedback and be a sparring partner when I needed it. His knowledge with regard to circular economy and procurement in the construction industry was really helpful in scoping the research and describing my findings in a scientific and objective way during the research.

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At last, I would like to thank the companies that participated in the interviews for participating.

Reading guide

This master thesis is structured based on the research proposal that is delivered on the 26th of January. The thesis starts in chapter 1 with a problem definition and a summarized version of the research proposal to discuss the research objectives, research questions and research methodology including how certain research techniques are applied.

This master thesis has the goal to determine how procurement processes can stimulate the transition to a circular economy. To achieve this goal, three sub research questions are determined. The first two research questions focus on the information that is available in literature and the last research questions has the objective to combine the first two research questions.

The first step in the research discusses the current business model of the Dutch construction industry and describes which business model is required for circular economy in chapter 2. In chapter 3 is circular economy regarded as an innovation that has to be stimulated by applying procurement processes. In this chapter are the factors within the innovative orientated procurement processes determined in combination with the legal framework. Chapter 4 combines the knowledge of chapter 2 and 3 by using semi structured interviews and discussed the impact on the construction process on a macro and project level.

The conclusions of the research are discussed in chapter 5 in combination with the generalizability and limitations of the research.

During this research, two different semi structured interviews are conducted which had a different objective. The interviews that where conducted in research question 2 (innovative orientated procurement) had the goal to verify information and is therefore referenced as a regular reference. The interviews that are conducted for research question 3 had to goal to attain information and are discussed in more detail in this thesis.

Table of Content

Introduction 1

Reading guide 2

Table of Content 3

List of figures 4

List of tables 5

Definition of terms 5

Management summary 8

Samenvatting 10

1. Structure of the research 13

1.1. Problem definition 13

1.2. Research objective 15

1.3. Research setup 16

1.4. Research questions 16

1.5. Research methodology 17

2. Circular economy in the construction industry 23

2.1. Current business model in the construction industry 23

2.2. Concept of circular economy 27

2.3. Definition of circular economy 29

2.4. Business model of circular economy 30

2.5. Business model of circular economy for the construction industry 31

2.6. Changes in the construction industry 35

2.7. Conclusion 36

3. Stimulation of innovation by applying procurement processes 38

3.1. Foundation and legal limits of procurement processes 38

3.2. Stimulation of innovation by applying procurement process 41

3.3. Conclusion 51

3.4. Acknowledgements 51

4. Stimulation of circular economy by using procurement processes 53

4.1. Transition stadium 53

4.2. Realizing the transition arena on macro level by applying procurement processes 55

4.3. The impact of the transition arena on the Dutch construction industry 62

4.4. Differences between current and circular procurement 67

4.5. Conclusion 68

4.6. Acknowledgements 68

5. Conclusion 70

5.1. Generalizability of the research 72

5.2. Validation of the research 72

5.3. Limits of the research 72

5.4. Future research 72

6. References 73

7. Appendix 77

Appendix I: Semi structured interview for innovative orientated procurement 77

Appendix II: Semi structured interviews for circular economy orientated procurement 78

List of figures

Figure 1: Complexity of circular economy versus sustainability (Iacovidou, et al., 2017) 14
Figure 2: General research setup (own source) 16
Figure 3: Research methodology (own source) 17
Figure 4: Research methodology research question 1 (own source) 18
Figure 5: Research methodology research question 2 (own source) 18
Figure 6: Research methodology research question 3 (own source) 19
Figure 7: Changes in market attitude (Dijksma & Kamp, 2016) 23
Figure 8: Material flow in the Dutch construction industry (Hashimoto, et al., 2007) 24
Figure 9: Process of the construction industry (own source) 24
Figure 10: Business model of the construction industry (own source) 25
Figure 11: Butterfly model Macarthur foundation (Ellen Macarthur Foundation, 2013) 27
Figure 12: Circular strategies (Kirchherr, et al., 2017) 28
Figure 13: Business models for circular economy (Accenture, 2015) 30
Figure 14: Circular business model developed by ARUP and BAM (ARUP, 2017) 31
Figure 15: Model of Brand (Brand, 1994) 32
Figure 16: Product-service systems (Tukker, 2004) 32
Figure 17: Process flow construction industry (own source) 34
Figure 18: Changes to realize a circular economy in the construction industry (own source) 35
Figure 19: Schematic representation of the traditional building process (Chao-Duivis, et al., 2013) 39
Figure 20: Processes related to innovations in the construction industry (Winch, 2010) 41
Figure 21: Phases of transition (Rotmans, et al., 2001) 43
Figure 22: Bell shaped curve (Rogers, 2010) 44
Figure 23: Learning cycle (Loorbach, 2010) 45
Figure 24: Relationships, Tension between competition and cooperation (Eriksson, 2008A) 46
Figure 25: Consequence of the relationship on the purchasing process (Eriksson, 2008B) 46
Figure 26: Barriers experienced by construction industry (Uyarra, et al., 2014) 47
Figure 27: Stage of development of circular economy in the municipality of Amsterdam (Municipality of Amsterdam, 2018) 53
Figure 28: Amount of published tender (own source, based on TenderNed) 54
Figure 29: Approaches to stimulate circular economy (own source) 63

List of tables

Table 1: Events that are used for observations (own source) 20
Table 2: Interviewees for innovative orientated procurement (own source) 20
Table 3: Interviewees for circular orientated procurement (own source) 21
Table 4: Actors involved in the construction process (own source) 26
Table 5: Responsibilities of the actors in the circular economy (own source) 34
Table 6: Framework of factors for stimulating a transition or innovation (own source) 50
Table 7: Companies that are interviewed during circular orientated procurement (own source) 55
Table 8: Results of interview 3 and 4 (own source, based on table used in interview) 56
Table 9: Factors of the procurement process for schematized design approach (own source) 57
Table 10: Location of the factors of the coopetition approach in the framework (own source) 57
Table 11: Results of interview 5,6 and 7 (own source) 58
Table 12: Factors of the procurement process for initiative approach (own source) 60
Table 13: Location of the factors of the cooperation approach in the framework (own source) 60
Table 14: Factors of procurement process for both approaches (own source) 61
Table 15: Responsibilities of the project for coopetition approach (own source) 65
Table 16: Responsibilities of the project for cooperation approach (own source) 66

Definition of terms

Adoption	Adoption refers to the model of Winch (2010) and describes that a project is realized structured by the desire to implement a change. Adoption is the opposite of a problem-solving attitude.
Award criteria	The award criteria describe on which subjects and how a bid that a participant of a procurement process provides is scored and awarded.
Boundary conditions	The boundary conditions are the conditions which have to be realized in a project, most of the times this results in a program of requirements or 'programma van eisen' in Dutch. The criteria grounds for exclusion, minimum requirements and suitability requirements are combined in this definition as boundary conditions.
Business model	A business model describes how products, services and information flows between actors and what their roles in combination with the benefits and sources of revenues are (Timmers, 1998).
Circular Economy	Circular economy regards end of life cycle products as resource instead of waste to preserve value and realize a sustainable future. By applying circular strategies on products, components or materials the value can be preserved and finite materials no longer leave the economic system which al contribute to a sustainable future
Circular strategies	Circular strategies are ten steps from refuse to incinerate that describe which option materials, components or products can undergo to be refed in the economic system

Competition approach	The competition approach is built on the idea that organizations act to realize their own interest. In this approach building costs and short-term relationships are leading and the industry is forced to compete which each other. This approach is well known as the current client and contractor relationship.
Construction industry	The construction industry takes the entire Dutch construction industry into account. This includes the sectors of infrastructure, utility and housing.
Construction object	The construction object in this thesis focusses on all parts that can be realized or are present in a building or infrastructure environment. A construction object is a combination of products., components and materials.
Cooperation approach	The cooperation approach is based on that every organization in the cooperation benefits from the cooperation. The project is solved in a collaborative effort in which equality, trust and transparency is present to realize that the cooperation is effective.
Coopetition approach	The coopetition approach is a combination of the competition and cooperation approach. In this approach, the project is solved in a collaborative effort while there is still the classic client, partner relationship.
Factors of procurement processes	Factors of the procurement process are subjects that have to be addressed in this procurement process and are relevant for the duration of the project. The factors can vary from seize of the contract, sharing of risks or providing room to develop an innovation.
Innovation	Innovation is the development of something that is not developed or applied before and has to be adopted throughout the construction industry. The impact of the innovation on the implementation depends on the magnitude of the desired development and is different for each innovation.
Innovation orientated procurement	Innovation orientated procurement is a procurement process that is focused on stimulating an innovation. This procurement process focusses on setting the boundary conditions of a project in order to realize that the intended type of innovation is realized during the execution of the project.
Linear economy	The linear economy is an economy in which materials are gathered and are used to manufacture project. These products are destroyed at the end of their life cycle.
Market	The market in this research is the Dutch construction industry without (semi) public organizations.
MCP	MCP refers to materials, components and products.

Partner	A partner in this thesis is the organization that is selected as the best bid in the procurement process and has the task to finish the project.
Problem solving	Problem solving refers to the model of Winch (2010) and has the ambition to solve a problem on a project level. In this approach, desiring and realizing a new office building because you need more office space is an example of a problem-solving attitude.
Procurement processes	The procurement process describes how a partner is selected and awarded to realize a certain project or activity. This definition of procurement processes focusses on the pillars of boundary conditions, selection criteria and award criteria and do not take certain predefined process into account.
Procurer	The procurer is the organization that publishes the procurement process and in this research, this is assumed to be an organization that is bound or using procurement legislation.
Qualitative criteria	Qualitative criteria are award criteria that are also known as soft criteria. These criteria score an idea based on text and not on numbers as is the standard.
Selection criteria	Selection criteria describe how and in which steps a partner is selected.
Transition arena	A transition arena is a contained environment in which the partner and procurer work together in order to realize an innovation. This arena is focused on learning and developing a concept and provides the boundary conditions in which this learning and developing takes place. This transition arena is formed by the procurement process.

Management summary

Stepping away from the linear/recycle economy and embracing the circular economy is vital to ensure a sustainability environment for generations to come. The Dutch construction industry is currently responsible for 40% (23,8Mt of waste) of the total waste generated in the Netherlands. Implementing circular economy could reduce this amount of waste and reduce CO_2 emissions by 10% and additional €7.3 billion of revenue can be generated which can result up to 54.000 additional jobs in the Netherlands. However, this transition to a circular economy is a system change which requires stimulation to ensure that industries are committed to the transition. The Dutch construction sector is project based and is challenged to compete by procurement processes, which makes it challenging to introduce a different economic system such as circular economy. The objective of this research is to determine how, which and to what extent procurement processes can be used to stimulate the transition to a circular economy in the construction industry.

The first step in achieving this objective was to determine what circular economy is, what business model is currently used and which business model should be applied. The construction industry in the Netherlands is a sector based on the linear model and has some aspects in common with the recycling model. This business model is focused on competition and is characterized by realizing turn over and short-term relations which has the result that the market realizes what is asked by a client. This results in a segmented business model and verification between the construction phases of design, construction, and maintenance. This linear approach has to change in order to realize a sustainable future for generations to come by embracing the circular economy. The circular economy has the ambition to not let materials leave the economic system by applying circular strategies during the life cycle of a construction product. This requires cooperation to ensure that circular strategies can be applied and that value is created and preserved throughout the life cycle. The business model of circular economy focusses on a collaborative effort which change the roles and responsibilities in the construction process. The contractor needs to take a coordinative role instead of a leading role, which will force manufactures to step out of the shadow and participate in the construction process. Designers have to use the knowledge of the manufacturers by cooperating to ensure that circular strategies can be applied. To ensure that manufacturers feel responsible for the materials that they use, different types of ownerships can be applied. Leasing and providing a service are different types of ownerships that realizes that the market becomes the owner and not the client, which realizes different business opportunities. However, what type of ownership should be applied depends on the life cycle of the product. Construction objects have a life span that can vary from 1 to 100+ years, which makes it challenging to have a single type of ownership for the entire construction object.

The next step in the research was to determine the basics of the Dutch legal framework and to broaden the research base by regarding circular economy as an innovation that has to be stimulated by using procurement processes. The legal framework describes procurement processes (such as open and competitive dialogue) but it is decided to focus on the three pillars that are used within these processes. Boundary conditions, selection criteria and award criteria are the three pillars on how a partner is selected and awarded within the procurement processes. In innovative orientated procurement, it is crucial to understand the influence of the current level of development of the innovation to determine what transition arena is desired. An early stage of development, as an innovation in this thesis is, requires a transition arena that is focused on learning and developing which also requires a collaborative effort that is focused on adopting an ambition and not on solving a problem. Determining how procurement process should be applied to stimulate the innovation was not feasible because it depends on the type of innovation. A small innovation requires a small transition arena while a complex system innovation will require a transition arena that is applied on several projects to ensure that it is possible to learn and develop the concept. However, innovative orientated procurement provided the subjects of cooperation, specifications, capabilities of procurer, risks, desire to innovative, magnitude of the contract and the management of intellectual property rights as the seven subjects that have to be

addressed when an innovation is stimulated. These subjects in combination with boundary conditions, selection criteria and award criteria are used as input for the stimulation of circular economy by applying procurement processes.

The transition to a circular economy is in an early stage of development, which means that the transition arena should focus on adopting the concept of circular economy by learning. The procurement process enables this transition arena that is focused on adopting the concept by setting goals and ambitions by specifications. To determine how the procurement process should be set, interviews with Dutch construction companies are conducted, structured by the theoretical framework of innovative orientated procurement. The first option that is discussed by the interviewees focus on a design, building, finance and maintenance contract in which the contractor is in the lead. The contractor is chosen on a mixture of qualitative criteria and construction costs that are determined on the schematized design that a contractor made in the procurement phase. This schematized design is based on the functional specifications of the procurer to enable that decisions on material, component and product level are still possible. During the project, the contractor is still in the lead as in current construction model. However, the client contributes to the transition by not demanding certain certificates or in acquiring certain permits to realize that additional circular solution can be seized. This approach is an example of the coopetition.

The second option to stimulate circular economy is an approach that is known as the cooperation approach. In this approach, the partner is selected during the initiative phase based on qualitative criteria such as their ambition or vision on circular economy. The aim of the procurement process is to select a partner that can help the procurer to finish the project. After the procurement phase, the procurer and partner work together to realize that maximum value and circular strategies are applied for the budget that is available. This process requires equality and transparency between the procurer and the partner to ensure that this cooperation is effective and successful.

The coopetition and cooperation approach describe a certain procurement process and project in which the transition arena that is required is realized and provides room for learning. However, to effectively cooperate, the current procurer and partner segmentation has to change. Transparency, equality, early procurement, cooperation, functional specifications and risks sharing are all required in this procurement process and project to stimulate the construction industry to embrace and apply the principles of circular economy. Equality realizes that the partner can apply innovative circular solutions or ideas and transparency realizes that the client has sufficient confidence in the partner. To provide enough opportunities for innovative solutions, functional specifications have to be applied in combination with procuring in an early stage based on qualitative criteria to enable as many circular solutions as possible. This collaborate attitude also requires risk sharing in the process and a risk budget to realize that there is room for learning in this collaborative effort. However, in order to finish the project in a collaborative way, the procurer needs to have sufficient capabilities to also work on the project on an equal way. These capabilities are also of importance in assessing the bids of the possible partners because knowledge is required to assess the qualitative bids to ensure that the best partner is chosen. These subjects are the necessary within the procurement process that are required to effectively stimulate the transition to a circular economy.

Stimulating the transition to a circular economy, in which adopting a solution or ambition instead of solving a problem is incorporated, requires a cooperative approach based on the procurement process that is previously described. The procurement process can realize the desired transition arena in the concept of circular economy can be developed. It will pave the way to new business models and ownership models as is required for a circular economy to thrive. However, the transition to a circular economy is not a one-time project and has to be stimulated over time in multiple projects to ensure that circularity and seizing circular possibilities becomes the new standard to realize the sustainable future for generations to come.

Samenvatting

Het afstappen van de lineaire/recycle economie door het omarmen van de circulaire economie is van essentieel belang om een duurzame leefomgeving voor toekomstige generaties te garanderen. De Nederland bouwsector genereert 40% (23,8Mt) van het totale afval van Nederland. Het implementeren van de circulaire economie kan deze afvalstroom verminderen. De uitstoot van CO2 kan gereduceerd worden met 10% en circulaire economie kan €7,3 miljard extra omzet generen wat 54.000 extra banen kan realiseren in Nederland. De transitie naar een circulaire economie is complex waardoor het stimuleren van de transitie naar een circulariteit economie van belang is om te verzekeren dat de samenleving toegewijd is. De Nederlandse bouwsector is project georiënteerd en wordt uitgedaagd door middel van aanbestedingsprocessen. Hierdoor is het een uitdaging om een ander economische systeem, zoals de circulaire economie, te introduceren. Het doel van dit onderzoek is om te bepalen hoe het aanbestedingsprocessen gebruikt kan worden om de transitie naar een circulaire economie te stimuleren.

De Nederlandse bouwsector is gebaseerd op het lineaire systeem waarin sommige onderdelen van het recycling model zijn geïntegreerd. Dit is een businessmodel dat is gericht op competitie en het is gekarakteriseerd door het generen van omzet en korte termijn relaties. Dit heeft als gevolg dat de markt slechts uitvoert wat de opdrachtgever vraagt. Daarnaast is het businessmodel gesegmenteerd door de verificatie fases tussen de bouwfases van ontwerpen, bouwen en beheren. De circulaire economie heeft als doel om materialen het economische systeem niet te laten verlaten. Dit kan worden gerealiseerd door het toepassen van circulaire strategieën tijdens de levenscycli van het bouw object. Samenwerken is nodig zodat circulaire strategieën toegepast kunnen worden om waarde te creëren en te behouden tijdens de levensduur. Het businessmodel van de circulaire economie concentreert zich op een samenwerkende benadering, wat ertoe leidt dat rollen en verantwoordelijkheden in de bouwsector verschuiven. Aannemers krijgen een coördinerende rol in plaats van een leidende rol met als gevolg dat producenten uit de schaduw stappen en gaan deelnemen aan het bouw- en aanbestedingsproces. Ontwerpers gebruiken de kennis van producten door samen te werken met producenten om ervoor te zorgen dat circulaire strategieën toegepast kunnen worden. Het toepassen van andere eigendomstypen is een mogelijkheid om ervoor te zorgen dat producenten verantwoordelijkheid nemen voor de materialen die ze gebruiken. Leasen en het leveren van een dienst zijn types van dit andere eigendomsmodel waarin de markt de eigenaar blijft van de materialen en niet de opdrachtgever, wat leidt tot andere omzet mogelijkheden. Welk type eigendom toegepast zou moeten worden, hangt echter af van de levensduur van een product. Bouwobjecten hebben een levensduur dat varieert van 1 tot 100+ jaar. Dit maakt het ingewikkeld om één eigendomsmodel voor het gehele object te bepalen.

Het Nederlandse aanbestedingsrecht beschrijft verschillende procedures (bijvoorbeeld: open en competitieve dialoog), maar de keuze is gemaakt om te focussen op de pilaren binnen deze procedures. De randvoorwaarden, selectiecriteria en gunningscriteria zijn de drie pillaren die gebruikt worden om een partner te selecteren en te belonen binnen het aanbestedingsproces. In innovatie gericht aanbesteden is het van cruciaal belang om te begrijpen waar de sector staat in de transitie van een innovatie om te bepalen welke transitie arena nodig is. Een innovatie die in een vroeg stadium van ontwikkeling staat heeft een transitie arena nodig die is gericht op het leren en ontwikkelen van een concept. Hierin staat samenwerking en het omarmen van een ambitie centraal. Het eenduidig bepalen hoe het aanbestedingsproces toegepast zouden moeten worden om innovatie te stimuleren, is niet haalbaar omdat het afhangt van de soort innovatie. Een kleine innovatie heeft een beperkte transitie arena nodig, terwijl een systeem innovatie een transitie arena nodig heeft die meerde projecten beslaat. Dit is om ervoor te zorgen dat er van geleerd kan worden en het concept zich kan ontwikkelen. Binnen het concept van innovatie gericht inkopen zijn zeven onderwerpen bepaald die behandeld moeten worden om een innovatie te kunnen stimuleren. Samenwerking, specificeren, kwaliteiten van de aanbestedende partij, risico's, wil om te innoveren, grootte van het contract en het management van intellectueel eigendom zijn de zeven onderwerpen die van belang zijn bij het stimuleren van een

innovatie. De zeven onderwerpen in combinatie met de pilaren randvoorwaarden, selectiecriteria en gunningscriteria zijn als basis gebruikt voor het bepalen hoe een circulaire economie gestimuleerd kan worden door middel van aanbestedingsprocessen.

De transitie naar een circulaire economie is in een vroeg stadium van de ontwikkeling. Dit betekent dat er een transitie arena nodig is die geconcentreerd is op het omarmen en ontwikkelen van het concept van circulaire economie. Het aanbestedingsproces vormt deze transitie arena door het stellen van doelen en ambities door middel van specificering. Het aanbestedingsproces dat als eerste is gediscussieerd is gebaseerd op een ontwerp, realisatie, financiering en onderhoud contract, waarin de aannemer de leidende organisatie is. De aannemer wordt gekozen op een combinatie van kwalitatieve criteria en realisatie kosten, die bepaald worden op basis van het schetsontwerp dat de aannemer maakt in de aanbestedingsfase. Dit schetsontwerp is gebaseerd op de functionele specificaties van de aanbestedende partij om ervoor te zorgen dat materiaalkeuzes nog mogelijk zijn. De aanbestedende partij draagt bij aan de transitie door bepaalde certificaten niet te vereisen of door bij te dragen aan het verkrijgen van vergunningen. Waardoor extra circulaire oplossingen gerealiseerd kunnen worden. Deze methode is een voorbeeld van de 'coopetition' methode waarin een mix van competitie en samenwerking wordt toegepast.

In de tweede methode ligt de nadruk op samenwerking en wordt het project samen gerealiseerd). De partner is geselecteerd tijdens de initiatie fase van een project op basis van kwalitatieve criteria. Het doel van het aanbestedingsproces is om een partner te zoeken zodat het project gerealiseerd kan worden. De aanbestedende partij en de partner werken samen om ervoor te zorgen dat waarde wordt gecreëerd en dat circulaire strategieën worden toegepast binnen het budget dat beschikbaar is. Deze methode is gebaseerd op gelijkheid en transparantie tussen aanbestedende partijen en de partner, zodat de samenwerking effectief en succesvol is. De tweede methode om circulaire economie te stimuleren is een methode die bekent staat als de 'cooperation' waarin op basis van samenwerking het project wordt gerealiseerd.

Beide methoden beschrijven een aanbestedingsproces en een projectverloop waarin de benodigde transitie arena is gerealiseerd door samen te werken waarin een verschuiving plaatsvindt van competitie naar samenwerking. Om circulaire economie effectief te stimuleren moet transparantie, gelijkheid, vroeg gunnen, samenwerking, functioneel specificeren en risicodeling toegepast of gerealiseerd worden in het aanbestedingsproces. Gelijkheid zorgt ervoor dat de partner innovatieve circulaire strategieën of ideeën kan toepassen en transparantie draagt eraan bij dat de aanbestedende partij vertrouwen heeft in de partner. Voor voldoende beschikbare circulaire oplossingen zal functioneel uitgevraagd moeten worden. Deze uitvraag zal vroeg in het bouwproces moeten plaatsvinden en de gunning zal gedaan moeten worden op basis van kwalitatieve criteria wat extra kennis vereist van de aanbestedende partij. Deze focus op samenwerking vereist ook het delen van risico en het beschikbaar stellen van een risicobudget om zodat er voldoende ruimte is om te leren en om effectief samen te werken. De aanbesteden partij heeft expertise nodig om gelijkheid te realiseren tussen aanbestedende partij en partner.

Het stimuleren van de transitie naar een circulaire economie moet zich richten op het realiseren van een ambitie. Het maakt de weg vrij voor nieuwe businessmodellen en eigendomsstructuren waardoor circulaire economie kan floreren. De transitie naar een circulaire economie zal gestimuleerd moeten worden gedurende een langere tijd in meerdere projecten om te realiseren dat circulariteit en het toepassen van circulaire oplossingen moet de nieuwe standaard worden. Dit is om te realiseren dat de duurzame toekomst voor komende generaties ook echt gerealiseerd wordt.

Gispen circular furniture
https://www.gispen.com/nl/projecten/gemeente-amsterdam-stadhuis

1. Structure of the research

The setup of the research is shortly described in this chapter to provide addition insight in the way the research is structured. This research setup is based on the research proposal that is delivered on the 26th of January 2018. The research is practically orientated based on the method of Verschuren and Doorewaard and focuses on the first three steps (Problem analysis, diagnostic and design) in practically orientated research (Verschuren & Doorewaard, 2015).

1.1. Problem definition

A sustainable future became a topic of discussion since the world commission on environment and development presented their vision entitled "Our Common Future" in 1987 (Ortiz, et al., 2009). The vision described the importance of a healthy sustainable environment for current and future generations (Brundtland Commission, 1987). To realize this sustainable environment for future generations the United Nations developed seventeen Sustainable Development Goals (SDG). These SDG's do not only describe subjects like CO2 emission but also focus on water and air quality, social interactions and use of materials (UN, 2015). As a response to realize this future proof environment by using SDG's, the Dutch national government participated in the "grondstoffenakkoord" to put context to SDG number 8 (decent work and economic growth) and 12 (Responsible production and consumption) (Het Groene Brein, 2018). In the "grondstoffenakkoord", the sustainable use of materials is discussed and the goal is set to not use primary resources in the year 2050 to prevent 'world over shoot day' by achieving SDG 8 and 12 (Dijksma & Kamp, 2016).

Realizing that primary resources are not used anymore can be achieved by realizing a circular economy. In the concept of circular economy, materials no longer leave the economic system and are reused on a high level which realizes that secondary resources can be used in the economic system as primary resources. This application of circular economy is vital to guaranty that the required resources for food, shelter, heat, clothing, electricity and mobility are available for future generation (Dijksma & Kamp, 2016). However, in the year 2010, the construction industry was responsible for 40% (23,8 Mt of waste) of the total waste production of the Netherlands (Mulders, 2013).

Next to contributing to a sustainable environment in which no primary resources are used, circularity can also contribute to economic prosperity in well-developed countries and to stimulate innovations by changing business models (Kirchherr, et al., 2017). By applying circular economy, 10% of CO_2 emissions can be reduced (17 megaton) and addition € 7.3 billon revenue can be generated which can results up to 54.000 additional jobs in the Netherlands (Dijksma & Kamp, 2016). This strengthens the argument that the concept of circular economy could help to realize a sustainable future for generations to come (Iacovidou, et al., 2017). Applying circular economy in the construction industry will not only ask for new sustainable methods but also demands a change in business models (Kirchherr, et al., 2017) (Lansink & Vries, 2010). The research of Iacovidou et al. (2017) divided circularity as three possible cycles. The cycles that are incorporated are materials, components and products in which value optimization is a core objective. A lot of well-known methods that have a role in sustainability and the linear economy in the construction industry are incorporated in the model of Iacovidou et al. (2017). The model of value preservation is shown in Figure 1.

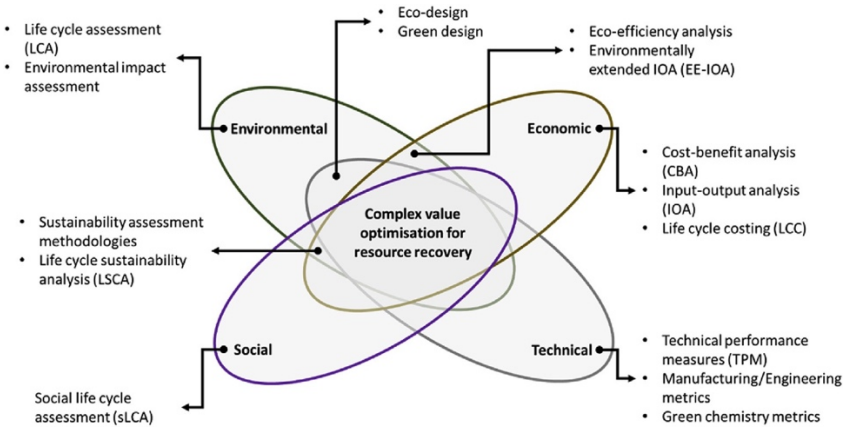

Figure 1: Complexity of circular economy versus sustainability (Iacovidou, et al., 2017)

However, Iacovidou et al. (2017) tried not only to make a connection between sustainability and circular economy but also discussed the challenges from switching from a linear/sustainable economy to a circular economy. The conclusion was that the change from a linear economy to a circular economy is in an early stage and need to be stimulated by public organization. However, how this transition should be stimulated is unclear.

This call for a more future proof attitude from the construction industry by embracing circular economy and changing business models forms a challenge because the industry is always challenged to compete by tendering with other companies based on standards (Demaid & Quintas, 2006). All these models and concepts that are mentioned as sustainable in the research of Iacovidou et al (2017). are focused on the business model that is currently applied instead of the entire economic model that is relevant for circularity. This change in business model demands a change in attitude from all actors that are involved in the construction process, which can result in different business models. This connection between the business model, sustainable models and economic competitiveness interact during the procurement phase of a project (Witjes & Rodrigo, 2016). However, the construction industry is asked to change but has no experience in changing business models (Bygballe & Ingemansson, 2014; Ghisellini, et al., 2016).

How sustainability in the Dutch construction industry can be stimulated by using procurement in the construction industry is a subject in which a lot of research has been conducted. Identifying critical factors for green construction is already done (Shi, et al., 2013) and the effect of the contracts and the risks related to it, is also determined (Varnäs, et al., 2009). However, all this research is focused on the stimulation of sustainability, like the methods that are mentioned in the research of Iacovidou et al. (2017), and not on the change from a linear/sustainable economy to a circular economy. The potential of stimulating sustainable, innovative or new options by using procurement is well known by governmental agencies (Edler & Georghiou, 2007; Bratt, et al., 2013). However, circularity is much more than a one-time project event in which sustainability plays a role. It is not only a method to increase sustainability by reducing waste but it also focused on the economic and social aspects of materials, components and products by taking value and efficiency into account (Kirchherr, et al., 2017). How procurement processes can be used to stimulate circular economy is an objective for future research (Bratt, et al., 2013; Ghisellini, et al., 2016). The difficulties that arise when circular economy would be stimulated by using procurement is related to the current business and procurement models of the construction industry. The construction industry is used to work on projects while collaborating with other companies. However, this corporation is most of the times temporarily and disbanded when construction is finished (Dubois & Gadde, 2000).

The concept of circular economy requires a long-term approach in which value preservation and reuse of materials is essential. This is different if it is compared to current construction methods (Crespin-Mazet & Portier, 2010). The construction industry is used to regard a project as a one-time event that is finished when the construction phase is completed. However, for the concept of circular economy, the scope is much longer because the entire life cycle and value preservation of the object is taken into account. This possible longer orientation of the construction process changes the risks for the contractor and also changes the required purchasing strategy of the client (Crespin-Mazet & Portier, 2010). The change in business model could require a different purchasing strategy because the focus will switch towards value preservation (Kirchherr, et al., 2017). This switch will probably cause a change in project related uncertainty, stakes and complexity which can lead to different business models in the construction industry which can lead to a change in purchasing behaviour.

There are some cases in which circular procurement has been applied to realize a circular product. In the facility management industry, procurement is already used to realize circular furniture or rethinking printer needs (European Union, 2017). These circular procurement processes focused on realizing a circular product that could be specified beforehand. However, how a construction object that contains numerous products should be procured is unclear (Iacovidou, et al., 2017).

The problem definition that is therefore used in this research is:

The construction industry is unknown how procurement processes have to be used in order to stimulate circular economy in the construction industry.

Problem definition

1.2. Research objective

This research focusses on this gap in the knowledge of procurement processes. The method of Verschuren and Doorewaard describe a distinction between the objective of and in the research. The objective of the research is practically orientated and the project in the research is the objective for scientific purposes. The research objectives that are present in this research are:

The goal of this research is to determine how procurement processes can stimulate the change to the circular economy in the construction industry.

Objective of the research

The goal in this research is to determine how procurement processes have to be applied for stimulating circular economy in the construction industry.

Objective in the research

1.3. Research setup

The research objective of this research focusses on how the transition from a linear to a circular economy can be stimulated by applying procurement processes. However, this objective can be broken down into two main subjects. The first subject is aimed at what circular economy is and the second objective describes how a procurement process is shaped and how it can be used to stimulate a transition. The research setup is shown in Figure 2.

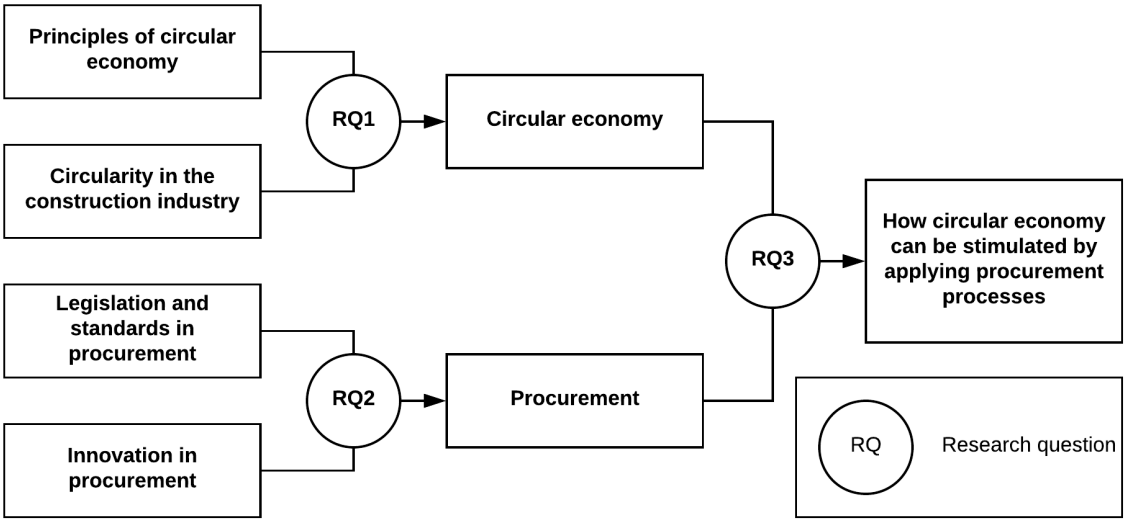

Figure 2: General research setup (own source)

The first pillar in this research is to determine how circular economy can be applied in the construction industry on a macro level. This is determined based on the general concept of circular economy in combination with an analysis of the construction industry. These two subjects will be used as the foundation to determine how a circular economy can be applied in the construction industry and how significant the change to a circular economy for the construction industry is.

The second pillar in this research setup is to determine how innovative orientated procurement can be used to stimulate circular economy to realize a theoretical framework because limited research is conducted to circular economy orientated procurement. Next to this step, the legal framework provides boundary conditions for the procurer.

1.4. Research questions

The research setup that is discussed, forms the base for the amount of research questions that are required next to the main research question. The main research question is based on the objective and problem definition that are previously discussed. The main research question that is addressed in this research is:

How can circular economy be stimulated in the Dutch construction industry by using procurement processes while taking current legislation and the change in business model into account?

Main research question

The research setup, that is mentioned in Figure 2, realized that three sub research questions are required to be able to main research question. The first of the three-sub research question is orientated from the concept of circular economy. The research question for circular economy therefore is:

> *How and when in the construction process can the concept of circular economy be applied in the Dutch construction industry and which changes are required in the Dutch construction industry to implement circular economy?*

Research question 1

The second sub research question focusses on innovative orientated procurement and the legal limits of the procurement process. The research question for this subject therefore is:

> *How can procurement processes be used to stimulate innovations in the Dutch construction industry and what are the legal limits of these stimulations by using procurement processes?*

Research question 2

The last sub research question is focused on combining the knowledge that is attained in the first two research questions. The research question is:

> *How can procurement processes be used to stimulate the determined business model of circular economy in the Dutch construction industry?*

Research question 3

1.5. Research methodology

The research methodology that is applied in this research is a literature review in combination with verification by applying semi structured interviews or observations by participating in events or projects. This methodology is chosen because it provides information of previous research but also incorporates the knowledge that is available in the construction industry. In the last step of the research a translation from innovative orientated procurement to circular economy orientated procurement has to be made. Due to the fact that the amount of scientific publications with regard to circular orientated procurement is limited, semi structured interviews are used to determine what measures are currently feasible for the market in the transition to circular economy. This semi structured interview is structured based on the subject of circular economy and innovative orientated procurement. The research methodology is graphically shown in Figure 3.

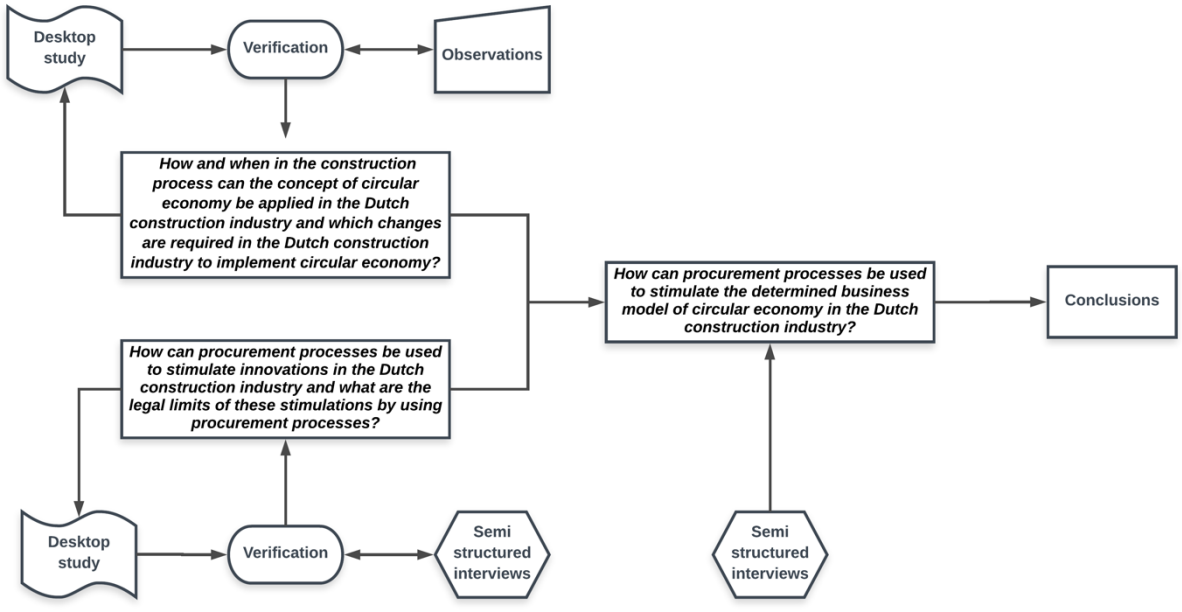

Figure 3: Research methodology (own source)

Methodology research question 1

To answer research question 1, the research methodology that is shown in Figure 4 is used. The starting point in this research setup is to determine what the current business model of the construction industry is by applying desktop research. Before the differences between the current business model and the circular business model could be determined, additional information regarding circular economy is required. First a description of circular economy is discussed and based on a desktop study a definition of circular economy for this master thesis is determined. The next step is to determine, based on this definition of circular economy, the circular business models that can be applied based on a desktop study. With the required knowledge of business models and a definition of circular economy, the research continues with determining a business model for the construction industry by applying a combination of desktop research and observations during the week of circular economy and by participating in multiple events and the project InnovA58 of RWS. The last step of the chapter is to compare the current business model and the circular economy business model of the construction industry to answer the research question. Based on this information, the difference between the current and circular business model can be determined.

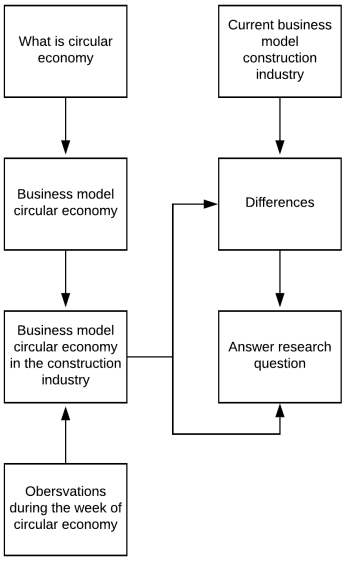

Figure 4: Research methodology research question 1 (own source)

Methodology research question 2

To research question 2, two research methodologies are used throughout the chapter. The base is a literature review that is verified by applying two semi structured interviews with three experts. The interviews are used to verify the information that is attained by a literature review. The first step within this methodology is to determine how procurement processes can be used by procurers to stimulate an innovation and what the legal limits of these stimulations are, based on the current legislation framework of the Netherlands. The next step is to determine how an innovation should be stimulated. To answer this research questions additional information regarding the concept of innovation and the transition to a major innovation is required. The research started with determining which processes and aspects are relevant to the concept of innovation. The magnitude of the desired innovation plays a crucial role in the related processes. A complex innovation like the concept of circular economy is a long-term transition. This conclusion from the concept of innovation steered the research towards transition management research. In this transition, it is important to have room to learn. However, to incorporate a learning process in a complex industry like the construction industry requires a custom-made transition arena. With the importance of the transition arena discussed, the research could focus on the barriers of realizing innovation by applying procurement processes because the procurement process is responsible for realizing this transition arena in the Dutch construction industry. Therefore, the last step of answering this research question is to determine which barriers/factors are present in innovative orientated procurement and to combine this knowledge with the three pillars of procurement processes. The methodology is graphically presented in Figure 5.

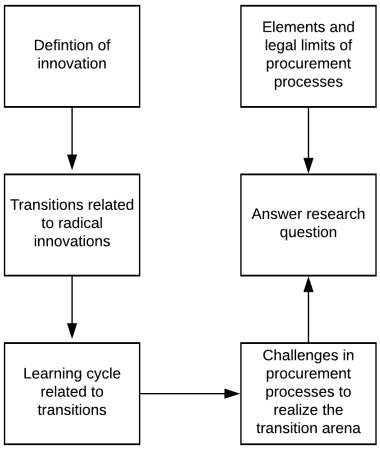

Figure 5: Research methodology research question 2 (own source)

Methodology research question 3

How an innovation can be stimulated was a primary objective of the previous chapter. However, it could not be answered because it depends on the type of innovation and the stage of transition. This lack of a clear answer from literature required a change in research setup that is described in the research proposal. To solve this challenge, the barriers that are determined in innovative orientated procurement as relevant, the transition stages and the circular business model are used as theoretical framework and are verified by using semi structured interviews with the market. The first step in answering this research question is to determine in what stage of the transition circular economy currently is to provide context to the semi structured interviews. The next step are the semi structured interviews with five private organisations to determine how procurement process have to be used structured by using Table 6 of innovation orientated procurement. However, due to the early stage of development it is not clear if the interviewee has the information or knowledge regarding innovative orientated procurement and the circular business model. To solve this challenge, the semi structured interview consists out of three stages to ensure that the interviewee has the required knowledge to fill in the table. The first stage is focused on the concept of circular economy and the second phase is focused on innovative orientated procurement. At the end of these stages, the interviewer has an impression on what the knowledge of the interviewee is and by using a handout, the interviewee will clarify the information that is already discussed in the research. The third step is to fill the table to determine and design the procurement process for circular economy on an abstract level. The next step is to compare the findings of these interviews to provide general insight in how the procurement process should be designed by using the determined factors. The last step is to translate the procurement process on macro and project level to describe the influence on the construction industry. Based on this comparison a conclusion can be drawn on how procurement processes can be used to stimulate the transition to a circular economy. The methodology is graphically presented in Figure 6.

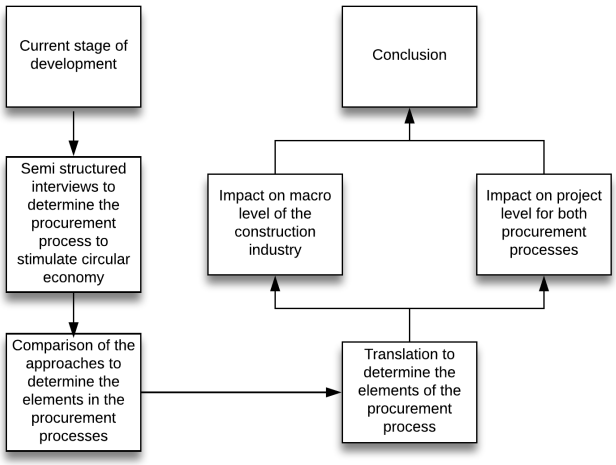

Figure 6: Research methodology research question 3 (own source)

Observations

The observations that are used to verify the concept of circular economy are conducted over the entire duration of the research with two main purposes. The first goal was to provide the researcher with additional inspiration and information with regard to the concept of circular economy and to stay in touch with the latest developments. Participating in the project of InnovA58 in the group 'lef om samen te werken', in which the group had the assignment to determine how cooperation can be implemented in the project of the A58 in order to stimulate circular economy, provided the researcher with additional opportunities to verify or reflect the conclusions of the research.

The second purpose was to use the observations to describe how significant certain changes to a circular economy are. The events that are used during this research are shown in Table 1.

Table 1: Events that are used for observations (own source)

Event	Date	Location
Ecovillage Boekel	19-1-18	Boekel
Inspiration session	18-1-18	N+H office Apeldoorn
Werkatelier Arnhem	25-1-18	Arnhem
Werkatelier Arnhem	1-2-18	Arnhem
Werksessie van Inkoop naar samenwerking	3-4-18	Rijkswaterstaat, Utrecht
InnovA58	Numerous occasions	Numerous
Presentation InnovA58	22-3-18	Oirschot
Presentation InnovA58	14-6-18	Oirschot

Interviews for innovative orientated procurement

The semi structured interviews that are used to verify the information of innovative orientated procurement are based on the literature review that is conducted. The process started with finding experts during the research and the next step was to determine what information was required to verify the conclusion of the literature. This information is used to describe unbiased questions in order to provide the interviewees with as much freedom as possible to not influence their answers.
The next step was to make a summary of the interviews and send them to the interviewee for feedback. The experts that are interviews are shown in Table 2 and the summaries of the interviews are added in text in Appendix I.

Table 2: Interviewees for innovative orientated procurement (own source)

Name and function	Organization	Date	Subject	Interview reference
Floris den Boer	Pianoo	14-2-2018	Innovative orientated procurement	1
Luuk Spijker	Antea Group	26-2-2018	Innovative orientated procurement	2
Jasper Flapper	Antea Group	26-2-2018	Innovative orientated procurement	2

These interviews are used to verify information which realizes that the expected outcome of the information is that no new knowledge is attained. Therefore, the information of the interviews is regarded as sources of information for the theoretical framework instead of new knowledge.

Interviews for circular orientated procurement

The semi structured interviews with regard to circular orientated procurement had the objective to determine how procurement processes can be used to stimulate circular economy. However, due to the early stage of transition, it is impossible to expect a certain outcome or that the experts all have the same level of knowledge. Therefore, the interview has two verification stages in which the information with regard to circular economy and innovative orientated procurement is verified or discussed to ensure that the interviewee is not obligated to read the first chapters of this research. The last step of the interview is to determine how the procurement process should be designed guided by the theoretical framework of orientated procurement. The experts that are interviews are shown in Table 3 and the summaries of the interviews are added in text in Appendix II.

Table 3: Interviewees for circular orientated procurement (own source)

Name and function	Organization	Date	Subject	Interview reference
Patrick Kip	Dura Vermeer	10-4-2018	The limits of circular economy and the related procurement process	3
Stephan van Dalen	Dijkencombi	20-4-2018	The limits of circular economy and the related procurement process	4
Christine Wortmann	Primum/Volker Wessel	16-5-18	The limits of circular economy and the related procurement process	5
Sander Holm	BAM	14-5-2018	The limits of circular economy and the related procurement process	6
Robby van den Broek	Roelofs	20-4-2018	The limits of circular economy and the related procurement process	7

These interviews are used to acquire new information from the private parties based on the theoretical framework of this research. The attainted information is reflected on this theoretical framework to provide context and to be able to answer the main research question to achieve the research objective.

ABN AMRO Circl in Amsterdam,
https://www.gebouwvanhetjaar.nl/entry/circl/

2. Circular economy in the construction industry

Resources are becoming rare and climate change is demanding more attention each day. Society should cope with this challenge by changing to a circular economy. Public organizations can stimulate this change by initiating the switch from a linear economy to a circular economy. However, this switch to circular economy is challenging because the principle of circular economy is still developing and the new business models related to circular economy are unfamiliar for the construction industry. This chapter is focused on these differences by determining what circular economy is and how it should be applied in the construction industry on a macro level.

2.1. Current business model in the construction industry

The transition to a circular economy is described by the Dutch government as a transition from a linear economy to a circular economy (Dijksma & Kamp, 2016). This transition, shown in Figure 7, would mean that the construction is currently not recycling any type of materials or products and that the applied business model is linear orientated in which monetary value and turn-over is the objective (Jonker, 2015).

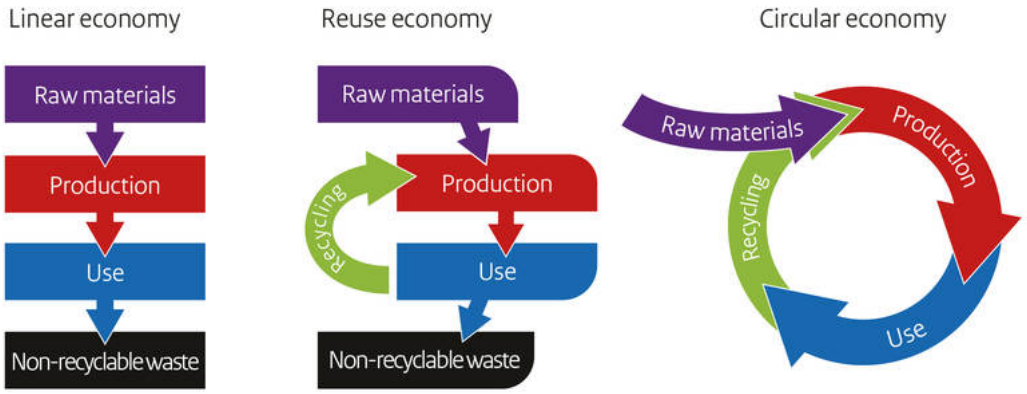

Figure 7: Changes in market attitude (Dijksma & Kamp, 2016)

However, is this really the case? Many methods are already developed that focus on sustainability and the reuse of materials (Kylili & Fokaides, 2017; Dijk, et al., 2014). The ladder of Lansink for example focused on recycling materials (Schall, 1992) and the principle of Trias Energetica is incorporated into design procedures and reduces the use of energy (Lysen, 1996). Next to these methods, Governments and construction companies are participating in cooperation's like Green deal sustainable GWW, Green deal Circular purchasing and Green capital to stimulate a transition to a sustainable future. Therefore, the conclusion is that many methods are incorporated in the construction process to asses or improve the sustainability of the construction industry (Iacovidou, et al., 2017). Based on the development of these methods, the current linear model of the construction industry does take recycling into account. However, when is an industry a reuse economy or a linear economy? This is a question that does not have a single answer because many levels of reuse or linear economy are possible. Because of this variability and the involvement of sustainability in the construction process, the decision is made to regard the construction industry as currently working on a transition from a linear economy to a reuse economy.

This transition results in a different flow of materials than is shown in Figure 7. This new flow of materials that has a combination of linear and recycling economy is shown in Figure 8 (Hashimoto, et al., 2007).

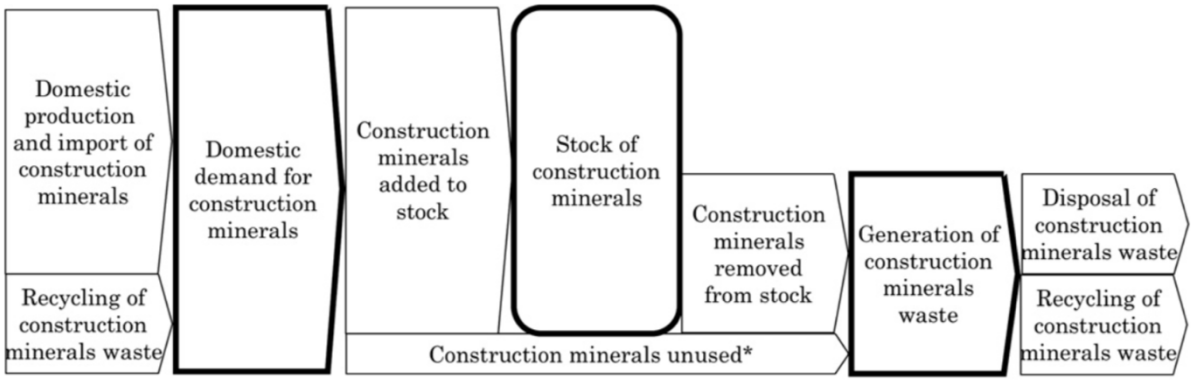

Figure 8: Material flow in the Dutch construction industry (Hashimoto, et al., 2007)

However, this material flow that is described by Hashimoto et al. (2007) in a construction industry is not the business model or process that is applied in the construction industry. A business model describes how products, services and information flows between actors and what their roles in combination with the benefits and sources of revenues are (Timmers, 1998). The generalized accepted business system of the construction industry that is found in literature for the Netherlands is:

> *"a collaborates system in which negotiated coordination in combination with interventions in the market to protect social values are of importance and in which the system relies on banks for industry financing"* (Winch, 2010).

However, this description is not specific enough to determine how the construction industry works and how products, service and information flows and how revenue is generated as Timmers (1998) described. This focuses the research towards a general process that describes the life cycle of a construction object and who is involved in each step on a macro level. In the life cycle of a construction object five main phases can be determined. the initiative phase, the design phase, construction phase, use/facility management phase, and demolishing phase (Winch, 2010). All these phases have a chronical order in which they are applied in the construction industry. Next to these five main phases there is also the procurement phase. This phase can be applied in any stage of the construction industry with a different scope and is therefore regarded as an over layered process. The currently applied process based on the phases of construction in the construction industry is shown in Figure 9. In this figure, recycling is added because this process is gaining momentum in the construction industry and plays a role in the current process. Next to adding the recycling phase, the design phase can be divided in concept, scheme and detailed design (Winch, 2010).

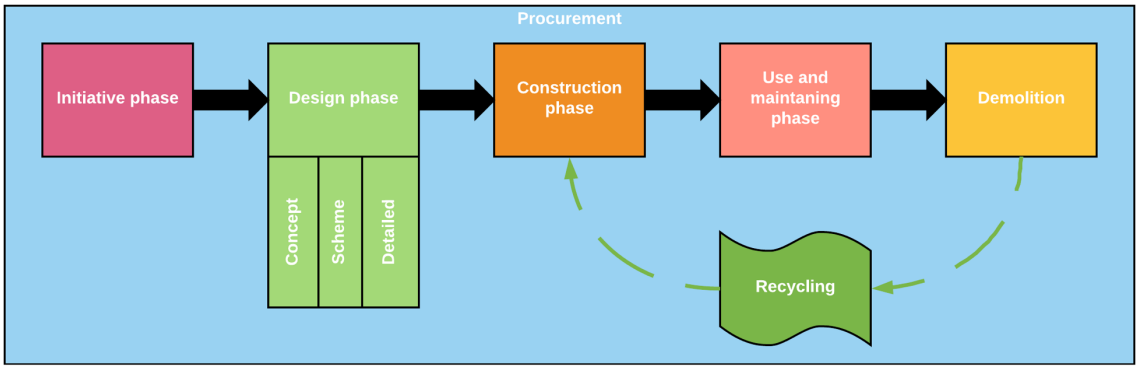

Figure 9: Process of the construction industry (own source)

However as discussed by Timmers (1998), this flow of materials and process knowledge does not result in a business model that is applied in the construction industry because the way how revenue is generated is not discussed and a business model also describes which organizations are involved in which stage of the process and how they interact in this process. The construction industry is project orientated in which short term cooperation and project interactions are leading (Dubois & Gadde, 2000). How these organizations interact and what the responsibilities are during the project is determined by the procurement process that is applied. Numerous combinations are possible from procuring all stages separately to different actors to full life cycle procurement to a cooperation of companies.

To still realize a current business model without taking all these social and cooperative options into account, the business model of the construction industry is regarded as separate actions or aspects that are conducted by participants that are essential to realize a construction project. The realized business model is shown in Figure 10. However, in the construction business model the procurement phase is not incorporated because it is addressed as an over layering process in this research. In this business model, the linear economy that is described and shown in Figure 7 is still representable because the focus is still towards a linear/recycle economy in which materials are recycled or destroyed as also shown in the material flow. The basic phases of the construction industry are incorporated into this business model. However, procurement is not shown in this business model because it can be different in each construction project when it is applied and it is a factor that determines how parties interact during the projects and these interactions are not taken into account for the business model. Manufacturers are added in this model because these companies are responsible for realizing products that are used by the contractor to realize a construction project. An informal connection between designers and product or component delivery is realized because designer sometimes use the knowledge of manufactures in the design process. The client will become the owner at the end of the project and the construction companies are focused on maximizing turnover and monetary profit based on the contract duration. The verification phases are not incorporated in the model but are present in the business model of the construction industry. After each phase, a verification phase is present to verify that the delivered products are conform the criteria that were set beforehand. The overview of actors that are involved in the construction industry and what their generalized responsibilities are, is shown in Table 4. However, the responsibilities and actors that are addressed could be incomplete. The decision is made to focus on these actors to realize a business model on macro level that does not incorporate to much edge involvement. To realize an efficient transition to a circular economy business model and it makes the comparison with the linear business model less complex.

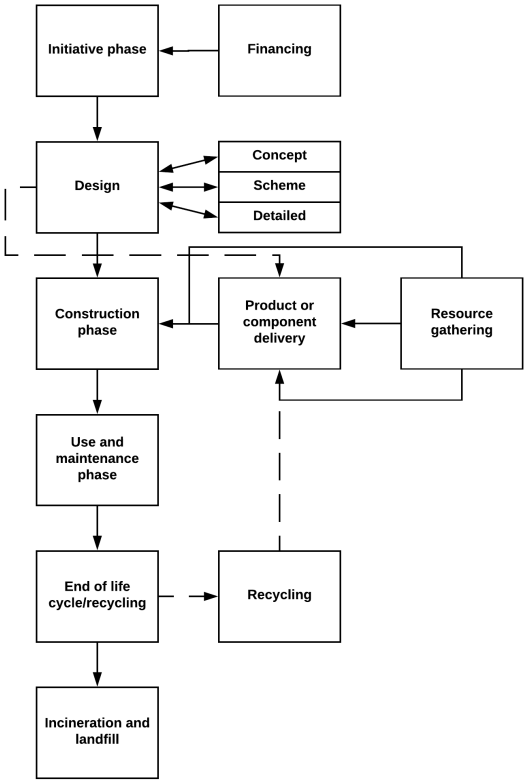

Figure 10: Business model of the construction industry (own source)

Table 4: Actors involved in the construction process (own source)

Phase	Actors involved	Actions and responsibilities
Initiative phase	Client/user	Determine what the client wants and what object is required
Financing	Client or investor	Realizing sufficient funds to realize the construction object and that the client can gain full ownership.
Design	Engineer	Designing the object based on the wishes and demands of the client
Construction	Contractor	Realizing the design that is designed by the engineers
Resource gathering	Contractor or manufacturer	Gaining raw materials that are required to realize the construction object
Product or component delivery	Manufacturer	Making and delivery of components or products that are required during the construction phase
Use and maintenance	Client	Using and maintaining the building during the life cycle by adjusting the objects to it needs and realizing that damages are repaired
End of life cycle/recycling	Client	Deciding if the objects reached its end of life cycle because object is to old or does not fulfill the needs
Recycling	Recycling industry	Recycling materials that are available in the object.
Incineration and landfill	Demolishing industry	Deconstruction of the objects and removing waste products that the recycling industry does not want to use.

The benefits of this business model for the participants is that limited amount of interactions have to take place and that limited multi actor decision making is required. This results in a clear process in which responsibilities are clear. Revenues are gained in each step of the process by providing a service or realizing a product (Jonker, 2015). Engineers can make a design as a service and the contractor can realize a product with the help of manufacturers (Winch, 2010). This realized product has value for the client who uses the product during its use and maintenance phase and at the end of the linear economy the object has to be demolished/removed which provides value for the demolishers and possibly the recycling industry. However, this value is all monetary orientated without taking social and environmental aspects taken into account (Jonker, 2015).

2.2. Concept of circular economy

Circular economy has many definitions and all focus on different aspects of the concept of circular economy. Some papers focus on the reuse of materials and other papers focus on the economic aspects and advantages of circular economy (Kirchherr, et al., 2017). The concept is not just a sustainable method but it is an entire business model that focuses on economic prosperity and the environmental impact of materials by preserving value and taking social values into account (Iacovidou, et al., 2017; Ghisellini, et al., 2016). This economic prosperity and environmental impact is based on the preservation of material value and applying alternative types of ownership (Wyman, 2017). This preservation of value is not only focused on the monetary value but also on the environmental value of a product. A proper start to discuss the principle of circular economy and the connection between economic prosperity and environmental impact is the well-known model of Macarthur foundation shown in Figure 11. This model takes the economic aspect into account by minimizing outflow from the system because outflow reduces value. This minimization of outflow of materials also reduce the environmental impact because no materials are destroyed. Next to these preservations of value the application circular economy provides opportunities to realize economic prosperity (Ellen Macarthur Foundation, 2013).

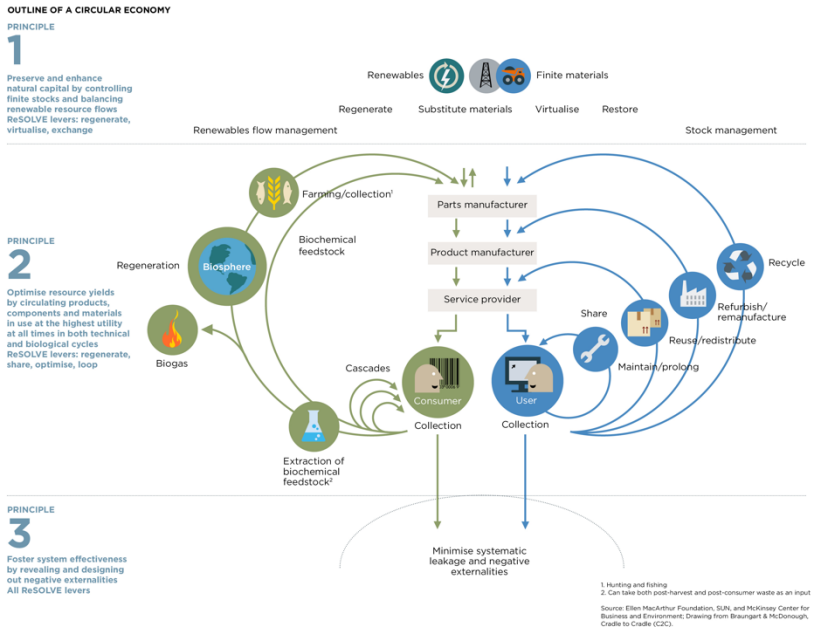

Figure 11: Butterfly model Macarthur foundation (Ellen Macarthur Foundation, 2013)

The model distinguishes a technical and a biological cycle in the principle of circular economy. Consumption happens only in biological cycles, where food and natural materials are designed and manufactured to be fed back into the system. This refeeding of natural products provides opportunities for other natural products to grow. The technological cycle recovers and restores products, components, and materials through “circular strategies”. The goal is to minimize material loses in the chain because materials loses is a direct loss of value from an economic and environmental point of view (Ellen Macarthur Foundation, 2013).

Biological cycle in circular economy

The biological cycle of the model is focused on the aspect of biological circle in which natural products after consumption can be used as resource to allow or stimulate natural products to grow (for example fertilizer). This cycle of natural products in circular economy reduces the scarcity of finite natural resources because it focuses on natural resources that have an infinite supply if properly managed (Ellen Macarthur Foundation, 2013).

Technological cycle in circular economy

The technological cycle of the model is focused on the manufacturing aspects of the concept of circular economy by focusing on the manufacturing industry and on the use of finite material. The manufacturing industry uses materials to manufacture products that are used by consumers. In this cycle five different levels of circular strategies are discussed to create the circular cycle. The first level is sharing the products followed by maintaining the product. The third level is reuse or redistribute the product. The product is in this phase relocated without changes to a new costumer. The fourth level is refurbishing or remanufacturing the product to increase the value of the product. The fifth and lowest level in the chain is the recycling chain in which the product is disassembled to realize a new product without spilling materials (Ellen Macarthur Foundation, 2013).

The possibilities how products and the related materials can be reused is a topic of discussion (Kirchherr, et al., 2017). In the model of Macarthur five levels are described that determine the possibilities of using/preservation of a product. However, in recent literature these five steps are changed towards ten strategies that are relevant to successfully implement circular economy (Kirchherr, et al., 2017). These ten strategies are shown in Figure 12.

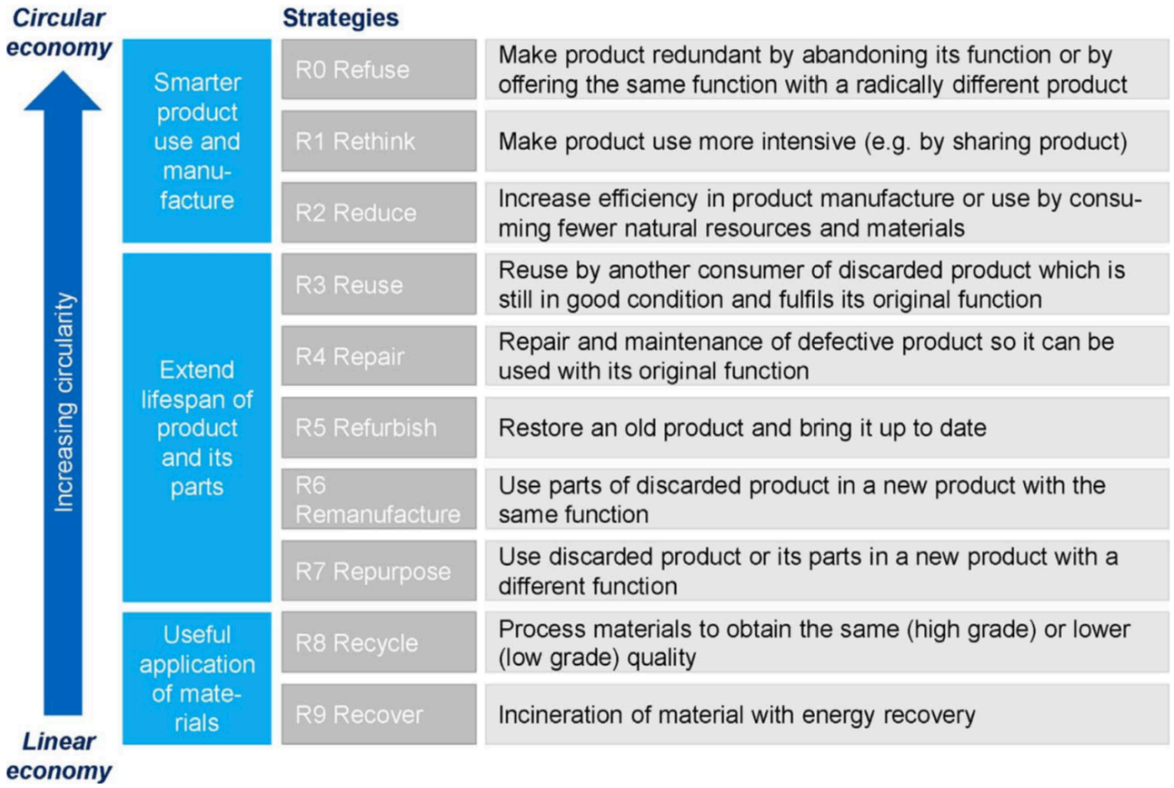

Figure 12: Circular strategies (Kirchherr, et al., 2017)

Increasing the amount of strategies that are available to apply in the technical cycle makes the concept of circular economy more complex because it incorporates more possibilities to use materials, components or products (Kirchherr, et al., 2017). However, these strategies represent the concept of circular economy more sufficient because it focuses on social and economic values as well. Therefore, these ten strategies are used in this master thesis. During the life cycle of the materials, the material can undergo a combination of these strategies. How a product is designed and how a certain strategy is applied on a material, component or product level determines which strategy can be applied in remaining life cycle of the material, components or product (Elia, et al., 2017).

Connection between biological and technological cycle in circular economy

Connecting the biological and technical side of the materials results in a business model that can realize economic prosperity while taking the environment into account by preserving value (Kirchherr, et al., 2017). Both these cycles meet in the manufacturing phase of products in which the value of materials is increased (Ellen Macarthur Foundation, 2013). Processing products from resource to product increase the value of the materials which increase the economic value and generates revenue. Using biological materials in the manufacturing chain reduces the use of finite materials and increases the circular strategies that can be applied. The use of finite materials in the manufacturing industry increases economic value reduces the environmental value of the product. To compensate this, the concept of circular economy focuses on limiting the use of finite elements by using natural products that have an infinite supply if properly management or applying circular strategies to reduce the demand of finite materials. This application of circular strategies can also realize economic opportunities for companies (Jonker, 2015).

2.3. Definition of circular economy

However as discussed in the start of this chapter, In the construction industry or the entire economic system no clear definition is available because circular economy is not just an economic system or a system to realize sustainable use of materials (Kirchherr, et al., 2017; Wyman, 2017). This broad focus of the circular economy does not only chance the way of working, it also chances the definition of profit and value (Jonker, 2015). However, for this master thesis it is relevant to define circular economy because it scopes the research. A few examples of available definitions in literature and reports are:

> Looking beyond the current "take, make and dispose" extractive industrial model, the circular economy is restorative and regenerative by design. Relying on system-wide innovation, it aims to redefine products and services to design waste out, while minimizing negative impacts. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural and social capital. (Ellen Macarthur Foundation, 2013)

> In a circular economy, growth is decoupled from the use of scarce resources through disruptive technology and business models based on longevity, renewability, reuse, repair, upgrade, refurbishment, capacity sharing, and dematerialization. Companies no longer focus mainly on driving more volume and squeezing out cost through greater efficiency in supply chains, factories and operations. Rather, they concentrate on rethinking products and services from the bottom up to "future proof" their operations to prepare for inevitable resource constraints – all the way through to the customer value proposition. (Accenture, 2015)

> Circular Economy aims at transforming waste into resources and on bridging production and consumption activities (Witjes & Rodrigo, 2016)

> The concept of circular economy (CE) is to an increasing extent treated as a solution to series of challenges such as waste generation, resource scarcity and sustaining economic benefits. However, the concept of circularity is not of novel as such. Specific circumstances and motivations have stimulated ideas relevant to circularity in the past through activities such as reuse, remanufacturing or recycling (Lieder & Rashid, 2016).

All these definitions have in common that they are orientated towards a way to realize a sustainable future. However, they also have in common that they are product or material orientated in which transforming waste into resources is an objective. This transforming of waste into resources can be achieved by applying circular strategies that Kirchherr et al. (2017) described. Therefore, the used definition of circular economy in this research is:

> *Circular economy regards end of life cycle products as resource instead of waste to preserve value and realize a sustainable future. By applying circular strategies on products, components or materials the value can be preserved and finite materials no longer leave the economic system which al contribute to a sustainable future*

Definition of circular economy used in this master thesis

2.4. Business model of circular economy

With the definition, what circular economy is and how it can generate value, a business model related to circular economy can be discussed. Products that are used by consumers and materials that are consumed by consumers all have a value that contribute to the economic system (Geissdoerfer, et al., 2017). The concept of circular economy is influenced by the blue society organization that is described in economic business models (Blomsma & Brennan, 2017). This economic model focus on five pillars namely: Purchase to pay, civilians and organization, Eco-innovation, communication management and shared and collective value creation (Jonker, 2015). Different types of ownerships can be applied and cooperation between private organizations is essential in this blue society to stimulate circular strategies (Jonker, 2015). Which strategy to preserve value can be applied is influenced by the design of the product and the history during the life cycle (Kirchherr, et al., 2017). This influence from the past and design of the product requires the participants in the chain to focus on the life cycle of a product and not just on the here and now (Ellen Macarthur Foundation, 2013). This requires the designer to work together with manufacturers to reduce the use of finite materials and realize that as much circular strategies as possible can be applied during the life cycle of the product. However, not only the designer has to work together with the manufacturers during the life cycle of the project but also the client or consumer has to work/stay in contact with the manufacturers because a product is primarily in the use phase of its life-cycle. This contact enables the manufacturers to use the most efficient circular strategy which reduces the loss of value. How these participants communicate with each other also determines how the product can be reapplied in the cycle. Based on the model of the Macarthur foundation five business models are developed that can be applied for circular economy. These five business models are shown in Figure 13 (Accenture, 2015).

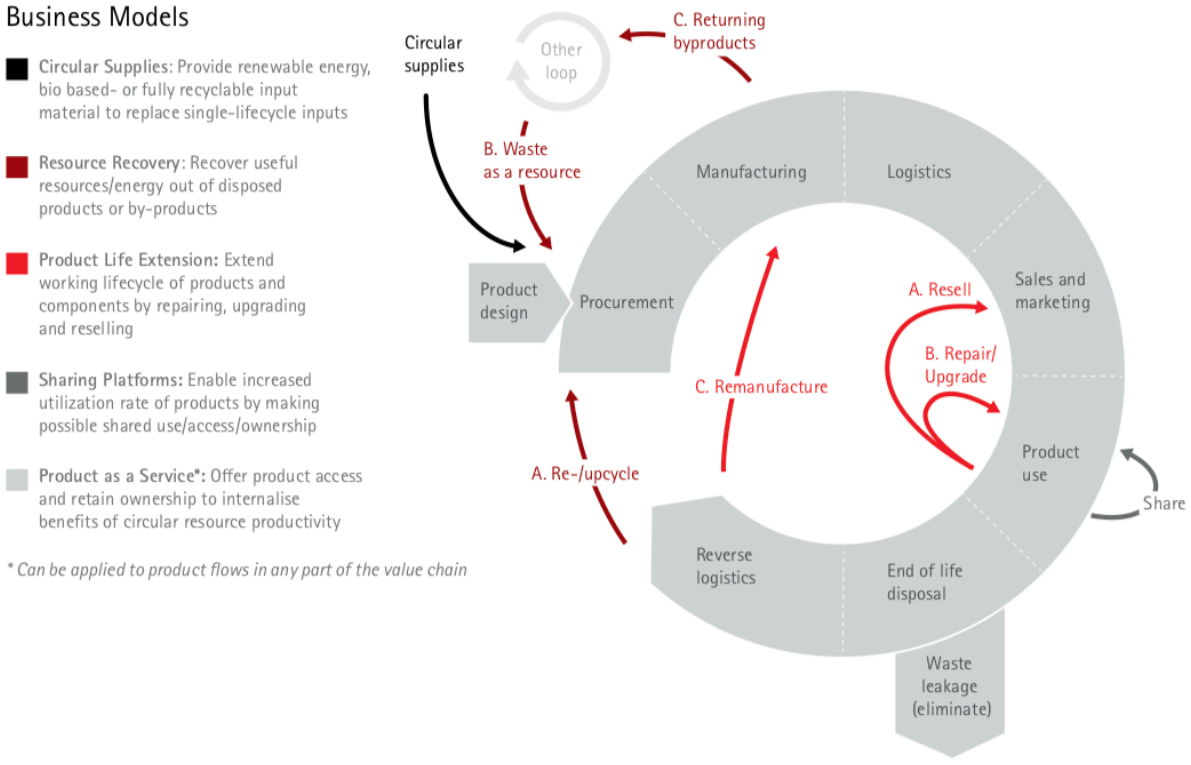

Figure 13: Business models for circular economy (Accenture, 2015)

These developed business models describe each a concept how a product should be treated throughout the life-cycle and what strategies should be applied to reduce value loss. However, this model focuses on just one strategy that could be applied to realize circular economy. To increase value a combination of these strategies is required to realize a maximum outcome. How a certain strategy can be applied depends on the product and the actors that are involved in the process. This business model is a generalization that has to be specified to a certain sector (Ellen Macarthur Foundation, 2013).

2.5. Business model of circular economy for the construction industry

The business models that are shown in Figure 13 focus on one particular product to apply circular economy and only one single circular strategy is applied. However, the final product of the construction process is an object that contains many products that are assembled based on components and materials (Durmisevic & Brouwer, 2006). How circular economy should be applied in the construction industry is not just one circular strategy but a combination of these strategies that are described by Kircherr et al. (2017). The BAM also experienced this and developed in cooperation with ARUP a business model for the construction industry that can tackle this difference. The developed business model is shown in Figure 14 (ARUP, 2017).

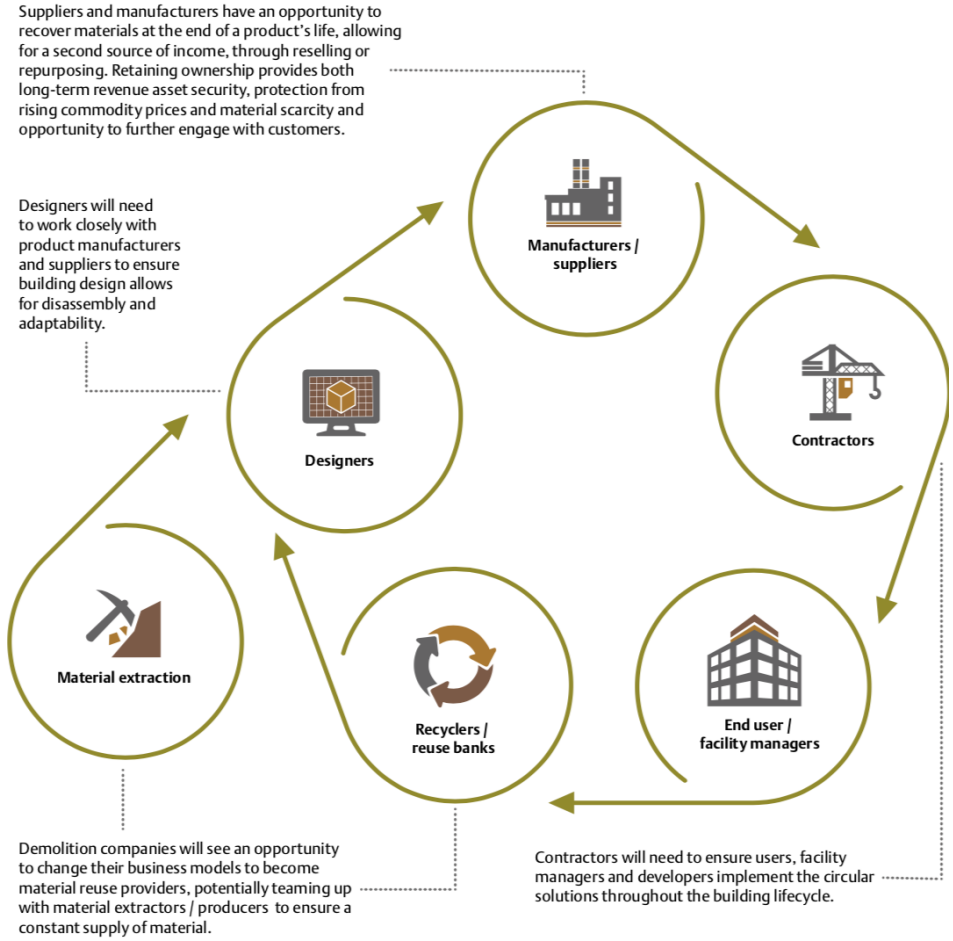

Figure 14: Circular business model developed by ARUP and BAM (ARUP, 2017)

The developed business model focuses on cooperation and describing the importance of involving all the actors just as the circular economy requires. Circular economy can only succeed if the market works together and are aware of their influence on the chain (Ghisellini, et al., 2016). Next to the focuses on cooperation, the business model focuses on five main ways to realize a circular economy in the construction industry. These five pillars are: Long-term thinking, Design for deconstruction, innovate, flexibility vs durability, utilize new models of production and consumption (ARUP, 2017). These strategies incorporate the methods that Kircherr et all (2017) describe as the strategies to successfully implement circular economy. However, the business model just mentions that the strategies can be applied but it does not describe how this is organised. Next to these strategies it also takes the financial aspects and the asset management of the objective into account as the model from Accenture describe. The long-term orientation increases risks and uncertainties which make the financial aspect difficult to describe for the BAM. To reduce these risks and uncertainties or make the concept of circular economy attractive the concept of leasing is suggested as a solution. However, other types of ownerships are applicable for the construction industry as well.

The switch to a long-term focus that the BAM describes, in which coordination and cooperation plays a crucial role, requires the construction industry to embrace the circular strategies of circular economy (Jonker, 2015). This desire to cooperate is also an important pillar in the circular business models that are shown in Figure 13. However, which circular strategy can be applied on a building depends on many factors and is hard to incorporate in the business model because a building contains numerous products with different life cycles. To still make room for different circular strategies in the business model, a construction object can be separated in different functions and life cycles (Brand, 1994). To simplify the construction object, the method of Brand can be used. This method divides a building in six main layers and provides different life cycles to these layers (Brand, 1994). The method is shown in Figure 15. The duration of the life-cycles of the products that are shown in this model are examples and are different for each construction project. This separation realizes the possibility to determine for each layer a different circular strategy to be used.

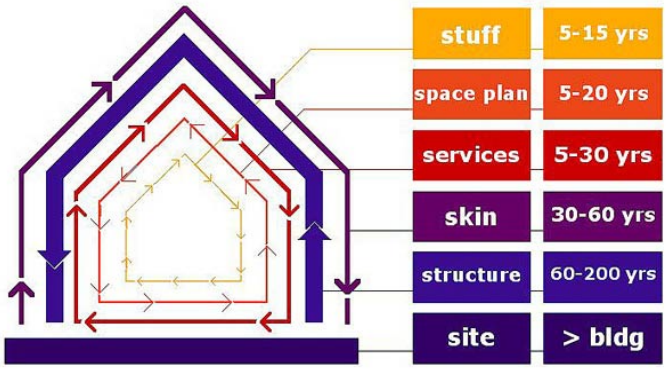

Figure 15: Model of Brand (Brand, 1994)

Next to layering and circular strategies, the types of ownerships for the construction industry are numerous and depends on the wishes and decisions of the client. The BAM only suggested leasing but there are numerous types of ownerships. a few examples are: product leasing, product renting, performance provider, sell and buy back (Achterberg, et al., 2016). All these types of ownership have one typology in common. They all determined, before selling a product or service, who is responsible for the product. This beforehand responsibility determination realizes the possibility to apply circular strategies (Kirchherr, et al., 2017). However, this change of ownership in the construction industry demands a different attitude from the financing organization. It is not anymore about providing funding for the construction funding but helping the client in determining the best ownership model (Wyman, 2017).

These types of ownerships change the product versus service balance and can be generalized in three categories in which eight financing models are available (Tukker, 2004). These categories and financing models are shown in Figure 16.

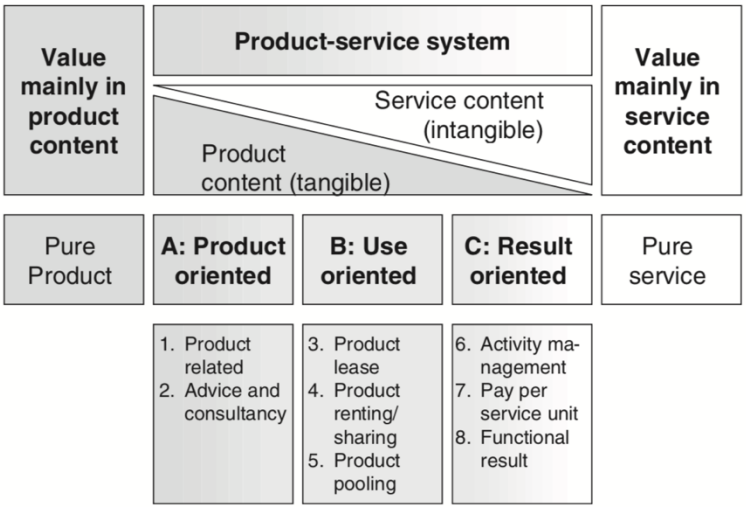

Figure 16: Product-service systems (Tukker, 2004)

However, some of these financing models don't have a role in circular economy in the construction industry because they are applied in a different way or not applicable. An example of this is the concept of product pooling, this method is already incorporated in the circular strategy by the strategy of refusing. Therefore, the types of ownership for circular economy is generalized to three types of ownership. Product oriented, use oriented and result oriented that is described based on the research on Tukker (2004).

The product oriented industry is focused on the classic type of ownership in which the client becomes the owner of the construction object. This realizes that the client is responsible for applying circular strategies. However, most clients don't have the possibilities to apply circular strategies because they do not have the facilities to reuse the materials, components and products. To solve this gap to stimulate circular strategies the idea of reuse/remanufacturers that the BAM suggested can be used. By applying this method, the client always has a place to relocate or exchange their used products and the construction industry is preserving value while benefiting of economic opportunities. However, this market is currently not present in the Netherlands and requires a change in the market (ARUP, 2017).

Leasing is one of the options that is popular in the circular economy and is use orientated. In this concept, the manufacturer or contractor remains the owner of the product and the client pays a price during the life cycle of the object for using this product as a service. When the product is at the end of its life cycle, the owner will take back the products and applies circular strategies. This type of ownership provides the manufacturers with additional options to generate revenue if the demands of the clients provide room for innovations while materials don't leave the economic system (Ellen Macarthur Foundation, 2013).

The next step would be to focus on result orientated purchasing in which a service is important. It changes the specification of a product from purchasing or leasing a certain product to paying for a service. This concept focuses on describing a problem to the market and they provide a solution. An example would be to describe a problem as a will to have transportation from A to B instead of wishes a type of car. However, the difference with leasing has a fine line and depends on the asset specification and the risks that are set or determined at the start of the lease construction (Tukker, 2015).

The shared responsibility to apply circular economy changes primarily the role of the contractor and the manufacturer. The manufacturer takes a leading role because they can apply the circular strategies to prevent value losses. The bigger role of the manufacturer reduces the role of the contractor and focusses their role on coordination and communication. The contractor becomes a service provider for the client to guide the construction process as efficient as possible while taking the circular strategies into account. The role of the financer is important to realize circular economy because the financer help to realize different types of ownership. The methods like; Design for deconstruction, innovate, flexibility vs durability that the BAM discusses is a subject that is project orientated and that has to be determined for each project based on the type of ownership. A client that focuses on a structure with a life span of ten years and lease as type of ownership will probably result in a design that is focused on deconstruction and this witches the focus for the manufacturer to a circular strategy that focusses on reuse.

The business model that the construction industry can use, based on the model of ARUP/BAM (2017), the circular strategies (Kirchherr, et al., 2017), the model of Brand (1994) and the different types of ownership (Tukker, 2004) is focused on the cooperation aspect of the circular economy. To successfully apply circular economy the first three circular strategies that describe to refuse, rethink and reduce demands commitment from all parties involved in the process. This broad responsibility reduces the segmentation in the market. Every actor, from clients to engineers and contractors to manufacturers, are all responsible for circular economy to thrive.

At the start of the construction project, a procurer has to determine what type of project it is, what their demands are and what type of layers are generalizable for this type of project. Based on this generalization, for each layer of the construction object, a type of ownership can be chosen. The next step is to realize the construction object based on these decisions of ownership by applying current design and construction phase. However, in these two activities the entire construction industry is responsible for the decision that are made. After this phase using and maintaining the object begins and changes will occur. Plans will change and facades can be updated. When this moment is reached, the owner of the product is responsible to apply circular strategies. The realized construction process based on this process flow is shown in Figure 17. How these products than should undergo circular strategies depends on the type of ownership. This business model provides room for different types of ownership next to the current purchasing strategy but is focused on the current type of ownership. Leasing and providing a service could be an option and realizes that the construction phases are combined instead of segmentation. However, the most important subject in the ownership discussion is that the owner takes responsibility for the materials and this can only be done if all organizations work together. The responsibilities for this circular business model are shown in Table 5. The type of ownership that is suitable has to be determined for each product or layer.

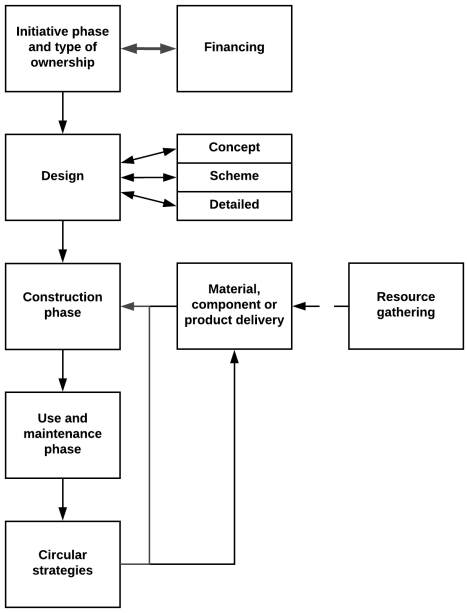

Figure 17: Process flow construction industry (own source)

Table 5: Responsibilities of the actors in the circular economy (own source).

Phase	Actors involved	Actions and responsibilities
Initiative phase	Client or user	Determine what the object required is and divide this in layers based on lifecycle
Financing	Client and investor	Determine for each layer what the type of ownership will be and realize funding for this type of ownership
Design	Engineer, contactor, manufacturer and client	Designing the object based on the wishes and demands of the client in cooperation with the parties involved. All parties are used to efficiently design the object while taken circular strategies and type of ownership taken into account
Construction	Contractor and manufacturers	The construction phase is managed by the contractor in cooperation with all manufacturers.
Resource gathering	Contractor or manufacturer	Gaining raw materials only if needed that are required to realize the construction object. In this phase, the focus will be primarily to biological raw materials instead of finite materials
Product delivery	Manufacturer	Making and delivery of components or products that are required during the construction phase.
Use and maintenance	Client or user	Using and maintaining the building during the life cycle by adjusting the objects to it needs and realizing that damages are repaired
Circular strategies	Owner of the product, component or material	Applying circular strategies to realize a circular economy

2.6. Changes in the construction industry

The developed business model does not only pave the way to apply circular strategies instead of recycling and incineration but is also incorporates different type of ownerships and cooperation but it also incorporates a change in responsibilities and reduces the segmentation in phases in the construction industry. Figure 18 presents the changes that the construction industry has to make to apply circular economy in a summarized way. Segmentation is removed and changes towards cooperation because the contractor takes a much more coordinative role instead of a leading role in the construction process by stimulating and coordinating communication. This less dominant role of the contractor requires the manufacturers to step in and take responsibilities and look to the future during the design and installation of their product. Designers are forced to communicate with these manufacturing to determine which products are available to fulfil the function that the client requires. Due to the application of circular strategies the work of the manufacturers also changes. They are not only responsible for creating products but can also expect work in reusing, repairing, refurbishing, remanufacturing and repurposing products to prevent material loses which provides the manufacturers with additions options to generating value instead of generating revenue. Financing parties have to stimulate the transition to this circular economy by not only providing the money but also to stimulate different ownership model to stimulate circular economy. This long term thinking to prevent material loses requires communication before, during and after the construction process. This require to communicate changes the responsibility of the construction company towards long term relationships instead of short term relationships. The connection of client and manufacturer, contractor and possible financer will always stay as long as the products are used in the construction object. The relationship does not end after the construction phase ended. This change to long-term thinking requires the market to focus on the long haul instead of the short-term profits which changes the construction attitude and procurement process that is currently known. It is not anymore about delivering quantity to generate revenue but about generating value by taking responsibilities for materials, components and products. All these differences are also mentioned as the required changes to switch from a linear to a circular (Jonker, 2015).

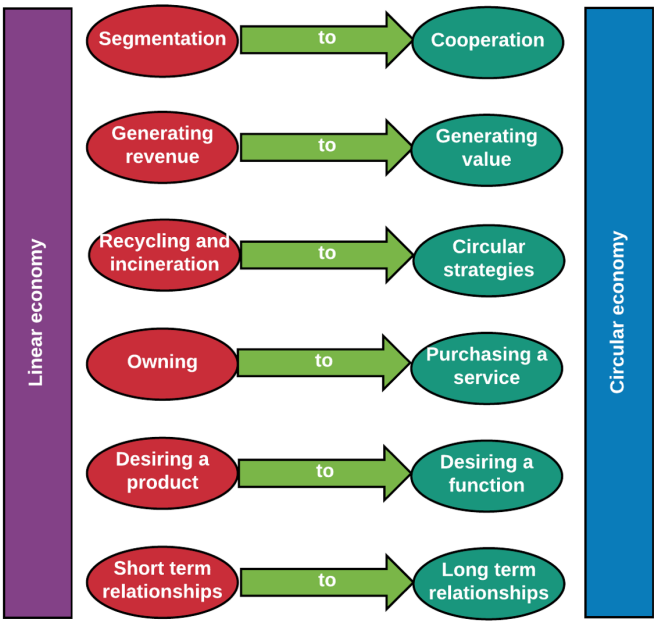

Figure 18: Changes to realize a circular economy in the construction industry (own source)

2.7. Conclusion

The current business model of the Dutch construction industry Is segmented and focusses on short term relationships and realizing turnover. This focus on short term relations and realizing turnover has to change to long term relationships and realizing value beyond the duration of the contract in the transition to circular economy. Value is generated throughout the life cycle of materials, components and products by applying circular strategies. This focus on circular strategies requires manufacturer to step out of the shadow and take an active role in the construction process which changes the role of a contractor. The contractor is not the dominant organizations that makes decisions but has a coordinative function in the new business model. Next to the shift in balance between contractors and manufacturers, designers/engineers determine which circular strategy can be applied by their design. The designers/engineers should focus beyond the use phase of the construction object and focus on applying circular strategies at the end of the construction life cycle. This change and focus on circular strategies provides opportunities for different types of ownerships. All these changes are all changes that occur on macro level in the construction industry while these changes also influence the project on micro level. Long term-thinking changes the attitude of all actors in the construction industry and cooperation takes a dominant role which changes how projects are executed. This collaborative attitude forces private organizations to work together but it also requires client and contractor to work together in order to realize that circular strategies can be applied. This type of cooperation will reduce the amount of verification between contractor and client because both these actor benefit from an effective construction process. All these changes are required in order to realize a circular economy. Switching from a linear economy to a circular economy is a system change that has to be stimulated over time because doing a single circular project wont transform the project orientated Dutch construction industry.

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3. Stimulation of innovation by applying procurement processes

The government has various methods for stimulating a change from legislation to providing informal incentives to realize a transition. One of these methods to stimulate a transition is applying procurement processes (Edler & Georghiou, 2007). Due to limited information regarding the stimulation of the transition from a linear economy to a circular economy, circular economy is regarded as an innovation to broaden the theoretical base.

3.1. Foundation and legal limits of procurement processes

Within purchase processes, two main subjects can be described. There is the process aspect that describe how a partner is chosen (procurement process) and the contract that describe what is expected from the partner (Chao-Duivis, et al., 2013). This chapter discussed the current standards of procurement processes and contracts. First a procurement processes is conducted to determine a partner and together with the decided partner a contract is signed. (Pianoo, 2018)

In the case of Dutch and European legislation works, supply and services are determined as the three types of purchases of public organizations. In the case of this research only works will be taken into account because the construction industry is current focused on works and this reduces the number of articles that have to be taken into account.

Procurement process

The procurement process is primarily used by public organizations to select a partner for work that has to be conducted. This procurement process is based on six main principles in order to realize that every interested organization has a fair change. These six principles are (Chao-Duivis, et al., 2013):

- The principle of equality;
- The principle of transparency;
- The principle or proportionality;
- The principle of competition;
- The obligation to state reasons;
- The protection of legitimate expectations.

When any of these principles are in conflict with each other, the principle of equality takes precedence (Chao-Duivis, et al., 2013).

Based on these six principles, public organizations determined several procurement processes that describe how a partner is selection for the purchase of works. These procurement processes are (Ministry of Economic Affairs and Climate Policy, 2016):

- The open procure;
- The restricted procedure;
- Competitive dialogue;
- Negotiated procedure with prior publication of a contract notice;
- Negotiated procedure without prior publication of a contract notice;
- Direct agreement procedure;
- Concession procedure;
- Framework agreement;
- Design contest;
- Innovative partnership.

All these procedures describe a general idea how a partner can be chosen or a product/service can be purchased. The decision is made to not focus on the current processes but focus on the three pillars that are incorporated in these procedures. These pillars are boundary conditions, selection criteria and award criteria (Chao-Duivis, et al., 2013). Determining these three pillars when stimulating an innovation instead of a procedure leaves room for organizations to choose which procedure has to be followed and

also the decisions that are related to this procedure. A procurement process should fit the goals or ambitions that the client determined and not the other way around (Interviewee 1).

In the boundary conditions, first contact with possible partners is made. The tone and ambition has to be clear and the scope of the project is described. The boundary conditions describe what the partner has to do but also describe what demands have to be fulfilled in the procurement process and during the project. The level of detail of the boundary conditions depend on the magnitude of the contract. A project that is focused on design and construct can only ask for limited technical demands or functions instead of technical details. The boundary conditions include the criteria of grounds for exclusions, minimum requirements and suitability requirements (Chao-Duivis, et al., 2013; Pianoo, 2018).

The selection criteria determine how the partner is chosen. On an abstract level, this is hard to describe on a macro level because this step is primarily meant to verify the participant (Chao-Duivis, et al., 2013). This stage has to be determined beforehand and is relevant for the market and procurer. For the market, it provides insight how a partner is selected in the procurement process and for public organizations it can be used to limit the number of participants in the procurement process to limit the tender costs (Chao-Duivis, et al., 2013) (Pianoo, 2018).

The award criteria are used to assess a bid and this is part of the competiveness attitude of the procurement phase. Participants deliver a bid on how and for what they can realize the contact that is put out for tender. Current legislation provides sufficient room to describe award criteria based on the ambitions and goals of the project. However, the type of award criteria depends on the magnitude of the contract. A procurement process that starts in the initiative phase with innovation as stimulation can only ask for an ambition or idea and not on specific outcome because the project is still on an abstract level (Chao-Duivis, et al., 2013; Pianoo, 2018).

Contract forms

In Dutch legislation the traditional model, the model of early contractor involvement, the integrated model, the alliance model and the public-private partnership model are described as the five contract models that are possible in the construction industry. However, it provides room for custom-made contract when the project requires such a contract (Chao-Duivis, et al., 2013).

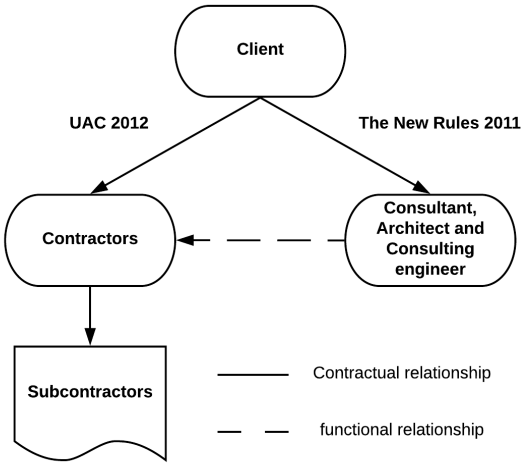

Figure 19: Schematic representation of the traditional building process (Chao-Duivis, et al., 2013)

The traditional model is the contract model that is applied in the majority of the construction projects. This contract model is situated around the classic role of design and execution that are both arbitrated by the procurer. The traditional contract model is shown in Figure 19. In this contract model the uniform administrate conditions (UAV/UAC in English) 2012 and the new rules (DNR) 2011 are contractual agreements that describe how organizations work together in which phase of the construction process and are applied throughout the construction industry. The contractual relationship is short term in this traditional model and the contract ends when the construction project is delivered (Chao-Duivis, et al., 2013).

The model of early contractor involvement focusses on realizing a team in which knowledge is shared to improve the design and execution phase of the construction project. The participants in the team are independent from each other but all share the responsibility for realizing the project. The members of the team are selected individually by the procurer at the start of the project and are combined together to realize the building team based on the contract that demands willingness to corporate. The scale of the project determines the amount of effort that a certain member has to perform during the duration of the contract. The variability also makes the amount of required tender procedures variables. If a certain threshold for specific members of the building team is exceeded, the function in the building team has to be put out to tender. When the design is finished, the contractor that was involved in the team has the first and only opportunity to realize this project. To require an open and transparent process the contractor has to submit a detailed costs calculation to allow the procurer to determine if the price that is provided by the contractor is fair and conform market price. If this is not the case the realized design can still be put out to tender. The contract will end after the construction phase is finished (Chao-Duivis, et al., 2013).

Next to these separate orientated contracts the integrated contract is described in the UAC-IC 2005 and focusses on combining a contract and award it to a single bidder. The contract can consist out of a design and construction element but it can also consist out of design, construction, maintain, operate and financing as the construction phases of which the partner is responsible for. Which part is described in the contract depends on the wishes of the client and the market has to respond. This integrated approach of construction phases provides the client with the possibility to realize a long-term relationship with a partner to realize a project. During the duration of the integrated contract the partner is in the lead. However, this does not mean that the client has no responsibilities. The client has to work together with the partner to realize a successful outcome but has less responsibilities if they are compared to the responsibilities related to the traditional model (Chao-Duivis, et al., 2013).

Both the alliance model and the public-private partnership model looks the same and are not described in detail as the traditional model, early contractor involvement and integrated model because it provides the client with the opportunity to realize an open contract outside the boundaries of standard contractual agreements. Both these contractual options are focused on realizing a relationship that is focused on cooperation to realize a project. The difference between the alliance model and the public-private partnership model is that the alliance model requires a separate company that acts independent from the client and is formed by client and partner. The public-private partnership is a way to realize long-term relationship between a market party and a public organization (Chao-Duivis, et al., 2013).

All contractual options that are previously described all focus on certain agreements or standard contracts are all examples that are possible based on the basics of contract law because every organization in the Netherlands has the fundamental right to the freedom of contract. The basic of contract law is that a certain party promises something to a certain partner and gets a certain reward for realizing this promise. Next to this basic idea of a contract, the contract requires the following five parts to be legally valid (Chao-Duivis, et al., 2013):

- Consensus;
- Compliance with the prescribed form;
- No incompatibility with the law, public morals and/or public order;
- No vitiated consent;
- No fraudulency in respect of creditors.

The number of possibilities in the type of contract is numerous and the client has the right to determine which phases of the construction process is being procured. The UAV and UAV-GC describe standard forms of contract to reduce transaction costs. However, clients are not obligated to use the UAV and therefore the contracts do not provide any legal barriers when a circular economy would be stimulated (Chao-Duivis, et al., 2013).

3.2. Stimulation of innovation by applying procurement process

The stimulation of an innovation or transition by applying procurement processes is just one of the many ways that an agency can stimulate a change. The stage of the innovation or transition plays a crucial role in what the options in the procurement processes are (Rotmans, et al., 2001). This chapter starts with providing a definition of innovation before continuing to the literature that describe how procurement processes can be used to stimulate an innovation.

The concept of innovation

Innovation has just as circular economy many definitions and many types of innovations are possible. Innovation is focused on developing something "new". However, when is something "new" that you can call it an innovation? Is something an innovation when somebody never used the product but other organizations already used it before? Or is something only "new" when somebody implements it for the first time. Current legislation provides a scope to this discussing by setting boundaries on what innovation is. An innovation for Dutch legislation is a development that is never been applied or researched and to determine this, thorough market reconnaissance is required (Ministry of Economic Affairs and Climate Policy, 2016).

This scope of Dutch legislation regarding the definition of innovation could be a definition of innovation. However, it does not describe what an innovation is or what the related processes of innovation are. Innovation are caused by the need of humans to seek satisfaction or solve societal problems and challenges (Edquist & Zabala-Iturriagagoitia, 2012). Within this innovation, product and process are distinguished in literature as separate types of innovations (Utterback & Abernathy, 1975). However, some papers also distinguish organizational innovation and marketing innovation as additional types of innovation (Tavassoli & Karlsson, 2015). For this research and the connection with circular economy the required innovation has certain process, product, organization and marketing innovations. Products has to change or be focused on circular strategies and processes have to change to facilitate this transition. Organizations have to adapt and marketing methods also change from sell orientated to providing services were possible when circular economy would be applied. This combination of many aspects to apply circular economy requires a system innovation in which systems have to change and technical innovations are required (Slaughter, 2010). This requirement for system innovations in the construction industry triggered Winch (2010) to develop a model that describes the main aspects that are relevant for the successful implementation of an innovation in the construction industry. Winch approached this model by combining the knowledge regarding the origin of the innovations and determined what aspects are important for an innovation to thrive in a complex industry like the construction industry (Winch, 2010). The model that is developed by Winch is shown in Figure 20.

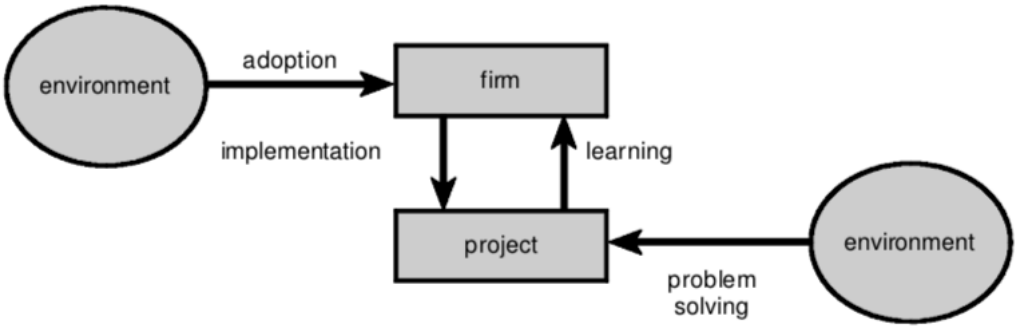

Figure 20: Processes related to innovations in the construction industry (Winch, 2010)

The model describes the process of adoption, implementation, learning and problem solving as the four main processes that have to be managed when an innovation is desired in the construction industry. The process of adoption and problem solving both describe the origin of the required innovation. The concept of problem solving is originated from that a problem is experienced by society and it requires a solution. The process of adoption is centralized by the desire to improve a certain process by applying change. Research and Development can trigger this process but a personal or public desire to improve a process can also form the base for the adoption process. Within these two motivations to innovate the concept of implementation and learning are placed. The description of these two processes depend on the type or origin of the innovation (Winch, 2010).

The process of the implementation of an innovation originated from adoption is focused on the implementation of an innovation from firm to a project. A certain innovation is desired and therefore implemented in the project. However, in this implementation phase, firms work with actors within the project coalition which requires a collaborative attitude to implement an innovation. The last process that has to be managed is the concept of learning. Implementing an innovation requires an outcome that has to be analysed to determine if the innovation that is originated from an adoption is as effective and efficient as desired. This knowledge can be used in future projects to develop the innovation (Winch, 2010).

Another approach to the model is the approach from problem solving in projects to the learning process. This approaches the project as the arena in which problems are experienced and have to be solved. However, before a solution to the problem can be implemented a throughout analysis is required to determine this solution. This is done in the learning phase in which a problem analysis is made to realize an effective and efficient innovation (Winch, 2010).

The model starts with the two perspectives that can trigger an innovation just as Edquist & Zabala-Iturriagagoitia (2012) describes and provides insight in the process that are present in the construction industry. The model does not describe a certain type of innovation as most literature did, but focusses on a more abstract level on the implementation of the innovation for radical innovations as Slaughter (2010) discussed. To prevent the use of two approaches to innovations as the model describes, the definition and model is specified to the transition to a circular economy. The concept of circular economy in the construction industry is currently applied by the Dutch government from an adoption perspective and tries to motivate companies into a transition. If the transition to a circular economy would not be stimulated, the industry will slowly move towards the problem orientated processes because resources are no longer available.

Due to the importance of the model of Winch, the definition of innovation that is used in this master thesis is based on the definition of Winch. The definition of innovation is:

> *Innovation is the development of something that is not developed or applied before and has to be adopted throughout the construction industry. The impact of the innovation on the implementation depends on the magnitude of the desired development and is different for each innovation.*

Definition of innovation (based on literature)

Theory related to transitions and system innovations

The knowledge and definitions of innovation and the decision to focus on adoption of a system innovation requires more insight into the theory related to a transition or change that is related to the adoption of an innovation. Changing and adapting to challenges is one of the boundary conditions of the human race (Creanza, et al., 2017). The will to change can be motivated out of survival instinct, realizing economic prosperity, social pressure, environmental pressure or even somebodies interest to develop can move society in a transition (Safarzyńska, et al., 2012). This transition starts small and has to mobilize the intended individual or group of actors. Within this transition process, four main stages can be identified. These four stages are graphically presented in Figure 21. However, major transitions are complex and requires commitment from the actors that are involved in the transition and the shape of this model depends on the type of innovation or transition (Rotmans, et al., 2001).

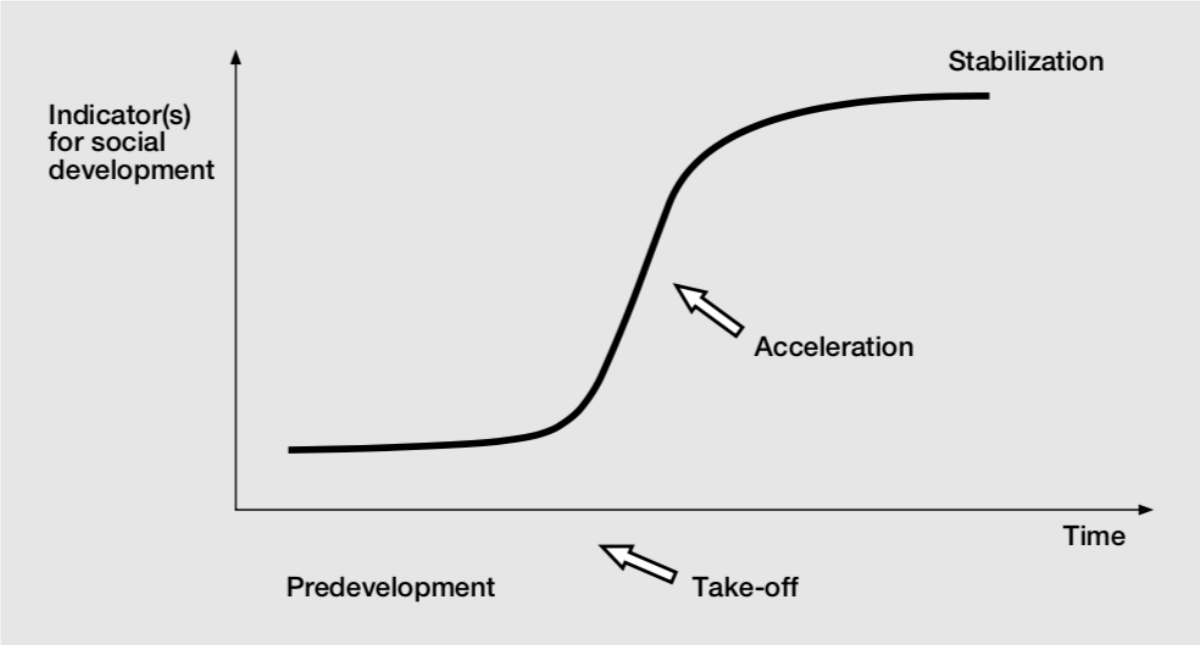

Figure 21: Phases of transition (Rotmans, et al., 2001)

The transition or implementation of an innovation starts with a predevelopment phase in which no real progress is made because it is about theoretical knowledge gaining and small experiments to test the desired development. The next phase is the take-off phase in which the concept gains a small momentum organized by a small group that is willing to make this change or innovation happen. When sufficient momentum is gained, the acceleration phase starts. In this phase, the group that is required to change, starts embracing this development and is motivated to change which realizes an acceleration effect. The last step in a transition is the stabilization phase in which the remaining organizations are changing due to social pressure and the transition ends because the concept is embraced and accepted as the new standard. The axis of the figure describes on the horizontal axis the time that is required to apply or develop the transition and the vertical axis describe the size of the transition cumulatively. The time that is required depends on the complexity of the transition. A small transition will require less time than a major economic and social change. The extent of the transition depends on the amount of people that have to change and the complexity of the change. A major transition requires a long term-vision in which there is room for errors and learning from these errors or possible successes. A new concept has to develop and gain momentum (Rotmans, et al., 2001).

Another model that describes how a transition progresses is the bell-shaped curve of the early adopters. This model describes five groups instead of four but is also based on this general idea of a start which gains momentum during the development which results in more organizations involved in the process. The model starts with a small group of innovators that start with developing the innovation. The innovators group mobilizes a group that is called the early adopters in which a transition is starting to take off. The next step is the early majority and late majority to take the step to the transition and are committed to change. These groups are part of the acceleration phase of the transition curve. The last step is to motivate the last group to put effort in the transition. This group is called the laggards (Rogers, 2002; Rogers, 2010). The bell-shaped curve of Rogers is shown in Figure 22.

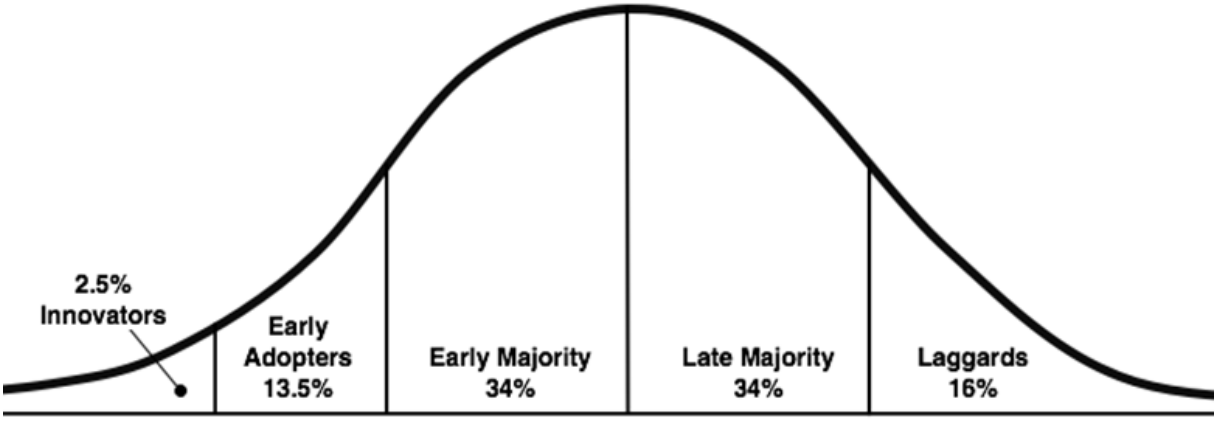

Figure 22: Bell shaped curve (Rogers, 2010)

The transition curve of Rotmans (2001) and the bell shaped early adopters model (Rogers, 2010) are comparable to each other. Both models can be combined because the transition curve is the cumulative of people that are already committed in the transition and the bell-shaped curve describes which group is moving towards the transition. This different mathematical approach results in a different graphical representation but is based on the same theory. Both theories start with a small group that is willing to develop or implement an innovation/transition motivated by on realizing economic prosperity, social pressure, environmental pressure or even somebodies interest to develop can move society in a transition (Safarzyńska, et al., 2012). This group will eventually motivate other actors to move into the transition as well which realizes that the entire industry embraces the innovation. During a certain period, people or companies are convinced of the success of the desired transition and are willing to commit to the cause which realizes a take-off momentum. This group will keep on increasing like the well-known oil spill dispersion effect which realizes an acceleration. At the end of the transition the last group will be forced to change based on social pressure. However, the motivations to change can differ throughout the transition curve and needs different types of motivation. This change of motivation throughout the transition curve demands a flexible attitude from a public organization during all stages of the transition (Steen, et al., 2015). During a complex transition this attitude has to be flexible because the role of the government changes from a facilitator, stimulator, controller to a director role in a transition (Steen, et al., 2015). These steps are required because at the start of the development of a transition the lack of information is present and cannot lead to proper boundary conditions (Steen, et al., 2014).

This lack of information at the start of a development is part of the learning cycle that is required for every major transition. It is not only about technical orientations but social factors also affect the duration and scale of the transition (Meadowcroft, 2009). It is not simply about the development of a product or change processes but it is also about changing society and learning from previous experiments. This complex orientation toward transition management are characterized as a circle with four main steps that take this complex transition management into account. The goal of this cycle is learning and providing a transition arena that is repeated in multiple projects throughout the transition phases (Loorbach, 2010). The learning cycle of Loorbach (2010) is shown in Figure 23.

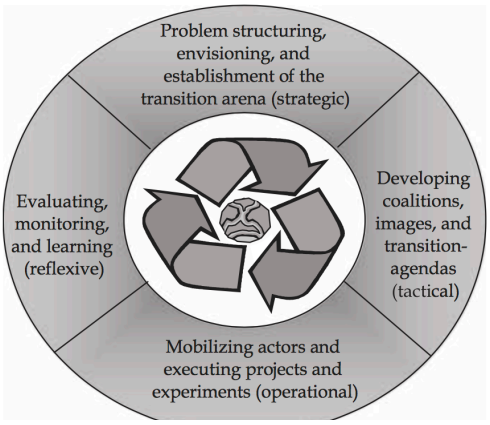

Figure 23: Learning cycle (Loorbach, 2010)

The learning cycle starts with structuring the problem or describing an ambition. Based on this step a transition arena is realized in which organizations or coalitions can operate to develop an innovation or move into transition. This transition arena describes what is desired and what the limits of the transition arena are. The next step is to develop the innovation by developing a solution if the transition is problem orientated or too describe transition agendas if the transition is vision orientated. The next step is testing or applying the innovation. This can be a new product that is realized in construction but this can also be a new process in which partners are cooperate to realize a circular economy. The last step is to evaluate and monitor the innovation to verify if it fulfils the desired innovation or contributes to the desired innovation. After this phase, the knowledge that is gained can be used in future projects to contribute to the transition cycle (Loorbach, 2010).

Applying the learning cycle throughout the transition process is of importance because it allows concepts to be developed. The opportunities that are realized for the development of a transition or innovation are formed by the transition arena. This transition arena describes the boundary conditions of the project in which the partner has room to innovate or change. In the case of the construction industry which is project orientated, the procurement process defines this transition arena that Loorbach (2010) describes (Crespin-Mazet & Portier, 2010). The focus is project orientated but the public organization that applies a procurement process can define a transition arena in which the desired innovation is clear which can results in an attractive project which stimulates a transition to a radical innovation. However, in a project orientated industry, this change will not take place overnight but has to be stimulated over a longer time span.

Factors and challenges of implementing an innovation by applying procurement processes

Realizing the desired transition arena that fits the stage of development of an innovation is done in the procurement process of a construction process (Crespin-Mazet & Portier, 2010). However, the development of an innovation requires organizations to take risks which realizes uncertainties and requires investment of capital (interview 1). This capital has a broad definition and does not only require monetary investment. It requires cooperation and knowledge sharing between actors and determining the required time to develop the innovation is difficult because no clear answer can be provided beforehand (Tödtling, et al., 2009). This focus the research to what factors are important in procurement process when an innovation is stimulated in the construction industry.

This combination of risks, uncertainties, investments and the call for cooperation that Tödtling, et al. (2009) describes focus the research towards the balance between competition and cooperation (Eriksson, 2008A). The call for cooperation in the development of an innovation can clash with the basic principles of procurement. Providing equal opportunities for every interested organization is one of the boundary conditions of procurement. Too much cooperation can prevent equal opportunities because competition is limited when only cooperation is applied. This tension between competition and cooperation is also described in the research of Eriksson (2008A) and is shown in Figure 24.

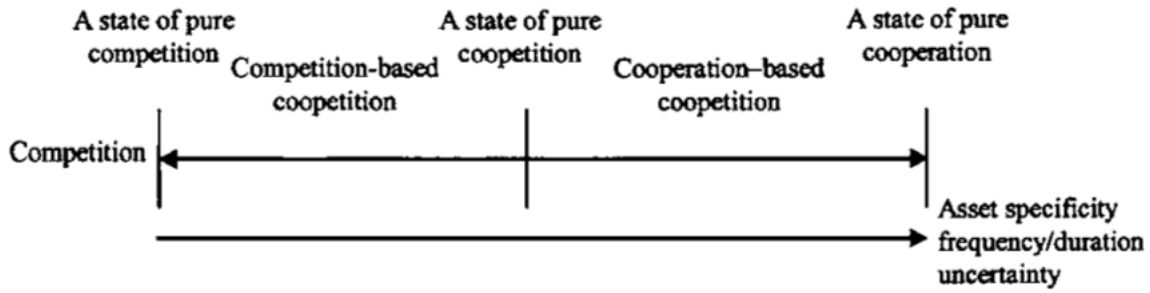

Figure 24: Relationships, Tension between competition and cooperation (Eriksson, 2008A)

The model describes competition, coopetition and cooperation as the three options that are possible as a relationship between client and contractor in the construction industry. Which type of relationship is applied depends on the project (Eriksson, 2008A). However, the chosen type of relationship influences the purchasing process (Johnston & Bonama, 1981). For example, A purchasing process that focus on competition will focus more on building costs but a relationship that is focus on cooperation will focus more on qualitative criteria (Eriksson, 2008B). The consequence that the type of relationship has on the purchasing process in the construction industry is shown in Figure 25.

Buying stage	Issues related to Competition	Issues related to Coopetition	Issues related to Cooperation
Specification	By the supplier (or by the client)	Joint specification with one party responsible	Joint specification with shared responsibilities
Bid invitation	Open bid procedure (multiple bids)	Limited bid invitation (a few bids)	Direct negotiation with one bidder
Bid evaluation	High weight on price	Equal weight on price and soft parameters	High weight on soft parameters
Contract formalization	Formal, comprehensive	Formal, comprehensive coupled with relational norms	Informal, incomplete coupled with relational norms
Compensation	Output based (fixed price)	Fixed price and shared profits	Including incentives (shared profits)
Collaborative tools	Low extent	Medium extent (including cooperative benchmarking, aggressive joint objectives)	High extent
Performance evaluation	By the client	Both by client and by supplier	By the supplier

Figure 25: Consequence of the relationship on the purchasing process (Eriksson, 2008B)

The degree of cooperation that is required to realize an innovation does not only depends on a personal judgement. Asset specificity, frequency/duration and uncertainty also plays a role (Eriksson, 2008A). This integration makes it challenging to determine a certain answer on what type of cooperation is required to realize an innovation. Intensive cooperation, also known as co-creation, should stimulate an innovation because risks can be shared or reduced by reducing uncertainty (O'Malley, 2000) and contracts could possibly be longer or have a higher frequency as Eriksson (2008A) described. The sharing of risks makes the uncertainties less important which realizes that companies are willing to invest if the reward is sufficient (Eriksson, 2008A)(interview 1). However, it is not only about this tension between competition and cooperation. There should also be room to learn and exchange knowledge for innovations to thrive as is described in the transition (Rotmans, et al., 2001) and learning cycle (Loorbach, 2010). This complex system to provide opportunities for innovation requires knowledge and risks to be shared and the common goals are leading instead of personal gains (Snippert, et al., 2015).

However, all these forms of cooperation that results in risks and information sharing do not address the problems regarding rewards and magnitude of the construction project (Brem, et al., 2016), boundary conditions (Brem, et al., 2016), the possibilities to learn (Bygballe & Ingemansson, 2014; Qi, et al., 2010) and realizing the possibilities to perform research and development (Ling, 2003; Xie, et al., 2016). Boundary conditions can be technical demands that prevent an innovation to be implement but it can also be legislation or guidelines that prevents certain materials or processes to be used. This subject is in line with what Eriksson (2008A) described with asset specification. The duration of the contract and the investment costs should be in balance to realize that the market wants to invest in the transition (El-Sayegh, 2008) and the boundary conditions should be open to provide options to innovate (Brem, et al., 2016). However limited boundary conditions can increase risks for the procurer because the procurer can no longer specify their demands and switches to demanding a function (Ridder, 2011).

Uyarra, et al. (2014) tried to analyze how the market experiences all these challenges that are previously discussed and tried to indicate based on a literature review that was verified by questionnaires which of these barriers have the largest influence on the stimulation of an innovation. The factors that were indicated in the papers are shown in Figure 26.

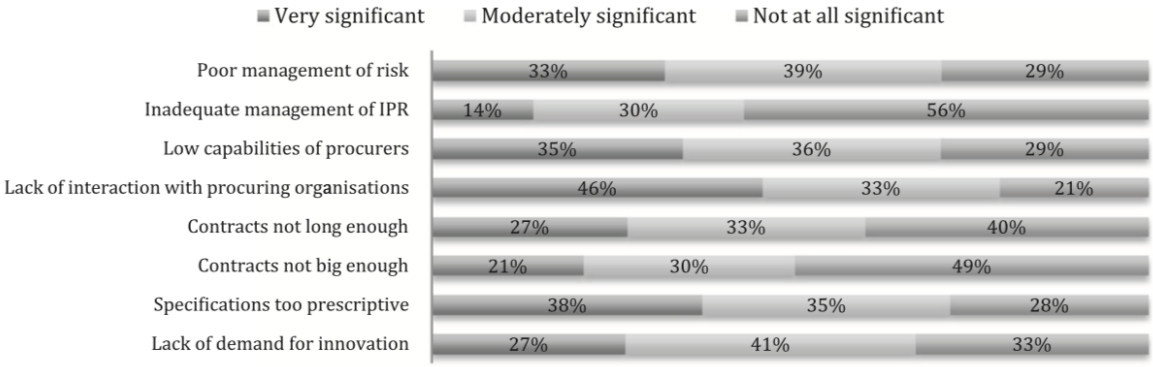

Figure 26: Barriers experienced by construction industry (Uyarra, et al., 2014)

The general conclusion from the paper is that the criteria of poor management of risks, lack of interactions and that specifications are too prescriptive are the three most significant barriers when innovation would be stimulated by applying procurement processes. However, the magnitude, relevance and type of the barriers primarily depend on the desired type of innovation and the related project and this make it difficult to describe which barriers are relevant (Uyarra, et al., 2014)(Interview 1). The procurement process should be custom-made to realize an effective stimulation of an innovation or change (Interview 1). Therefore, the barriers that are important can be different for each project (Uyarra & Flanagan, 2010; Georghiou, et al., 2014). This requirement to design the procurement process to effectively stimulate the innovation reduce the importance of the barriers. The procurement process has to be in balance to effectively stimulate an innovation. This research focus on the macro level of

stimulating a transition to a circular economy and does not focus on a project level which realizes that all barriers are important. Therefore, all the barriers that Uyarra, et al. (2014) describe will be used in this research. However, to still take the outcome of Uyarra into account, the ordering of the factors will be done based on how the market experienced the barrier.

The barrier of lack of interaction with procuring organization is determined as the most significant barrier. This barrier is originated from the relation between buyer and supplier and describe the importance of communication and the involvement of the market to prevent the structural disconnection of supplier, user and buyer. This lack of interaction can be caused by the lack of skills, risk aversion or too rigid application of procurement procedures and practices (Uyarra, et al., 2014)(Interview 1). This definition and desire to interact with procuring organization is a matching description of cooperation as Eriksson (2008A) described in his research in which asset specification plays a role. The type of cooperation should be in balance with the desired innovation or transition and the required knowledge (Eriksson, 2008A)(Interview 1). Based on the description of Uyarra, et al (2014) and Eriksson (2008A) the description of this barrier is changed to cooperation.

The barrier of specification too prescriptive is originated from the broader perspective from tender specification. The nature of the tender specifications determines the outcome and the possibilities for innovation (Uyarra, et al., 2014). This requires to procuring organization to switch from prescriptive specification to functional specifications to provide room for innovations to thrive (Brem, et al., 2016)(Interview 1 and 2).

The barrier that describe the low capabilities of procurer is originated from the switch to an innovative product instead of a regular “off- the-shelf goods”. This switch to innovation requires different technical experience because of the explorative attitude of the procurement process which also requires a procurer to have additional knowledge (Interview 2). The research describes that the professional procurers are focused on the well-known procurement processes instead of processes that are more innovation friendly (Uyarra, et al., 2014) (interview 1).

The management of risks associated with procuring innovation resulted in the barrier of risk management. The subject focus on the broad sense of the description of risk. It focusses on the requirement for transparency and accountability but also on the risks that are involved in R&D processes. This broad focus of risk in the research of Uyarra, et al. (2014) incorporates the research of Ling (2003) and Xie,et al. (2016) in which the importance of research and development in innovation as a risk to incorporate in the procurement processes. Next to a general description the research of Uyarra, et al. (2014) also discussed the subject of rewards that Brem, et al. (2016) discussed. The risks have to be in balance with the rewards. This requires financial incentives, insurances or/and not requiring certain certificates (Brem, et al., 2016)(Interview 1 and 2).

The desire to innovate depends on many factors and is caused by the desire to solve a problem or the desire to work more effective (Edquist & Zabala-Iturriagagoitia, 2012) just as the innovative model as Winch (2010) describes. This need or desire has to be urgent enough to be responsible for the risks or put the efforts to realize a change. However, this desire should be accepted by the whole organization and not only by policy makers (interview 1). Without this commitment, the market won’t be challenged to innovate because the required incentives are not there (Uyarra, et al., 2014).

The barriers of ‘contracts not long enough’ and ‘contract not big enough’ are both originated from the subject of incentives for the supple of innovative solutions (Interview 2). The desire for innovation from the public sector is not sufficient to mobilize private organization in realizing the desired innovation. The incentives have to be sufficient. The magnitude of the contact plays a crucial role in providing incentives. Pooling resources or longer contracts provides more possibilities for the market to respond which increases the incentive attitude of the procurement process (Uyarra, et al., 2014; Brem, et al.,

2016) (Interview 1 and 2). Based on this description these two factors of the research of Uyarra, et al. (2014) will be generalized to the concept of magnitude of the contract in which the scope (project phases) and rewards of the contract is defined.

The last barrier that Uyarra, et al. (2014) indicated is the management of intellectual property rights. The management of Intellectual property is of importance because the related license conditions can provide additional incentives for the market to invest in the tender (Interview 1). However, this barrier is primarily present in organization that focus on R&D in which product development is the ambition (Uyarra, et al., 2014) (interview 1).

These seven factors that are important in the stimulation of an innovation by applying procurement processes take most of the aspects into account that are previously discussed and are in line with the concept of innovation. All these seven factors are important for realizing the required transition arena as Loorbach (2010) described. However, all these factors still don't describe the concept of learning as Winch describes and (Bygballe & Ingemansson, 2014; Qi, et al., 2010). How can this subject of learning be incorporated in a complex project orientated system like the construction industry? The project orientation of the construction industry realizes that learning is conducted in the relationships of the project (Edmondson & Nembhard, 2009). However, within this relationship there are two types of learning. There are possibilities to learn or develop within a project (Druskat & Kayes, 2000) or when the project is finished (Loorbach, 2010). This learning or evaluating at the end of a project is a reward for a client because it determines the effectiveness and efficiency of the desired innovation. However, this evaluating at the end is a type of reward for the partner because it provides insight in how effective and efficient the innovation is and can use this knowledge in future tenders (Interview 1). The options of learning within the relationship depends primarily on the type of cooperation (Eriksson, 2008A).

The factors that are discussed describe how the factors are experienced in the procurement processes and how they are related to the development of an innovation and the related transition. However, the next step is to combine these factors with the pillars procurement processes in which the procurer can stimulate an innovation.

How to tackle these factors and challenges by applying procurement processes

The barriers that are previously discussed are the barriers that are known in the literature and describe on macro level the complexity of realizing the required transition arena that Loorbach (2010) described. The knowledge regarding a transition and innovation provides a framework in which the barriers of innovative procurement plays a role. The barriers that are indicated provides guidance to how the required transition arena can be realized by applying procurement processes to realize the adoption and implementation of an innovation or transition that Winch (2010) described. However, the learning process plays a role in the development of an innovation but does not have a clear place in the construction process. Learning from projects is essentials but does not have a centralized role in the current construction industry (Winch, 2010). The next step is to combine the knowledge related to the three parts of procurement processes that can be used by public organizations to realize a transition and the subjects that are important to address in this procurement process.

Combining the determined barriers in combination with the three parts of procurement processes that can be used to stimulate a transition or innovation is graphically presented in Table 6. This table has on the horizontal axes the three pillars of procurement which can be used to stimulate a transition and on the vertical axis the seven barriers that are indicated in the literature. This table forms the theoretical framework for the subject of stimulating a transition by applying procurement processes. However, to effectively stimulate a major transition, long term vision is required to realize a learning cycle and one innovative orientated procurement processes wont realize a radical innovation (Slaughter, 2010).

Table 6: Framework of factors for stimulating a transition or innovation (own source)

	Boundary conditions	Selection criteria	Award criteria
Cooperation			
Specifications			
Capabilities of procurer			
Risks			
Desire to innovate			
Magnitude of contract			
Management of IPR			

This framework provides a graphical presentation how a procurement processes can be designed based on decisions and factors that have to be specified for the desired innovation. Specifying the procurement process to the desired innovation is crucial to realize an effective procurement process. This limitation makes it complex to answer the research question because a single answer cannot be provided. It depends on the type of desired innovation (Interview 1).

The research question focused on how procurement processes can be used to stimulate an innovation in combination with the legal framework. The legal framework described procurement processes. such as selection and open procedure, that are used in the construction industry and the essentials principles that are relevant when designing a procurement process. This legal outline led to the three pillars of procurement processes that can be used to stimulate a transition. The boundary conditions, selection criteria and award criteria are the pillars which a procuring organization can use to stimulate an innovation or transition.

Within these three pillars, the procurer has to determine how and to what extend it wants to stimulate the desired innovation or change. The seven indicated factors describe which subjects have to be addressed in the design of the procurement process to effectively stimulate a transition or innovation. These factors have to be custom made to stimulate a change. For example, A major project with much risk for the partner will most likely not results in participants in the tender procedure unless the incentive is sufficient. The only limit that the procurer has are the six principles of procuring processes. As long they are accommodated, the procurer has much freedom.

The developed framework can be used to analyze and compare projects in the later stage of the research. Next to this comparison it can also be used to determine if procurement processes are in balance by addressing all the relevant barriers.

3.3. Conclusion

This chapter focused on stimulating an innovation in a broad context in which transitions play a crucial role by applying procurement processes. Embracing the concept of an innovation and applying the innovation is time-consuming and requires an attitude from the procurer that focusses on stimulating the innovation for a longer time span. A system transition is a long-term process in which the learning cycle has to be repeated to realize or improve the desired innovation. This requires a transition arena which is customised to the desired innovation for each construction project. To realize this transition arena in the construction industry the procurement process is used. This procurement process describes the boundaries, scope of a project and also describes the room for innovation in which the partner can act. The boundary conditions, selection criteria and the award criteria are the three pillars that a public organization has, within the procurement process, to stimulate a transition. The legal possibilities of these pillars are endless as long as the procurement process provides every organizations with equal opportunities and is transparent from the start. However, these pillars do not describe how an innovation can be stimulated by applying procurement process, it just describes which and to what extent. The part of the research question that describe exactly how a procurement process should be used to stimulate a transition is difficult to describe because how an innovation has to be stimulated depends on the desired innovation or transition. A small innovation that is project/problem orientated will require a different type of stimulation than a system innovation in which economic and social changes are desired. A system innovation requires an attitude that is focused on realizing an ambition instead of solving a problem. The determined seven factors provide context to which subjects have to be addressed in an effective procurement process that is focused on realizing this ambition. The combination of the three pillars and factors resulted in a model that can be used to design and analyse procurement processes that have the goal to realize a system transition or innovation. These pillars and the factors have to be used to realize a transition arena in which the system transition or innovation can thrive. The relevance of the factors and the impact of these factors for the transition arena depend on the desired system transition or innovation.

3.4. Acknowledgements

The realized framework for the stimulation of innovation describes the process on a macro level based on literature. The abstract level of the framework does not discuss certain options like Best Value procurement(BVP) or procurement processes like innovative partnership to stimulate an innovation because the suitability of these methods depends on the desired innovation. The determined factors that are related to a stimulation of innovation could be inconclusive because of the complexity. The decision to only focus on the Dutch legislation related to the purchase on works can be a weakness in the later stage of the research. Leasing a certain type of a building is not a work but is purchasing a service which could change the theoretical framework. However, the attitude of this research is to look towards the possibilities of the stimulations instead of the legal boundaries when a circular economy would be stimulated. This focus resulted in the decision to focus on the three pillars of procurement process instead of the well-known procedures. These pillars are the same for any type of purchase and therefore this weakness is limited.

Unilever Food innovation center in Wageningen, http://www.bewustebouwers.nl/bouwplaatsen/unilever-fic-te-wageningen/

4. Stimulation of circular economy by using procurement processes

Chapter three discussed the possibilities and challenges for procurement processes to stimulate an innovation or to move society into a transition. This information is used as the foundation how the transition to a circular economy can be stimulated because the TU Delft already concluded that there is sufficient room in procurement process for circular economy from a legal perspective (Castelein, 2018; Haagen, 2018). However, the research did not take the complexity of a system transition to the circular economy into account. The focus of this research, and this chapter, is to fill this gap and describe on a macro level how and procurement processes can be used to realize a transition arena that contributes to the transition to a circular economy.

4.1. Transition stadium

The first step is to determine how much the concept of circular economy is applied in the construction industry. This information is required to provide context and guidance to the availability of information and the required transition arena. The description of the business model of circular economy and the need to regard circular economy as an innovation already indicates that circular economy is in an early stage of development. However, it is difficult to pinpoint exactly where the construction industry is in the transition from a linear to a circular economy. When is someone an innovator or an early adopter or when is a concept in the predevelop phase or in the take-off phase. The municipality of Amsterdam struggled with this discussion in their policy evaluation. They described that their municipality is currently in the stage of innovators and has the desire to move the transition to the early adopters as graphically presented in Figure 27 (Municipality of Amsterdam, 2018).

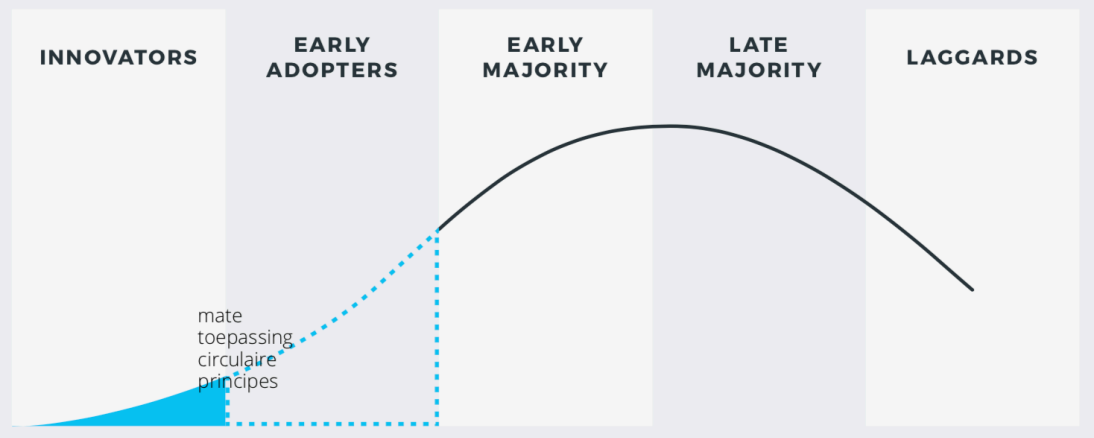

Figure 27: Stage of development of circular economy in the municipality of Amsterdam (Municipality of Amsterdam, 2018)

Next to this descriptive approach to the stage of development, the amount of publications of tenders published on Tenderned can also provide an indication of the stage of development. Tenderned is the platform used by public organization in the Netherlands to publish a purchase that is being procured. The percentage of tenders which has a form of circular economy in their publication provides insight in which stage the transition is. To filter the outcome of this analysis to the construction industry, multiple filters are applied. These filters are:

- The first filter that is relevant is the period in which tenders can participate in this analysis. In 2015 the Dutch Government and the EU started publishing their ambition of circular economy (Dijksma & Kamp, 2016) and therefore the year 2015 is indicated as the starting point and a period of 1 year is used.
- The next filter that is applied describes the type of purchase. The decision is made to only focus on the type works (werken) and not on services and deliveries because the construction industry is currently focused on this type of works.
- The last filter that is relevant is the search term with regard to circular economy. The decision is made to focus on circular economy (circulaire economy) and circularity (circulariteit).

The outcome of this analysis is shown in Figure 28.

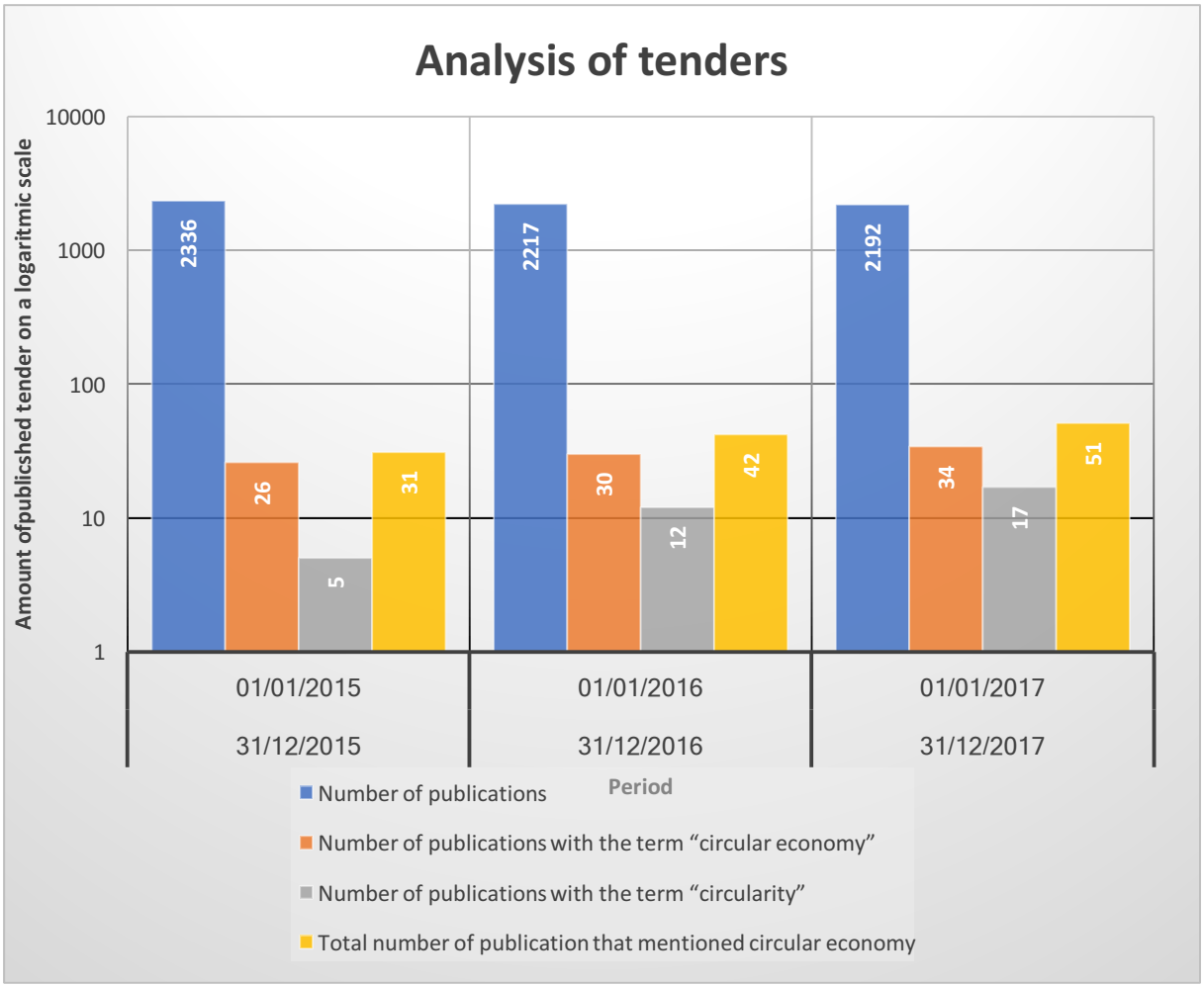

Figure 28: Amount of published tender (own source, based on TenderNed)

The publication with the term circular economy and circularity have not been filtered for uniqueness which could result that in the total number of publications certain publications are counted double. However, due to the limited number of published tenders that have a circular aspect, this will not make a major difference. Figure 28 indicated that only a small number of the published tenders have some kind of circular economy components. In 2015, around 1% had a circular aspect and in 2017 close to 3% of the publisher tenders had a circular aspect. This means that many projects do not have any circular ambition and are not executed based on the principle of circular economy.

In combination with the publication of the municipality of Amsterdam and this numerical analysis of the published tenders, the Dutch construction industry is currently in the transition from the innovators to the early adopters that described into a transition curve of Rogers (2010). This transition stage requires a transition arena which is focused on the predevelopment phase that Rotmans, et al. (2001) described. This early stage of the transition to a circular economy realizes that the procurement process should realize a transition arena which provides room for learning (Loorbach, 2010) and is focused on adopting a concept (Winch, 2010).

Therefore, this could change the knowledge that the interviewee has. Therefore, the interview has to not only focus on attaining information but also has to verify information of this research with the interviewee to realize that the information that is attained also matches with the theoretical framework of this research.

4.2. Realizing the transition arena on macro level by applying procurement processes

The realized transition arena should comply with the goals that are determined beforehand by the procurer. In the case of realizing the transition arena that is required for the transition to a circular economy of the construction industry, the procurer has to be aware of boundary conditions that are project related and the decisions that have to be made in the procurement process in order to realize a transition arena in which there is room for learning. The early stages of development of circular economy makes it challenging to determine or except a single answer from all the interviews how circular economy should be stimulated by applying procurement processes. In total five experts are interviewed from construction companies and are chosen on their experience with the concept of circular economy. In Table 7 is an overview of the interviewed company shown that participated in this phase of the research in combination with their experience with circular economy.

Table 7: Companies that are interviewed during circular orientated procurement (own source)

Number	Company	Background interviewee
3	Dura Vermeer	Project leader at Dura Vermeer for the construction project of Unilever that is focused on sustainability and BREEAM in which circularity plays a crucial role.
4	Dijkencombi	Project manager who participated in a tender team of the Croezelaan in Utrecht in which the tender team had the idea to provide the road as a service to the municipality.
5	Primum/Volker Wessels	Team leader and consultant sustainability who has experience with regard to sustainability in the build environment and advises construction companies how to implement sustainable solutions like circular economy
6	BAM	Sustainability manager who worked on the circle pavilion of the ABN and is well informed on subjects like madaster and focusses on the information management aspect of materials, components and products
7	Roelofs	Head kenniscluster Energie en Milieu who participates in the project of the Parken in Apeldoorn in which rapid circular contracting is applied to stimulate circular economy

The decisions of the interviews

In total five interviews are conducted which all provide information on how procurement processes can be used to stimulate circular economy. However, the interviews did not provide a single consistent outcome on how the procurement process should be designed to stimulate the circular economy. Interview 3 and 4 choose to focus on a design, build, maintenance and possible a finance aspect in the magnitude of the contract and that the projects starts from the schematic design phase. Interview 5,6 and 7 focuses on a different approach due to that they focus on awarding in the initiative phase of a project with a design and build contract that is conducted in a collaborative effort. These two approaches are used as the starting points in which the interviews are analysed.

The schematized design approach

The schematized design approach focuses on a design, building, finance and maintenance contract in which a schematized design is used to assess the bids. The information that is attained during the interviews is shown in a generalized way in Table 8. The transcripts in text provide additional insight in what the expert meant with the comments in the table.

Table 8: Results of interview 3 and 4 (own source, based on table used in interview)

Interview 3	Interview 4
Cooperation from schematic design	Cooperation from schematic design phase in an integrated effort
Design has to comply with program of requirements (POR)	Schematic design has to comply with program of requirements
Award on cooperation and trust	Award on the ideas of participant in the tender
Functional POR	Functional specification
Knowledge is required in order to cooperate	Knowledge is required in order to cooperate
Knowledge is required to assess bids for the soft criteria	Risks can be for partner. However, client has to take a facilitating role
Money time and quality. Provide room in one of these 3 subjects	Award on risk management plan
Award on the ideas on how to manage risks	Desire has to be there in order to cooperate
Ambition to apply circular economy has to be present	Design build and maintenance and possible finance as magnitude of the contract
Award on the ambition of circular economy	Award on the innovative ideas
Integrated contract which contains DBFM	Be open for intellectual property rights
Be open for innovation	

Both the interviews have certain aspects next to the magnitude of the contract in common which are therefore not additionally discussed. These aspects are:

- Cooperation from schematic design;
- Design has to comply with POR;
- Functional POR/functional specification;
- Knowledge is required in order to cooperate;
- Be open for innovation (IPR).

The first difference between the interviews is that interviewee 3 awards the partner on how they score on cooperation, trust, ambition on circular economy while interviewee 4 awards on the ideas of a partner and that the partner is scored on their innovative ideas. Both subjects are probably just as important but can be generalized to scoring on qualitative criteria instead of on merely lowest construction costs. Scoring a tender participant on their ambition can result in scoring a partner on their innovative ideas which can only be done based on qualitative data. However, both the interviewees also mentioned that construction costs can play a role in this procurement process and therefore construction costs should also play a role in this procurement process. Therefore, awarding is generalized towards that awarding the bid should be done based on a mixture of construction costs and qualitative award criteria.

Interviewee 3 mentioned that the procuring organization also needs the required knowledge to assess the bids due to the qualitative description of some of the award criteria. This knowledge is required for procurers because it is not only about comparing buildings costs but also about qualitative ideas or innovative solutions and ambitions.

Interviewee 3 also decided to regard the subject of risks in the classic triangle of time, costs and quality and mentioned that one of these subjects has to provide room to implement circular strategies. Determining deadlines together can result in using materials, components or products from other (construction) locations which can increase the circularity of the project. This could therefore be a viable solution that contributes to the required transition arena. However, the risks should still be managed by the organization who can influence the risks because that the partner is in the lead.

Combining both these methodologies provides a transition arena in which circular economy can be stimulated. The combined procurement process based on both interviews as just discussed is shown in Table 9 and the locations of these factors in the framework that is used, is shown in Table 10.

Table 9: Factors of the procurement process for schematized design approach (own source)

Factors of procurement process for schematized design approach
Cooperation based on schematized design
Design has to comply with POR
Functional specifications
Knowledgeable procurer is required to cooperate
Be open for innovation
Awarding on combination of buildings costs and qualitative criteria
Procurer needs knowledge to assess bids
Provide room on the subject of time
Risks are for the organizations that can influence the risks

Table 10: Location of the factors of the coopetition approach in the framework (own source)

	Boundary conditions	Selection criteria	Award criteria
Cooperation	Cooperation based on schematized design	-	Award on combination of buildings costs and qualitative criteria
Specifications	Functional	-	-
Capabilities of procurer	Knowledge is required to cooperate	-	Needs knowledge to assess bids
Risks	Provide room on the subject of time and risks are for the organizations that can influence the risks	-	-
Desire to innovate	-	-	-
Magnitude of contract	DBFM	-	Award on combination of buildings costs and qualitative criteria
Management of IPR	Be open for innovation		

The combined procurement process of interviewee 3 and 4 is an example of the coopetition approach as Eriksson (2008B) describes in Figure 25. The bid is assessed on a mixture of price (construction costs) and soft parameter cooperation and risk management plan and the schematized design that is made by the participants in the tender is based on the functional specifications that are published by the procurer which realizes that one organization is responsible for the specifications. The contract formalization is formal but comprehensive with relational norms because the risks are shared but are primarily for the partner and the procurer takes a facilitating role in order to assist the partner.

The initiative approach

The initiative approach is an approach that is suggested by three interviews and focusses cooperation that starts in the initiative phase of the project with the aim to find a partner instead of a technical solution. All the decisions that are mentioned during the interviews are shown in Table 11 and are based on what the interviewee filled in on the table that was used during the interview. The transcripts in text provide additional insight in what the expert meant with the comment in the table.

Table 11: Results of interview 5,6 and 7 (own source)

Interview 5	Interview 6	Interview 7
From initiative phase in which equality and transparency is present	Transparency and start in the initiative phase but limit the level of detail	Initiative phase
Award on vision	Award on the vision of the partner	Work together from confidence
Award on plan of action	Functional specifications	Select on a consortium
Find a balance between details (award criteria)	Knowledge of the procurer has to be present to cooperate	Award on vision
Functional specifications	Procurer has to have confidence in the partner	Award on cooperation
Procurer needs to have the knowledge to effectively cooperate, this needs education	Knowledge is required for the procurer to assess the bids	Award on environmental management
Awarding can be subjective and good solutions can be determined as risky (capabilities of procurer)	Share the risks	Functional specifications
Share the risks	Make the people who can influence the risks responsible	Procurer has to be aware of relevance of circular economy
Budget for risks	Desire to implement circular economy has to be present	Procurer has to have the knowledge to assess the bids
Deadlines are determined together	Design and build and possibly finance and maintenance.	Share the risks and have a budget for risks
Desire to implement circular economy has to be present and has to be part of the organization	-	Use the knowledge of the partner in the award criteria of risks
Magnitude of the contract should be design and build and possibly finance and maintenance but lose the separate budgets	-	Desire to implement circular economy have to be present
-	-	Magnitude of the contract should be design and build but remove separate budgets
-	-	Contract could result in IPR
-	-	Award on what the part is going to do to attain this IPR

The three interviews have certain aspects next to the magnitude of the contract in common which are not additionally discussed. These aspects are:

- Cooperation from initiative phase;
- Functional specifications;
- Procurer needs to have the knowledge to assess the bids;
- Procurer needs to have the knowledge in order to cooperate;
- Desire to implement circular economy;
- Risk sharing.

All the interviews mention certain types of qualitative criteria such as award on vision, plan of action or on the cooperation. Therefore, all these suggestions on how a partner should be awarded is generalized to award on qualitative criteria just as in the schematized design approach. However, due to procuring in the initiative phase, this results in that the partner is selected based on only qualitative criteria because construction costs cannot be determined in this stage. Interviewee 5 also mentioned that a balance has to be found in the level of detail that is asked in the bid. Requiring a lot of details will probably increase tender costs which limit the required cooperation in a later stage.

The concept of risk is discussed by all interviewees and they indicate that the risks should be shared, however two of the three interviewees argument that there should be a risk budget for procurer and partner but another interviewee said that the risks should be shared but the organisation that can influence the risk is also responsible for managing the risks. However, in this cooperative attitude in the initiative approach each organization benefits if risks are manged and risks are prevented from occurring. This also incorporates that the knowledge of the partner is used to manage a risk as interviewee 7 indicated. Therefore, this concept is generalized towards that a risk budget should be present for procurer and partner.

Two interviewees mentioned that confidence in the partner is essential in order to cooperate. If the procurer and partner will execute the project in a cooperate effort then this confidence in each other is important to cooperate. If scepticism is present in the process, this will limit the cooperation effort. Within this confidence the transparency of what interviewee 5 mentioned is of importance as well. If the process between procurer and partner is not transparent, it will not contribute to establishing the required confidence between partner and procurer. Therefore, transparency and confidence is essential in the procurement process and during the project execution in this approach.

Interviewee 7 also mentioned that the partner should be a consortium in order to realize that the project team has all the required knowledge. From the perspective of circular economy and the circular business model this could certainly be a proper solution because it focusses on the required cooperation as the business model discussed. However, this approach is also a challenge because how can a procurer know what consortium is required to realize the project while the outcome is not determined? This probably has a connection with the principle of equality that all interviews discussed during the interview but not filled in on the table. The cooperation between partner and procurer should be based on equality which realizes that additional organizations can play a role in the project which leaves the possibilities open for a consortium. Therefore, this discussion is generalized towards equality.

The idea of interviewee 5 that deadlines should be determined together is an interesting idea for the concept of circular economy. This idea was also mentioned as an option in interview 3. In this approach, which is focused on executing the project together, deadlines should be determined together. However, starting in the initiative phase and working together on the project already provides opportunities because deadlines still have to be determined in cooperative effort. Therefore, this is not added in the next step in the table.

The last step in this comparison is how to handle the subject of intellectual property right. Interviewee 7 mentioned as only interviewee that intellectual property rights are of importance for the construction industry. However, the other four interviewees did not mention anything about IPR or mentioned that IPR is not really relevant for the Dutch construction industry. In this approach, the focus is on a cooperate effort to realize as much quality as possible which will provide knowledge for the partner and possibly innovative solution. This knowledge is something which will provide additional solutions for the partner which can be seen as intellectual property right. Therefore, it is not added in the procurement process. Combining all three methodologies provides a transition arena in which circular economy can be stimulated. The combined approach based on all the three interviews as just discussed is shown in Table 12 and the locations of these factors in the framework that is used, is shown in Table 13.

Table 12: Factors of the procurement process for initiative approach (own source)

Factors of procurement process for initiative approach
Cooperation from initiative phase
Functional specifications
Procurer needs to have the knowledge to assess the bids
Procurer needs to have the knowledge in order to cooperate
Desire to implement circular economy has to be present
Risk sharing
Award on qualitative criteria
Have a risk budget for procurer and partner
Have confidence in the partner
Have transparency between partner and procurer
Have equality between partner and procurer

Table 13: Location of the factors of the cooperation approach in the framework (own source)

	Boundary conditions	Selection criteria	Award criteria
Cooperation	Cooperation from initiative phase based on confidence, transparency and equality	-	Qualitative criteria
Specifications	Functional	-	-
Capabilities of procurer	Needs knowledge in order to cooperate	-	Needs knowledge to assess the bids
Risks	Risk budget	-	-
Desire to innovate	Desire to implement circular economy	-	-
Magnitude of contract	DB	-	Qualitative criteria
Management of IPR	-	-	-

This approach is a clear example of the cooperation approach as Eriksson (2008B) described by setting boundary conditions together and focus on qualitative criteria in the award criteria. The focus on finding a partner realizes that the contract formalization will be limited and be based on relational norms because the amount of information at the time of contracting is limited which realizes an open contract. The entire project is executed in a collaborative effort which requires a high extend of collaborative tools to execute the project.

The comparison between both methodologies

The interviews provided two approaches that could realize a transition arena that is required to apply circular economy. In Table 14 are both approaches that are previously discussed combined to provide insight between the approaches.

Table 14: Factors of procurement process for both approaches (own source)

Coopetition approach	Cooperation approach
Cooperation based on schematized design	Cooperation from initiative phase
Design has to comply with POR	Functional specifications
Functional specifications	Procurer needs to have the knowledge to assess the bids
Knowledge is required to cooperate	Procurer needs to have the knowledge in order to cooperate
Be open for innovation	Desire to implement circular economy has to be present
Awarding on combination of buildings costs and qualitative criteria	Risk sharing
Procurer needs knowledge to assess bids	Award on qualitative criteria
Risks are for the organizations that can influence the risks	Have a risk budget for procurer and partner
-	Have confidence in the partner
-	Have transparency between partner and procurer
-	Have equality between partner and procurer

Both methods take a different approach and the factors within the procurement process are different, which realized a different relationship between partner and procurer. However, both solutions also have certain aspects in common. Subjects as cooperation, risks sharing, functional demands, qualitative criteria are present in both approaches. Equality and transparency will be important to realize a common ground for the cooperation as is mentioned in the cooperation approach and risks sharing is part of this cooperative effort. The focus on functional demands is to provide opportunities for circular economy to thrive because there is room to make choices on MCP level which can increase the overall circularity. Realizing these factors in the procurement process can result in a transition arena in which there is room for learning.

The differences between the approaches are primarily caused by the phases that are incorporated in the contract and when the procurement process starts. A procurement process that start in the initiative phase has the limits that no technical demands can be set in the specifications which automatically results in functional specifications. Starting after the initiative approach realizes clear boundary conditions which can be used for a client to specify a certain outcome which also realizes that risks and costs can take a more prominent role in the procurement process because they can be determined on macro level. The incorporation of the finance and maintenance phase in the coopetition approach is probably to realize that the partner takes responsibility for MCP's that are used in the project based on the current type of ownership model while the initiative approach provides options to provide different types of ownership, such as leasing or sell-buy back which also realizes responsibilities for MCP's.

4.3. The impact of the transition arena on the Dutch construction industry

The main goal of this research is to determine how circular economy can be stimulated by applying procurement processes. The previous chapters described two procurement processes that can be used to stimulate circular economy in the Dutch construction industry and also compared the two methodologies. However, what does this really mean for the construction industry and how can this knowledge be incorporated in the current procurement processes of the construction industry? The goal of this section is to make this translation on macro and project level by describing how the circular procurement process influences the construction industry on a macro level and how the coopetition and cooperation approach influences the project. This chapter is primarily an argumentation by the researcher based on the information that is attained during this research by conducting interviews, literature reviews and observations by participating in projects.

Impact on macro level of the construction industry

The transition arena that is described in the previous chapter describe the coopetition and cooperation approach as the two procurement processes that can be applied to stimulate circular economy. Both the approaches focus on an early stage in the construction process in combination with a combined effort to realize a successful project which results in a limited procurement process. This combined effort is the first impact on the construction effort because it removes the segmentation and verification between construction phases but focusses on an integrated team approach. This integrated team approach has influence on how partner and procurer are working together. Contractors have to step away from realizing turn-over to realizing quality and clients are forced to treat contractors as an equal. This type of equality between client and contractor will result in that the focus is on realizing quality instead of quantity which could realize circular strategies because responsibility of the use of materials in combination with cooperation is present.

The collaborative effort approach will require equality to work effectively because equality can only be realized if trust and transparency is present. If trust is not there, the cooperation won't be effective which will result in verification and risks diverting as is currently present in the construction industry. The risks are shared in both approaches which also contributes to establishing confidence and equality between partners.

The last change in the construction process on macro level is the change to life cycle costs instead of construction costs. All the experts discussed this change but could not put specific context to this approach in the procurement process. This focus on life cycle costs requires procurers to step away from separate budgets for realization and maintenance but to focus on life cycle costs just as interviews 5 and 7 mentioned.

Impact on project level of the construction industry

The impact of the procurement process on the projects of the construction industry provide insight in how the factors of both approaches influence the project. The influence on project level of the life cycle of the construction objects of both approaches is shown in Figure 29. This figure is a graphical representation of what the interviewee's said during the interview in combination with the magnitude of the contract. The phases that are used in this figure are based on Figure 9 that is previously discussed. The current construction project process is not added because multiple options are possible and differ for each contract. However, in the current construction projects each phase transition has a procurement or verification phase.

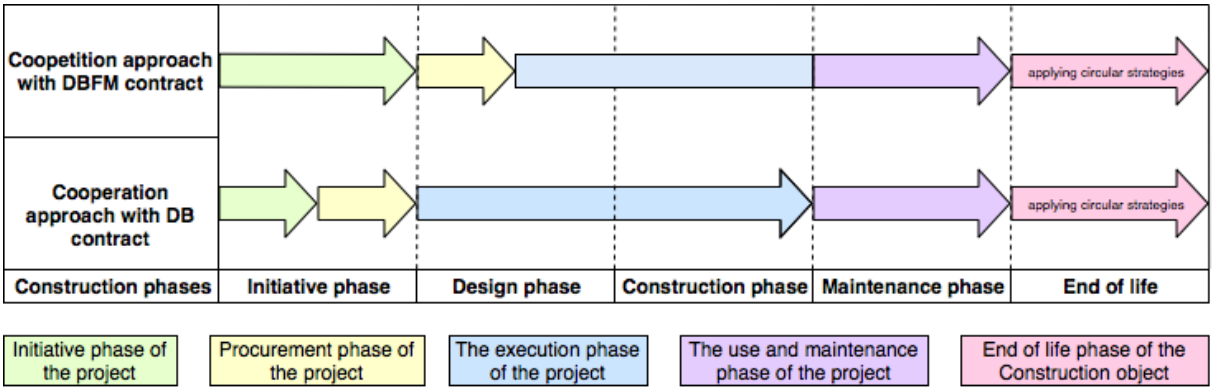

Figure 29: Approaches to stimulate circular economy (own source)

In Figure 29, both approaches use a single procurement process to choose a partner and focuses on at least two construction phases. However, procurement processes determine the future of the project. A rigid procurement process with no room to use the knowledge of the market will results in a linear model in which turnover is the objective. Both approaches focus on an early phase in the construction process to realize that the knowledge of the market can be used and that the procurement process divines the relationship in the design phase. By using functional specifications, material choices are still possible in the design phase of the project. This approach realizes the transition arena as is required to develop the concept of circular economy because there is are still opportunities to make decisions with regard to circular economy.

The use and maintenance phase of the cooperation approach depends on the seize of contract and the information that is provided by the interviewees. Maintenance can be part of the contract which could be a benefit for circular economy.

How and which circular strategies should be applied depends on the design of the construction object but also on the type of ownership that is applied. The type of ownership is a challenge for the construction industry because the construction objects have different life cycles and durations as is incorporated in the circular business model. The focus on design should incorporate a lot of circular solutions during the realization of the construction object and should realize that applying circular strategies at the end of life phase is easier. However, the responsibility depends on the type of ownership. If the partner stays the owner of the materials, components and products it could result in different business models but it is not a guarantee that circular strategies are applied. It is more important to realize a construction object which is conform the circular principles and that materials, components and products are reused on a high-grade way.

The responsibilities in the coopetition approach

In the first phase of the project, the partner has to take no actions because the procurer is preparing the procurement process in combination with the project. In this phase, the procurer needs to realize a first impression and describe functional specifications. The next step is to determine the procurement process and which qualitative criteria are relevant and important for the procurer. This can depend on the location of the construction object but can also depend on the ambitions of the procurer. The last step is to find a weighing scale between the buildings costs and qualitative criteria followed by publishing the tender.

After the publication, the partner that is interested in the project has to make a schematized design based on the functional demands. The partner will have the goal to realize the ambition that are set by the procurer to show why they are the best match in order to win the tender which is the competition aspect in this process. The next step is to assess the bids based on the criteria that are determined in the first phase of the project. Assessing the construction costs will be straight forward but assessing the qualitative criteria can be difficult because what is a good circular solution? In order to assess this objectively, the procurer needs to have sufficient knowledge. The last step in this process is to award the project to a partner.

The next step in this project is that the partner continues to work ('execute') on the project structured by the schematized design that is made by the partner in the procurement phase (previous phase). The aim is to have as many circular strategies in the construction of the object but also to make sure that circular strategies can be applied in the future. The procurer has a role in this by facilitating certain materials or permits in order to realize that innovative circular strategies or materials are applied. This requires a procurer who has the knowledge to cooperate and determine if the materials are applicable. After the design is finished, the partner will realize the construction project and at the end of the construction phase the procurer will use the construction object. During the use phase, the relationship between procurer and partner is still present because the partner is also responsible for the maintenance of the construction object which could realize that the construction object has a high quality. However, the risks are for the partner in this approach because the partner is primarily in the lead.

The responsibilities and actions for the coopetition approach are shown in a summarized way in Table 15.

Table 15: Responsibilities of the project for coopetition approach (own source)

Project phase	Procurer	Partner
The initiative phase of the project	Procurer realizes a first impression and describes functional specifications. A procurement process is described in which a balance between budget and qualitative criteria is determined.	No action for partner in this phase.
The procurement phase of the project	Procurer participates in the procurement process and assess the bids of the partner based on construction costs and the qualitative criteria. To effectively work together and assess the bids, procurer required knowledge.	Partner participates in the tender by realising a schematised design based on the functional specifications he products that are determined by client. The partner has the goal to realise the 'best' design that complies with the functional specifications and qualitative criteria.
The 'execution' phase of the project	The procurer takes a step back and only verifies if the partner realises the construction object conform the specifications. Next to verifying the procurer also takes a cooperative approach in order to facilitate certain circular solutions by providing permits or not demanding a certain certificate. After the construction phase, the procurer will use the construction object.	The partner is responsible for realising the design, construction and maintenance of the object for the duration that is described in the contract. This realises that the partner is in the lead and this also realises that most of the risks are for the partner as well. By designing based on the functional specifications, the partner can seize additional circular strategies which realises value which provides the partner with revenues.

The responsibilities in the cooperation approach

The project starts with an initiative phase in which the procurer describes functional demands for the construction objects in combination with determining the qualitative criteria that are used in the procurement process. The focus of this phase is to describe a project on an abstract level with a maximum budget. The last step in this phase is publishing the tender documents. In this phase, the partner has no activities.

The next step in this approach is the procurement process in which the procurer and partner participates. The focus of this process is to find a partner to execute the project. The partner describes their ambition or vision on the qualitative criteria and the procurer assess the bids. The focus on qualitative criteria requires the procurement organizations to have a lot of knowledge with regard to circular economy or the ambitions that are described to realize that the bids are assessed and the best partner is selected.

The execution phase of the project is based on equality and transparency and has the objective to work together to realize the project and ambitions. The procurement process was the first step in this approach by scoring on qualitative criteria. During the project execution, the procurer and partner work together to realize the project for the budget that is available. This means that the partner is transparent about the buildings costs but also realizes that certain circular opportunities are not seized because there is simply no budget. This type of cooperation realizes that the wishes and demands of the procurer are realized while there is room to develop and learn. The availability of a maximum/shared budget also

realizes that there is the possibility to share the risks. If an unexpected event happens, the partner and procurer are both responsible and it limits the available budget.

The last step in this approach is the use and maintenance phase. All the interviewees focused on a design and construct contract which realizes that maintenance is not part of the relationship and is therefore ended after the construction phase. The procurer is responsible for the use and maintenance of the construction object. The approach did not describe anything about the maintenance phase and is therefore not discussed in this thesis.

The responsibilities and actions for the cooperation approach are shown in a summarized way in Table 16.

Table 16: Responsibilities of the project for cooperation approach (own source)

Project phase	Procurer	Partner
The initiative phase of the project	Initiative phase in which procure has to determine the available budget and which project is conducted. In this phase, the procurer needs to design the procurement strategy and specify the qualitative criteria that are used to assess the bids.	No action for partner in this phase
The procurement phase of the project	Procurer participates in the procurement process and assess the bids of the partner based on the qualitative criteria. To effectively work together and assess the bids, the procurer requires knowledge.	The partner participates in the tender by delivering the products that are determined by procurer. The partner has the goal to show to the procurer why they are the best match.
The 'execution' phase of the project	The procurer works together with the partner to design the required solution guided by the budget that is available. In this phase equality and transparency between partner and procurer has to be present in order to realize the confidence in each other. During the construction phase, the procurer will not construct but only participates in the construction process when partner experiences challenges in which procurer can take a facilitating role.	Partner works together with procurer the design the solution and is guided by the budget based on equality and transparency. The partner is transparent in the construction costs. The partner realises the design that is made in a cooperative effort and provides quality and circular strategies on available materials and realises that the project is circular in the future.
The use and maintenance phase of the project	The procurer uses the construction object and is responsible for maintenance. It is possible that this phase would be procured because procurer does not have the possibilities to maintain the construction object. However, this is not in the scope of this procurement approach.	The partner has no activities in this stage because it is not part of the scope of procurement process or contract.

4.4. Differences between current and circular procurement

The two procurement processes that are determined in this chapter provide insight in how procurement process can be used to realize the desired transition arena on macro level to allow circular economy to thrive based. This circular orientated procurement focusses on qualitative criteria and cooperation in combination with a design and build (DB) or design, build, maintenance and finance (DBFM) contract. However, what is the difference of this circular procurement if it is compared to current procurement processes? The construction industry is already using qualitative criteria in combination with DB(FM) contracts.

The first difference between circular procurement and current procurement processes is related to the model of Winch (2010). The focus on adoption instead of problem solving realizes that there is room for the concept to be developed but the focus on adoption also realizes that boundary conditions are set to stimulate a transition. All actors involved in the process are aware and are also confident that the transition to a circular economy is essential and is therefore willing to invest in the transition. This internal motivation realizes that there is sufficient desire to contribute to the transition.

This internal motivation to change to a circular economy is required to realize that the focus of the selected partner is beyond the contract duration. While a DB(FM) contract is put out to tender, the focus of this procurement process lasts beyond this predetermined duration. The maintenance contract can have a focus of 20 years while certain parts of the entire construction object are there for 100+ years as Brand (1994) described. By embracing the circular strategies of Kirchherr et all (2017). this transition can be realized. As discussed in the circular business model, the strategies of refusing rethinking and reducing are cornerstone in the circular procurement process and project. Short term focus and realizing turn over make room to realize a future proof attitude in which value is generated.

This focus on circular strategies changes the position of manufacturers in the construction process. In the current business model, manufactures have a place in the background while they have a prominent role in the circular economy because they apply circular strategies on materials, components and products. This centralized role of manufactures will require manufactures to be part of the procurement process as interviewee 7 mentioned by selection a consortium. By incorporating the manufacturer in the process instead of only the main contractors realizes that the true potential of the partner can be assed. However, how this true potential is awarded in the procurement process is essential to determine if it will move organizations into a transition because the business case has to be beneficial.

The circular procurement process that the interviewees indicated all move from the left side (competition) to the right side (cooperation) of the Eriksson model which change relationship between buyer and supplier. This focus on cooperation in combination with the focus on adopting the idea instead of solving a problem is a change in the construction industry because it requires organizations to step away from competition by generating turn-over and doing what is asked because the focus is on realizing an ambition and not solving a problem.

The circular procurement process is different from current procurement processes because it focuses on realizing an ambition, instead of finding the solution. The selected partner fits to the circular ambitions of the procurer which make it a ‘circular partner’. The trust and confidence is present between all the organization which realizes that verifications by risks management plans and environmental management plans in the procurement process take a less prominent role while the circular ambitions are the key objective.

4.5. Conclusion

The Dutch construction industry is currently in an early stage of the transition from a linear/recycle economy to a circular economy. This early stage of transition of a system innovation requires a transition arena that is focused on adoption that Winch (2010) described and providing opportunities to learn or develop a concept as Loorbach (2010) described. The focus should be on long term thinking and realize circular strategies instead of short term focus as discussed in the circular business model. To realize this transition arena by applying procurement processes, the schematized design approach in which the magnitude of the contract contains the phases of design, build, maintenance and possible finance can be applied. The design is based on functional demands that are determined by the procurer and after the procurement process, procurer and partner will work together to realize quality. This approach is an example of the coopetition approach that Eriksson (2008B) described. Another solution is to select the partner in the initiative phase of the project based on qualitative criteria with magnitude of the contract that includes the design and construction phases. After the procurement process the boundary conditions of the project will be determined and procurer and partner will work in a combined effort to realize the project and to realize circular economy. This approach is an example of the cooperation approach that Eriksson (2008B). Both the approaches realize a change on macro and project level in the construction industry because both approaches move to the right of the model of Eriksson (2008A) because the approaches focus on a form of cooperation. On a macro level, transparency, equality, risk sharing, equality, cooperation and functional specifications are required between organisations. Transparency and equality can result in the required confidence in each other to allow effective cooperation instead of risks aversion and functional specifications provide opportunities for materials, components and products. On a project level both approaches influence the construction industry in a different way. In the coopetition approach (schematized design approach), in which the partner is selected based on qualitative criteria and building costs, the changes are limited because it is still based on the current phases of the construction industry. However, this approach is still a change because the procurer and partner work together to realize quality and client also provides room for this cooperation by using functional specifications. The other approach is a bigger change for the construction industry because it removes the directedness of the procurer and realizes an equal playing field by setting boundary conditions in a cooperative effort. However, transparency, equality, early procurement, cooperation, functional specifications and risks sharing are all changes that are required in this procurement process and project to effectively stimulate the construction industry to apply circular economy.

4.6. Acknowledgements

The procurement process that is determined provide insight in how circular economy can be stimulated by applying a transition arena and what subjects are important in this transition arena. However, it could be that certain changes are missing due to the limited number of interviews that are conducted. All the interviewees where willing and well known with the concept of circular economy which realizes that they are well aware of the relevance of the implementation of circular economy in the construction industry. This realizes that they are well aware of what is required to implement circular economy which also guides their answers. They are innovators in the Dutch construction industry which can realize that the changes in procurement processes could be different for companies that are unfamiliar with the concept of circular economy. In that stage, commitments and realizing awareness/urgency is probably just as important as realizing the transition arena by using procurement processes.

Temporary courthouse in Amsterdam,
https://www.architectuur.nl/project/tijdelijke-rechtbank-amsterdam/

5. Conclusion

Society is confronted these days by multiple challenges at the same time to ensure a suitable future for generations to come. One of these challenges is changing the way society uses materials. Finite materials are becoming scare which jeopardies the production capacities in every sector. This can be prevented by stepping away from the linear economy and by implementing circular economy. The circular economy focuses on realizing an economy in which materials loses are prevented by focusing on value. By applying circular strategies materials, components and products are reused on a high-grade way. However, changing the economic system of the construction industry is a major change which requires transition management and a facilitating role of public organization. Therefore, the goal of the research was to determine how the transition to a circular economy can be stimulated by applying procurement processes and the main research question was:

> *How can circular economy be stimulated in the Dutch construction industry by using procurement processes while taking current legislation and the change in business model into account?*

Main research question

The concept of circular economy focusses on applying circular strategies with the goal to reuse materials, components and products (MCP's) on a high-grade way in combination with different types of ownerships. The traditional buy/sell relationship is replaced for buy and resell guarantees that focus on long term relationships instead of short term relationships. Lease and providing a service are types of ownership models that are options in the circular economy to ensure that organizations take responsibility for MCP's. The change in ownership has the goal to realize that manufacturers feel responsible for the materials, components and products that they use and do not focus on turn over but on value preservation by applying circular strategies. However, the life cycle of the construction objects also forms a risk for these long-term relationships because certain layers of the construction industry have life cycles over 100 years. What the value is of a product in 100 years is difficult to determine because countless factors play a role in this determination. This major transition is required to ensure that materials no longer leave the economic system. The focus on value preservation by manufacturers change the construction process because they take a more leading role in the construction process. This additional room for manufactures change the role of contractors as well. Instead of a leading organization, the manufacturers are leading and contractors provide a more coordinative role. Designers are also challenged in this change because it is not anymore about the most prestige construction object but by using materials that are available. All these changes require manufacturers, designers and contractors to work together to apply circular strategies which removes the segmentation in the process and the construction industry.

All these changes in attitude and in the economic system requires room for learning in which society can develop and apply the concept. Each transition or innovation starts with a small group of people that recognizes opportunities in applying a concept or experience a problem that has to be solved. This small group of people will grow when society is aware of the importance or experiences the benefits and dares to contribute to the transition. However, the nature of the construction industry, which is project orientated, realizes that each project is a learning room on its own. The boundary conditions of a project determine how an innovation can be applied or developed within the project. These boundary conditions are formed or communicated in the procurement process. This procurement process should realize a transition arena in which the desired transition or innovation has sufficient room to be developed or applied. Within the procurement process there are three pillars that procurers can use to form this transition arena. The boundary condition which describe what has to be done, the selection criteria that describe how a partner is chosen and the award criteria which describe how a bid is assed. Adjusting these three pillars can realize the desired transition arena to stimulate a transition.

However, based on literature, seven factors are determined as relevant in forming this transition arena. These are:

- Cooperation;
- Specifications;
- Capabilities of procurer;
- Risks;
- Desire to innovate;
- Magnitude of the contract;
- Management of IPR.

How these subjects should be formed by using the pillars of procurement processes depends on the desired transition or innovation. A small product innovation will require different options as a small process innovation or a major economic transition. Finding a balance by using the pillars of procurement process for the industry is crucial in realizing the desired transition arena.

Translating this knowledge of innovative orientated procurement and the business model of circular economy is done by applying semi structured interviews. The development of circular economy is in an early stage of development and is orientated from a will to change. This realizes that an adoption perspective is applied in the transition to a circular economy which realizes that the solution is not problem orientated which makes the change not only technical but also social. For stimulating circular economy by using procurement process, two solutions are provided. The first way to stimulate a transition to a circular economy is focused on a design and build contract and that the project is procured in the initiative phase. This results in a procurement process that is based on functional specifications and award criteria that can only focus on qualitative criteria because construction costs cannot be determined because there is no solution. The second option focusses on an design, building, finance and maintenance contract and the cooperation starts after the first design phase. However, this option should also focus on functional demands to provide room for material chooses. In this variant, building costs could play a role but the focus should be on qualitative criteria to ensure that circular ideas are rewarded instead of discarded due to advantage in building costs. Within both variants, it is important to focus on the long term in which the life cycle costs are leading instead of the costs to build something.

The circular economy in the Dutch construction industry can be stimulated by stepping away from the competition approach based on problem solving. The coopetition and cooperation approach that focus on realizing an ambition has to be applied in procurement processes to realize the desired transition arena in which circular economy can be developed. The transition arena should focus on the development of the concept of circular economy because in the current stage of development it is unknown what circular economy is. The transition arena should therefore focus on cooperation and on early procurement because it reduces the directive powers of the procurer and realizes equality and transparency in the executing of the project between all actors. However, this requires a different attitude from the construction industry. It is about realizing ambition and value beyond the contract duration by focusing on cooperation. This requires to step away from the segmentation in the construction process and in the construction industry. Designing together and having input should realize that the concept of circular economy thrives in the Dutch construction industry as long as all actors take responsibilities for the transition arena instead of risks aversion to realize a sustainable environment for future generations.

5.1. Generalizability of the research

The research provides an answer on macro and project level to how procurement processes can be used to stimulate circular economy in the Dutch construction industry. The coopetition and cooperation approach both describe a type of procurement process that should be applied in order to stimulate the Dutch construction industry. This answer is probably difficult to use in other countries that do not have similar procurement processes or construction industry as the Netherlands. However, the transition arena on a macro level of the construction industry describe certain changes that are relevant in order to realize the transition arena for circular economy which are not bound by the procurement process. The concept of cooperation based on equality and transparency and determining a solution in a combined effort is applicable in every construction industry. How this transition arena should be realized can be different in each country but the transition arena should be focused on a combined effort stimulated by circular procurement.

5.2. Validation of the research

This first two research questions are validated by applying interviews and observation. However, the third research question is based on interviews that are structured based on literature which realizes that this chapter is not validated. The researcher attempted to validate this chapter by organization an expert session on the 24th of May in Circl Amsterdam. However, experts of circular economy and procurement canceled which resulted in that expert session was canceled. Planning an additional expert meeting in the limited amount of time that is available was not possible and therefore this chapter is not validated.

5.3. Limits of the research

The biggest limit of this research is the factor of time because this results in that certain decisions are made. A limited number of interviews are conducted which could have the result that certain changess are missing or that a third approach is not determined as a viable solution to stimulate circular economy. However, by interviewing different experts from different construction companies and having incorporated literature that discusses the relationships limits this limitation of the research because the industry has to step away from the competition model.

5.4. Future research

Within this research some assumptions are made and it opens doors for future research as well. This research should fill the gap on a macro level how circular economy can be stimulated by applying procurement processes and provides an insight on project level. However, the following subjects for future research are also indicated in this research:

- Translating this research, the first subject for future research is to apply the recommendations in projects and evaluate these projects to determine if the coopetition and cooperation approach are suitable to stimulate the transition.
- Management of materials, reusing materials, components or products is a prime objective in the circular economy. The MCP's have to be managed to ensure that all circular possibilities are seized. Within this model, it is relevant to know when MCP's are available or when they reach the end of their life circle. Application like Building information modelling (BIM) or the "materialenpaspoort" can be a solution but how this should be formed or organized is a subject for future research.
- Supply chain management, the involvement of the manufacturer in the construction process and removing the segmentation between the construction phases change the relationship in the supply chain as well. How this supply chain should be formed from a strategic and economic perspective is a subject for future research as well.
- Long life cycle objects, the model of Brand provides a layer system for the life cycle of the construction objects. For the layers that have a minimized life cycle, different ownership models

are already determined (for example Gispen and their lease furniture). However, how should a structure be leased or how should the value of the materials be determined or measured is a subject for future research as well.

- The last subject is focused on the organization aspect of the transition. The decision to procure a partner in an early stage of the construction process changes the way public organization procure their projects significantly. The focus will change from costs and budgets to life cycle cost analysis and seizing opportunities that are not always the cheapest in order to realize value. This change is not only a process change but also a social change. How this should be organised within procuring organization is a subject for future research as well.

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7. Appendix

Appendix I: Semi structured interview for innovative orientated procurement

Transcript interview

Stimulating an innovation by applying procurement processes

Interviewee:	Floris den Boer
Company:	Pianoo
Function:	Senior advisor
Date:	14 February 2018
Location:	Prinses Beatrixlaan 2, The Hague

Introduction

This questionnaire is part of the Master Thesis with the subject: "Circular economy stimulated by applying procurement process in the Dutch construction industry". Before this goal can be reached, it is relevant to determine how innovation can be stimulated by applying procurement processes in the construction industry. This subject is added to broaden the research base because limited research is conducted with the subject how circular economy can be stimulated by applying procurement processes. This questionnaire is based on a literature review and has the goal to verify or contradict the attained information regarding the stimulation of an innovation by applying procurement processes. The attained information that describes how innovations can be stimulated by applying procurement processes will form the theoretical framework to determine how circular economy can be stimulated by applying procurement processes.

This questionnaire is divided into three parts. The first part will describe a general idea on what a transition is and what factors are relevant in applying this change. The next step is to discuss what innovation is and if it can be stimulated by applying procurement processes. Finally, the barriers and challenges specific to procurement processes are discussed and viable options to overcome these barriers and challenges are discussed.

Part 1: Stimulating a transition

What do you experience as reasons to apply a change/transition in the construction industry?

Innovation are primarily solutions that realize that public organisations are capable of executing their responsibilities more efficient and effective. Innovation is not a goal on its own but a method for these public organisations to act more efficient and effective. This can result in beter roads of providing beter healthcare. Society is changing as well which requires public organisations to change as well which requires innovation. This can require technical innovations but also require social innovations.

What aspects are relevant when a change/transition would be stimulated?

The wish to improve improvement because they can be improved. An example of this is that the current roads are fine. However, shall we make them a bit more circular? To achieve this goal, risks have to be taken and that the current road has to be altered. The sentence of "don't fix it when it aint broken" is repeated multiple times.

Part 2: Stimulation of an innovation

What do you regard as an innovation in the construction industry?

First of all, innovation is not a goal but it is a method to achieve a goal. The type of innovations in the construction sector is diverse. It can be divided in material, component products and system innovation. Of these innovations, the system innovation is the most complex because this is about integral problem.

To stimulate this innovation, what are the important factor taken into account, while designing procurement strategies?

The challenge in stimulating an innovation is not in the process that are already dividing but in realizing the public organisation are capable on managing the transition. Who is responsible for which risk and how to compensate the partner for the costs. These subjects are bigger to determine then which procurement process should be applied because that is based on the decisions. The procurement process is the results of the decisions that are previously made.

Innovating requires time from public organization and for companies as well which realizes risks. How these risks should be divided between public organization and companies or between public organizations does not have a single answer because multiple options are possible which realizes that it is a difficult challenge. It is about who is willing to take the risks and also take responsibility for these risks when it goes wrong.

Who is leading within the public organization is also very important. There is a gap between policy makers and public servant who execute the work. Should the executing side get the resource and room to develop the innovation or should policy maker make progress by providing resources and development opportunities. The executing branch has connection with the market but the policy makers know the (political) reasoning behind a certain decision. These two sides should meet to realize that innovative orientated procurement can thrive. This requires the executing branch to be aware of political ambitions and policy makers should be aware what is happing in the market. Bridging the gap would be a proper start in this process.

A mistake that is made is to let innovative orientated procurement be conducted by a research and development department. In the end, the people that work in the project should be willing to realize an innovative solution to solve their problem or ambition. If this is not present the innovation will be executed in a pilot but will never be implemented in regular processes. A successful approach is to provide these people with a centralized role in the process and let an R&D department be supportive to these people.

Intellectual property right is a challenge for public organisation because they are used of acquiring IPR. However, this can make it less interesting for companies to participate or invest in the innovation. It is understandable from a governmental point of view because it prevents them from entering a vendor lock in which can realize extra costs. Providing companies with IPR under certain conditions can prevent this vendor lock in but can also provide companies with sufficient incentives to invest.

In the case of radical innovation, companies also want to sell their inventory before contributing to the transition. The transition should be slow in order to provide companies with opportunities to sell their inventory and to invest.

Next to all these factors it is important to just do and contribute to the transition. From the abstract problem to a solid action is not done.

Part 3: Stimulating an innovation by applying procurement processes

What procurement processes would you use to stimulate innovation?

The challenge of stimulating an innovation is not in the procurement process that are defined but to realize that a public organisation can operate in the transition by designing the procurement process by using the elements within these processes.

How would you apply these stimulations of innovation in procurement processes?

First determine as a procuring organization what your needs and problem are that needs to be solved in the project that is intended. Based on this project the desired innovation can be determined and what risks you are willing to take. The next step is to realize that the reward for companies is sufficient enough for them to participate to ensure that the procurement process is a success. In this step, it is of most importance to learn and gain experience.

The next major aspect is to specifying wishes and demands together with the procurement process instead of specifying the entire project followed by a dialogue with possible suppliers. In this dialogue, there is no room left for innovative solutions because the scope is already set by the administrative processes.

The last step is to be aware of the complexity of the specification process for governmental organisations is. Demands originate from somewhere. They are described in legislation or design tools. To allow innovations to thrive room has to be found within this legislation or design tools to effectively stimulate the innovation.

What would be the scope of this procurement process to successfully apply an innovation?

The abstract problem or goal should first be translated to actions by making the stimulating of the innovation manageable. To realize a manageable environment experience is required.
A radical innovation for a material, component or product realizes (to) much risks if an integrated contract would be applied on a system level for a manufacture. This can result that the manufacturer does not apply an innovative solution. Finding a balance is important by sharing risks. To share this risk sufficient market knowledge is required.

What factors do you experience as important when stimulating innovation by applying procurement processes?

Sufficient room in legislation and design guidelines is required to develop an innovation. This can be room provided by politics in which there is room for failure. This can be realized by providing sufficient financial resources and time to work on the transition. It is of importance that not only low hanging fruit is reached but that there is a focus on the future in which improvements are realizes as long as the risks are in balance with the rewards.

General comments

In the transition to a circular economy it is important to make the transition specific and use this definition to realize a project planning in which it is described which steps have to be taken.

Transcript interview

Stimulating an innovation by applying procurement processes

Interviewee:	Jasper Flapper & Luuk Spijker
Company:	Antea Group Nederland
Function:	Circulair & Best Value tender en aanbestedingsbegeleiding, Adviseur contracten
Date:	16 February 2018
Location:	Zutphenseweg 31D, Deventer

Introduction

This questionnaire is part of the Master Thesis with the subject: "Circular economy stimulated by applying procurement process in the Dutch construction industry". Before this goal can be reached, it is relevant to determine how innovation can be stimulated by applying procurement processes in the construction industry. This subject is added to broaden the research base because limited research is conducted with the subject how circular economy can be stimulated by applying procurement processes. This questionnaire is based on a literature review and has the goal to verify or contradict the attained information regarding the stimulation of an innovation by applying procurement processes. The attained information that describes how innovations can be stimulated by applying procurement processes will form the theoretical framework to determine how circular economy can be stimulated by applying procurement processes.

This questionnaire is divided into three parts. The first part will describe a general idea on what a transition is and what factors are relevant in applying this change. The next step is to discuss what innovation is and if it can be stimulated by applying procurement processes. Finally, the barriers and challenges specific to procurement processes are discussed and viable options to overcome these barriers and challenges are discussed.

Part 1: Stimulating a transition

What do you experience as reasons to apply a change/transition in the construction industry?

The primary reason to move into a transition has a commercial origin. The transition to circular economy or developing an innovation will only occur when the business case is positive. The financial incentives have to be sufficient to stimulate the development of an innovation or a transition to a circular economy.

What aspects are relevant when a change/transition would be stimulated?

The most important aspect when a transition should be stimulated or the development of an innovation is that the business case is positive. In this transition or develop it is possible that additional transaction costs have to be made. The government has a key role in reducing or compensating these transaction costs to realize a positive business case. Next to this aspect it is important that the desired innovation or transition is long lasting to ensure that the investment of the private party is not a one-time investment but an investment in the future. The investment will only be worth it if the innovation or transition is procured multiple times. Participating in a green deal is a proper instrument because it realizes that a public organisation has a broad message to private organizations that they are committed to this transition. The last aspects are the so-called pull and push factors. Something is an innovation desired due to a problem but something an innovation is originated from the desire to change.

Part 2: Stimulation of an innovation

What do you regard as an innovation in the construction industry?

In the construction industry, it is easy to focus on physical innovations but an innovation is a new product or process.

To stimulate this innovation, what are the important factor taken into account, while designing procurement strategies?

For decades, the RAW contracts that are put out to tender had the result that there was no real innovation in the construction industry. The integrated contacts were introduced to make room for contractor to introduce or develop innovations in the construction industry. However, in the last decades the innovation capabilities of these contractors have been killed due to the RAW contracts. Therefore, providing room for innovations does not necessarily mean that innovations are realized because the contractor is not jet in this modus. This switch of modus is of importance to realize an innovation or contribute to the transition to a circular economy. However, it is not only the contractor that is in this modus. The public organisations are just as well in this modus.

The conditions to stimulate an innovation has to be custom made. In the case of a transition to a circular economy the taxes on labour should be low and the taxes on materials should be high. This results in a stimulation to use labour to allow materials to be upcycled and to be refed into the economy system. If companies experience the advantages of this system it will help and stimulate the transition. In this transition, the technical aspects are not the most important aspect to change.

Applying new products in the construction sector is a challenge because applying new products introduces risks for clients. Introducing standard is a results of risks averse behaviour. Insurance is central in this approach of introducing standards. However, what worked yesterday does not work today anymore. The boundary conditions have to change.

Applying EMVI in the procurement process could to innovation. However, is does not necessarily have to results in an innovation. The commission that is responsible for grading the ideas are afraid for risks as well. Something new does therefore not have to lead to a higher score. However, trying the innovation is of importance and the risks have to be taken. These risks should be for clients and not for contractor.

Next to all these barriers, the knowledge of the purchasing party has to be sufficient and the purchasing party has to be aware of what their knowledge is. The purchasing public servant is responsible for the project and the budget related to the project and not for circularity or innovation of the project. The budgets for public organisations have to be merged as well so the budget for using and maintenance can also be used in the construction phase to realize innovative solutions.

Part 3: Stimulating an innovation by applying procurement processes

What procurement processes would you use to stimulate innovation?

This answer depends on the goal that is set beforehand and the next question would be if the organisation has worked with UAV-GC. Based on these answers a reference design would be made to determine a starting point and the market will be asked to improve the design. This approach realizes that a clear question is presented and tendered to the market.

How would you apply these stimulations of innovation in procurement processes?

The most important aspect is that the goal should be in balance with the reward. Starting with a functional design could result in higher tender costs for organizations and should be compensated in some way. Applying integrated contracts should provide room to stimulate an innovation and should also be sufficient to stimulate a change if the procurement process is in balance.

What would be the scope of this procurement process to successfully apply an innovation?
The scope should start with a functional specification because it contributes to a successful procurement process that is aimed at innovation. Integrated contracts play an important role in this process. However, the focus should be primarily on design and construct.

Try not to make the procurement process to force a certain innovation but let the private parties suggest innovations to use their expertise. The scope of the experiment depends on the risks. However, the magnitude of this risks depends on the project.

What factors do you experience as important when stimulating innovation by applying procurement processes?
Finding the balance between functional demands to provide room for the contractor and describing certain demands is complex. Functional specification is certainly part of this stimulation but only using function demands make it difficult to compare bids because there is no starting point. To determine if the desired goal is realistic a competitive dialogue can be used.

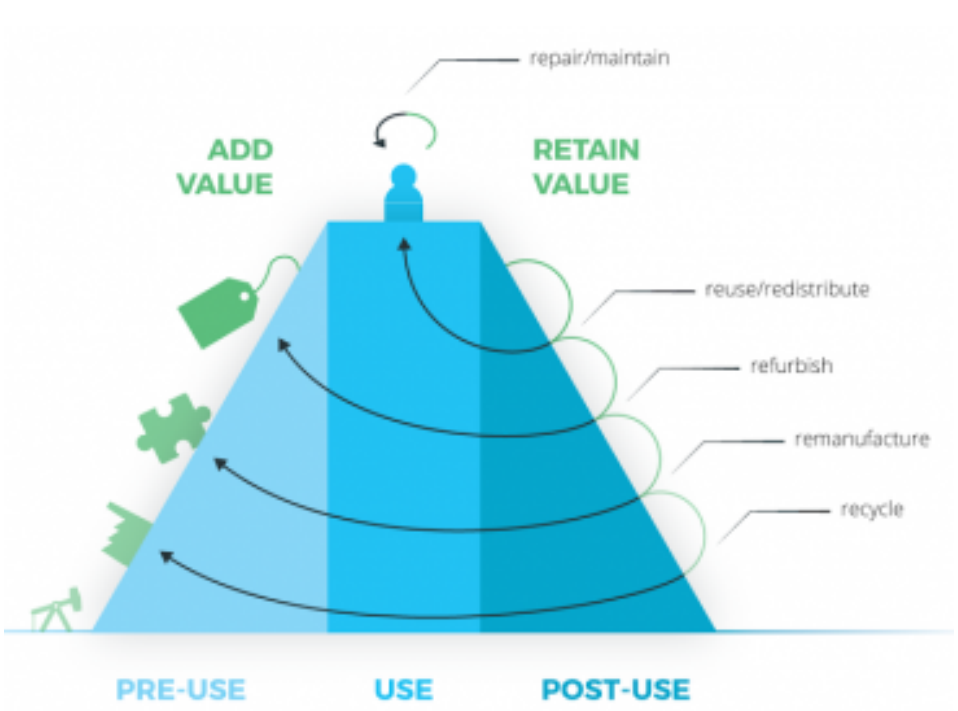
All the subjects that are previously discussed as relevant in the transition to a circular economy. It helps if a client has its possessions determined to allow circular strategies to be applied. Circular economy is about reusing materials and to realize this a client has to be aware were they have materials. If a client realizes this beforehand it can realize additional options for private parties to realize additional circular strategies without increasing the tender costs.

The type of cooperation between client and contractor depends on the project and the knowledge that is available. Cooperation is not a goal, cooperation is important because there is a lack of knowledge at one of the parties that are involved in the project.

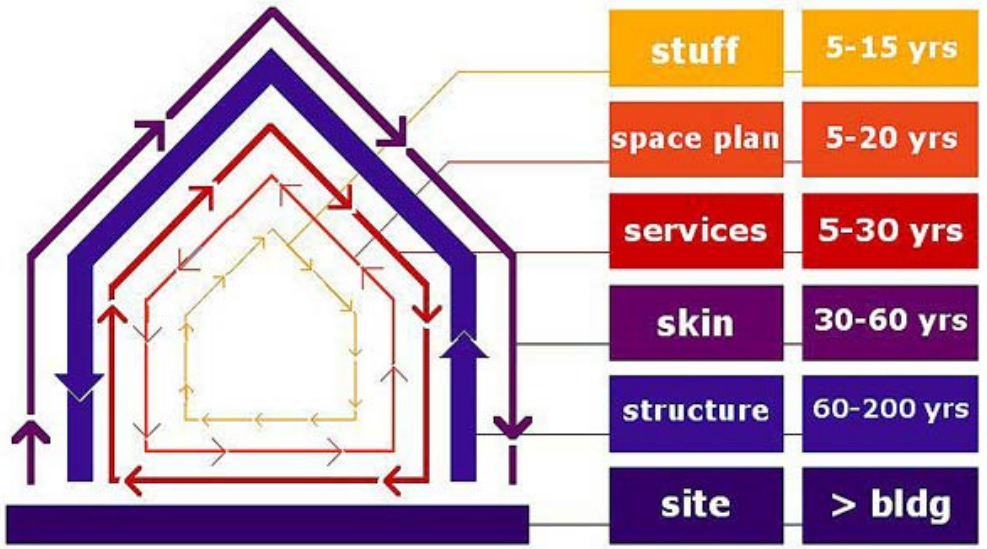
Appendix II: Semi structured interviews for circular economy orientated procurement

Circular economy business models

Circular strategies, from recycle to refuse



Layers of a building based on life cycles on which circular strategies can be applied



Ownership and responsibilities

Buy and sell opportuni ty

Buy and resell

Leasing

Providing a service

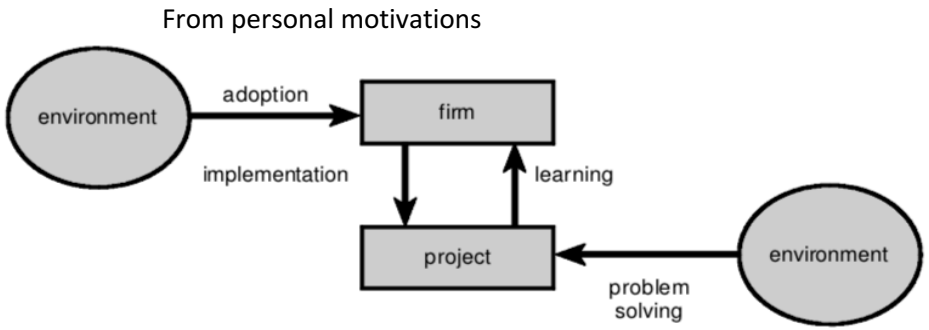
Changing the type of ownership can results that the construction industry takes responsibility for using materials, components and products.

Chain approach and cooperation

Made by: Jesper Pots
Date: 6 April 2018
University of Twente & KplusV

Innovative orientated procurement

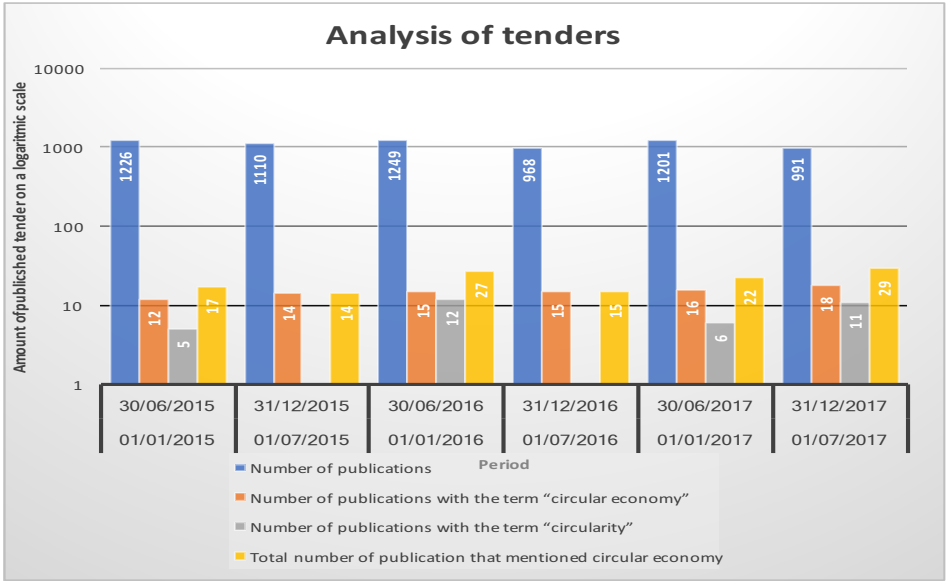
The required transition arena for circular economy



Stimulating an innovation can have two separate origins. It can be caused by a problem that needs to be solved or it can be caused by an personal ambition to improve

The transition to a circular economy is nog being stimulated from the will to improve. If nothing is done it will become problem orientated

Status of the transition to circular economy



Few tenders have a circular aspects which means that the construction industry is in a early stage of development which limits the amount of knowledge

How do the chooses that are made in the transition to a circular economy affect the procurement process

	Boundary conditions	Selection criteria	Award criteria
Cooperation			
Specifications			
Capabilities of procurer			
Risks			
Desire to innovate			
Magnitude of contract			
Management of IPR			

The procurement process defines the transition arena that is required in the transition to a circular economy

Made by: Jesper Pots
Date: 6 April 2018
University of Twente & KplusV

Standard version	Boundary conditions (POR/PVE)	Selection criteria	Award criteria
Cooperation			
Specification			
Capabilities of the procurer			
Risks			
Desire to implement circular economy			
Magnitude of the contract			
Management of IPR			

Dura Vermeer Patrick Kip	Boundary conditions (POR/PVE)	Selection criteria	Award criteria
Cooperation	Cooperation from schematic design	Design has to comply with POR	Award on cooperation and trust
Specification	Functional POR	-	-
Capabilities of the procurer	Knowledge is required in order to cooperate		Knowledge is required to asses bids for the soft criteria
Risks	Money, time and quality. Provide room in one of these 3 subjects		Award on the ideas on how to management risks
Desire to implement circular economy	Ambition has to be present		Award on the ambition of circular economy
Magnitude of the contract	Integrated contract which contains DBFM	-	-
Management of IPR	Be open for innovation	-	-

Transcript interview

Stimulating the transition to a circular economy by using procurement processes

Interviewee	Patrick Kip
Organization	Dura Vermeer
Function	Project leader
Date	10 April 2018
Location	Construction site Unilever, Wageningen

Objective of the interview

The objective of this interview is to determine which chooses are relevant and how the procurement process should be designed to ensure that the market responses and moves to a transition to a circular economy. These answers as based on the business model for circular economy and on the conclusions of innovative orientated procurement. The handouts are used to ensure that the interviewee has the desired knowledge of research question (subject)1 and 2

Subject 1, Knowledge with regard to circular economy

What is your experience with circular economy in the construction industry?

The experience with circular economy is currently focused on products that have a limited life cycle. Realizing the concept of sustainability is currently focused on the concept of Breeam in combination with the concept of circular economy. It is important to think about the whole concept and that the client has the inventory clear. This is relevant because reuse is possible in every layer of the construction industry.

What are actions that directly contribute to transition to a circular economy?

Providing room and freedom in combination with client that are willing to take a step by not demanding a certain certificate because these are not always possible when materials are reused. This problem is primary relevant for objects that focus on a long-life cycle. This is slowly changing but a lot of steps still have to be taken. A lot of technical solutions are already possible. However, it is important that the client dares to apply circular strategies. A lot of major steps can be taken by making clever material choices. However, 100% circular is hard because certain materials (glass requires 70%) always require new recourses. However, this Is always limited.

What is now required to realize a circular construction industry in 2050?

Daring and realizing new boundary conditions. If nobody wants to discuss the rules then nothing will change (3A). A client has a powerful role in this change. Next to this, the height of a building also has a crucial role in this change because if the buildings gains height the strength of the building will play a more crucial role.

Handout 1, business model circular economy

Points to discuss:

- Circular strategies
- Layering based on life cycles
- Change of ownership.

Subject 2, What does this knowledge change

With this knowledge, what are actions that directly contribute to a transition to a circular economy?

The transition to a circular economy is primarily about materials choices and it will stay that way. However, it is difficult if a client does not want a certain material choice. It would be interesting to provide a building as a lease option to a client and that the contractor can provide sustainable solutions. The contractor is willing to be responsible for this risks on a small-scale project. This could be done based on the layers system in the procurement system especially for low life cycle layers. The low life cycle costs layers are suitable for circular strategies. However, for longer life cycle objects the risks are just too big.

What challenges do you experience when applying the concept of circular economy?

Clients should be willing and have the guts to take the step and to step away from rules that provide boundaries for circular economy (3B). Changing the ownership of construction objects is a major step. The contractor takes a more communicative role in this choice instead of a leading role. By the decision which ownership should be applied the focus is too much on the short term instead of the long term. Next to the short-term approach, clients still focus on making their buildings more sustainable instead of long term thinking to a circular economy.

Handout 2, transition and innovative orientated procurement

Points to discuss:

- Attitude of innovation
- Current status of the transition to a circular economy
- 3 elements and 7 subjects of innovative orientated procurement

Subject 3, Circular orientated procurement

Which choices should clients make before a project that has the goal to contribute to the transition to a circular economy before it should be tendered?

- Clients should dare to focus on cooperation and form an integrated team.
- It should offer freedom in combination with demands and focus on functional demands to provide opportunities for material chooses.
- Choose as a client how the risks have to be tackled. Provide room in one of the pillars of price, time and quality. Time could provide additional circular solutions.
- The seize of the contract or ambition should contain multiple construction phases (DBFM) to realize a maximum of circularity especially for long life cycle objects. For short term objects, it can be done separately.
- A client also has to choose what has to be done with the current build environment.

What are the consequences of the choices on the procurement process?

- Selecting is done based on the SO that is developed by the partner which results in that selecting and awarding is done based on this SO and it is checked if the SO complies with the POR (PVE). Asking for a higher level of detail in the tender phase will be too expensive.
- Another consequence of demanding an SO is that budget can play a role in the tender process because a design is made.
- The focus on cooperation after the SO phase between client and contract has the consequence that the procurer needs to have sufficient knowledge with regard to circular economy to enable this cooperation.
- The consequence of applying functional demands is that knowledge at the procuring organization is required to assess the bids.

- Functional specifications also have the consequence that it provides room for the partner to apply circular economy. This is a direct consequence that in the boundary conditions is room for circular economy.
- The management of IPR has the boundary conditions that the project provides room for innovation. By functional specifications there is room for this development.

Based on the table, how should the procurement process be designed based on these decisions and consequences?

- The focus provides the opportunity to select a partner and incorporate cooperation. This cooperation is of importance to test or adjust the boundaries and therefore cooperation should be used in the award criteria as well. The cooperation should be based on mutual confidence in each other.
- In the subject of specification are no real options to select of award due to the fact that functional demands are applied.
- The subject of risks is the most challenging subject because it has aspects on each subject. The risk scan be divided in an aspect of time, costs and quality. Specifying all three subjects limits the possibilities to innovate. A client could choose to not specify one of these three subjects. Costs could be specified but quality and time are required to apply circular economy. The next step is to award the participant in the procurement process on these three subjects. Providing room in the subject of time also stimulated circular economy because additional solutions because materials from other projects can be applied. There is a limit to this room because it is impossible to wait forever.
- The ambitions of the procurement organization also have to be clear in the boundary conditions in the desire to implement circular economy. Don't specify to much because this limits the opportunities to apply innovative ideas of the market.
- The seize of the contract does not have any selection or award criteria
- The construction has limit connection with intellectual property right because the innovations are used in the following projects. Therefore, it cannot have an additional stimulation in the selection and award criteria because the goal is to improve together. An innovative construction companies has the advantages to keep on innovation because innovations are not infinite.

Comments

Cooperation is essential in contributing to the transition to a circular economy because it has to be developed together. Implementing different types of ownership can be done simultaneously with the implementation of circular economy. Moving toward leasing has to be done in small steps and have to start with low life cycle layers.

Dijkencombi Stephan van Dalen	**Boundary conditions (POR/PVE)**	**Selection criteria**	**Award criteria**
Cooperation	Cooperate from schematic design phase in an integrated effort	Schematic design has to comply with POR	Award on the idea
Specification	Functional	-	Award on the idea
Capabilities of the procurer	Knowledge is required in order to cooperate	-	-
Risks	Risks can be for partner, however, client has to take a facilitating role	-	Award on risk management plan
Desire to implement circular economy	Has to be there in order to cooperate	-	-
Magnitude of the contract	Design, build and maintenance and possible finance		Award on the innovative ideas
Management of IPR	Be open for IPR		

Transcript interview

Stimulating the transition to a circular economy by using procurement processes

Interviewee	Stephan van Dalen
Organization	Dijkencombi
Function	Project manager
Date	20 April 2018
Location	Dijkencombi, construction site Zoetermeer

Objective of the interview

The objective of this interview is to determine which chooses are relevant and how the procurement process should be designed to ensure that the market responses and moves to a transition to a circular economy. These answers as based on the business model for circular economy and on the conclusions of innovative orientated procurement. The handouts are used to ensure that the interviewee has the desired knowledge of research question (subject)1 and 2

Subject 1, Knowledge with regard to circular economy

What is your experience with circular economy in the construction industry?

The experience in circular economy and procurement is related to the tender of the Croeselaan in Utrecht in which the interviewee participated. The goal in this project was to realize the most sustainable road in the province of Utrecht. As a response, the interviewee provided the road as a service to realize a circular road but this bid was discarded because it was not in the scope of the project.

What are actions that directly contribute to transition to a circular economy?

Manufacturers have to take responsibilities for the material, component or product that they produce and they should realize that circular strategies can be applied. Another step would be to remove the budgets from client perspective to provide additional room for circular economy. By integrated contract that include maintenance, additional options to realize circular strategies are realized.

What is now required to realize a circular construction industry in 2050?

How budgets are divided at client side have to change and the mindset of the contractor have to change. It is about taking responsibility for the product that the contractor delivers. Next to this, it is also important that people who work on the project feel responsible as well.

Handout 1, business model circular economy

Points to discuss:

- Circular strategies
- Layering based on life cycles
- Change of ownership.

Subject 2, What does this knowledge change

With this knowledge, what are actions that directly contribute to a transition to a circular economy?

The mindset if people has to change to contribute to the transition. We (as a consumer) have to be aware of the products that we use and what their environmental footprint is. We should move away from giving what is asked but providing quality.

What challenges do you experience when applying the concept of circular economy?

Changing the mindset of people is already a major step in realizing a circular economy. Next to that it is important to focus on total costs of ownership instead of lowest construction costs.

Handout 2, transition and innovative orientated procurement

Points to discuss:

- Attitude of innovation
- Current status of the transition to a circular economy
- 3 elements and 7 subjects of innovative orientated procurement

Subject 3, Circular orientated procurement

Which choices should clients make before a project that has the goal to contribute to the transition to a circular economy before it should be tendered?

- The process should focus on cooperation to ensure that quality is realized. The cooperation should start on VO (voor ontwerp) to ensure that bids can be measured. However, the level of detail of an VO for an infra contractor is comparable with the SO level of a utility contractor.
- Functional specification is a must as well in combination with a design, build and maintenance contract. A financial aspect in this contract is possible as well as long as client and contractor work together instead of risks diverting by sticking to the letter of the contract.
- The risks should be divided to the parties that can also influence these risks.

What are the consequences of the choices on the procurement process?

- The decision to cooperate based on a VO has the consequence that the in the selection criteria demands an VO and that this VO complies with the functional demands. This has the consequence that awarding is done on the VO as well.
- Applying a DB(F)M contract has the consequence that the knowledge of the client is sufficient because this knowledge is required to assess the bid of the contractor.
- The stimulation of circular economy and communicating the ambitions has the consequence that on the subject of “desire to implement circular economy” is sufficient as a boundary condition.
- Using a DBM-contract has as a consequence that in the award criteria the innovative opportunities of the contractor is assed as well.

Based on the table, how should the procurement process be designed based on these decisions and consequences?

- The design, that is part of the bid, but the cooperation is the foundation for the project. `the award criteria should also be used in order to focus on this cooperation.
- The decision to make the contractor responsible for the risks realizes that the project can lead to more circular solutions. However, it is important that client take a facilitating role in order to help with these circular solutions. An example would be that clients (public organizations) helps in attaining the required permits. Next to this, use the knowledge of the contractor in the award criteria and award on a risk management plan.
- Attaining IPR should be open in the procurement process in the boundary conditions and does not have to play an active role in the procurement process.

Comments

The goal/ambition of the procurement process should comply with the procurement process and the responsibilities of events should also be for the organizations that can have influence on these events.

Christine Wortmann Primum/Volkerwessels	Boundary conditions (POR/PVE)	Selection criteria	Award criteria
Cooperation	From initiative phase in which quality and transparency is present	-	Vision Plan of action Find a balance between details
Specification	Functional	-	-
Capabilities of the procurer	Need to have the knowledge to effectively cooperate This needs education	-	Awarding can be subjective and good solutions can be determined as to risky
Risks	Share the risks Budget for risks Deadline are determined together	-	-
Desire to implement circular economy	Has to be present and it has to be part of the organisation	-	-
Magnitude of the contract	DB(FM) Lose the separate budgets	-	-
Management of IPR	-	-	-

Transcript interview

Stimulating the transition to a circular economy by using procurement processes

Interviewee	Christine Wortmann
Organization	Primum/VolkerWessels
Function	Team leader and consultant sustainability
Date	16 May 2018
Location	Podium 9, Amersfoort

Objective of the interview

The objective of this interview is to determine which chooses are relevant and how the procurement process should be designed to ensure that the market responses and moves to a transition to a circular economy. These answers as based on the business model for circular economy and on the conclusions of innovative orientated procurement. The handouts are used to ensure that the interviewee has the desired knowledge of research question (subject)1 and 2

Subject 1, Knowledge with regard to circular economy

What is your experience with circular economy in the construction industry?

The circular economy is currently being developed in the construction industry and is slowly getting addressed in procurement processes. However, the construction industry is in an early stage of transition. We are currently in the phase of getting awareness for public and private organization in which a definition of circular economy still has to be determined. The definition should focus on the chain to ensure that is also ensures responsibility and that the best circular strategy is applied. The opportunities of different types of ownerships is unclear because it is not jet applied. However, the life cycle of the objects plays a crucial role in this determination especially for infrastructures.

What are actions that directly contribute to transition to a circular economy?

The definition of circular economy has to be clear to make sure that organizations understand each other. It ensures that the entire industry moves towards the same direction which can contribute to the transition.

What is now required to realize a circular construction industry in 2050?

The same answer as previous question, However, it is also important to start doing in a project in cooperation between contractor and client. This ensures that it does not stay with talking but also focusses gains momentum.

Handout 1, business model circular economy

Points to discuss:

- Circular strategies
- Layering based on life cycles
- Change of ownership.

Subject 2, What does this knowledge change

With this knowledge, what are actions that directly contribute to a transition to a circular economy?
Not asked due to the fact that the interviewee had the same focus as the handout.

What challenges do you experience when applying the concept of circular economy?
Next to realizing a definition of circular economy which is a challenge as well, the guts to try circular economy has to be present as well in order to realize an experiment. Making a step will determine which barriers are relevant. Are the rules or costs prohibiting circular economy? This question can be asked by experimenting with circular economy because the required practical experience Is missing. The theory of circular economy is quite clear but how to apply it in the construction industry is a subject of future discussion.

Handout 2, transition and innovative orientated procurement

Points to discuss:

- Attitude of innovation
- Current status of the transition to a circular economy
- 3 elements and 7 subjects of innovative orientated procurement

Subject 3, Circular orientated procurement

Which choices should clients make before a project that has the goal to contribute to the transition to a circular economy before it should be tendered?

- Do not specify too much. For circularity, the design is important. Therefore, it is relevant to start cooperating in the initiative phase in the construction process. It is important to determine the solution together instead of tendering a solution to ensure that circular strategies can be applied. Transparency has a crucial role in this process.
- To realize that the cooperation has an effective outcome the contract has to contain at least Design and build. It is unclear if maintenance or finance should be part of the tender is unclear. It is about cooperating so amount of different partner should be limited. This cooperation should be based on confidence in each other in combination with equality. The example of the circular bridge of van Hattum and Blankevoort is discussed, which is an example of confidence and equality have a key role.

What are the consequences of the choices on the procurement process?

- Procuring in an early stage of the construction process has the consequence that the capabilities at the procurer also have the required knowledge to cooperate and assess the bids. The knowledge in the award criteria has to be present in order to ensure that the best circular solution is awarded as well. This is also influenced by the structure of the organization and how the circular economy is stimulated within the organization. This also results in if the desire to implemented circular economy is sufficient or not.
- The consequence of cooperating in an early stage is that risks are shared and that client and private organization are responsible. This sharing of risks requires a special budget for risks for client and private organizations. Time has to be flexible because for circular economy to thrive, deadlines have to be flexible.
- The consequence of early effective cooperation is that budgets is less important because it provides room for an honest dialogue what the costs are. Soft criteria in the award criteria are the primary focus.

Based on the table, how should the procurement process be designed based on these decisions and consequences?

- The focus in the award criteria should be not only what somebody is going to do but also how they are going to realize the circular economy. This is about vision and how this vision is realized. This has to play a role in the award criteria. This can also realize the required confidence in each other. The level of detail that is asked in these plans has to be limited in order to limit tender costs.
- The focus of the procurement process should be on finding a partner and not on technical demands.
- The interviewee does not have the information with regard to management of IPR in order to put context to this subject.

Comments

The budgets have to be combined from client perspective. However, this will not be realized overnight and therefore creativity is also required. A special budget for trying this type of cooperation should help to stimulate circular economy.

BAM Sander Holm	Boundary conditions (POR/PVE)	Selection criteria	Award criteria
Cooperation	Transparency and start in the initiative phase but limit the level of detail	-	Award on the vision of the partner
Specification	Functional	-	-
Capabilities of the procurer	Knowledge has to be present to cooperate and procurer has to have confidence in the partner	-	Knowledge is required to asses bids
Risks	Share the risks and make the people who can influence the risks responsible	-	-
Desire to implement circular economy	Has to be present just as in the subject of capaiblities of procurer	-	-
Magnitude of the contract	Design and build and possibly finance and maintenance.	-	-
Management of IPR	-	-	-

Transcript interview

Stimulating the transition to a circular economy by using procurement processes

Interviewee	Sander Holm
Organization	BAM
Function	Sustainability Manager
Date	14 May 2018
Location	Building E, Runnenburg 12, Bunnik

Objective of the interview

The objective of this interview is to determine which chooses are relevant and how the procurement process should be designed to ensure that the market responses and moves to a transition to a circular economy. These answers as based on the business model for circular economy and on the conclusions of innovative orientated procurement. The handouts are used to ensure that the interviewee has the desired knowledge of research question (subject)1 and 2

Subject 1, Knowledge with regard to circular economy

What is your experience with circular economy in the construction industry?

The experience with circular economy is related to several projects. One of these project is the ABN circle Pavilion. Which was originally a regular construction project but due the decisions of ABN the project was disbanded and the decision was made to realize in a cooperative effort the circle pavilion. Another experience is orientated from within the BAM. In this research questions like: What circular business models should be applied in combination with the investment of circular building platform which looks like Madaster by providing end of life value and providing a space to sell used construction materials, components and products. Next to this, the BAM is also part of the Ellen Macarthur foundation. The focus within BAM is to have the information when materials, components and products are realized which also required a lot of engineers who are capable of BIM.

What are actions that directly contribute to transition to a circular economy?

It is important to have ambitions but to make small steps by experimenting in order to realize circular economy. But keep in mind that it is about the long haul and not about a single project. By determining what is required to make the next step will provides opportunities to move into the transition to a circular economy.

What is now required to realize a circular construction industry in 2050?

Government have a role in stimulating the transition to a circular economy and has to be aware of this role. However, the government is not the only organization that has a role in this transition. Private parties have to take responsibility as well and move into the transition.

Handout 1, business model circular economy

Points to discuss:

- Circular strategies
- Layering based on life cycles
- Change of ownership.

Subject 2, What does this knowledge change

With this knowledge, what are actions that directly contribute to a transition to a circular economy?

Changing the focus to the long term instead of short term. Focusing on the long term and on cooperation will results in value preservation as circular economies requires. By combining construction phases additional options in the transition to circular economy are realized. This long-term relationship is based on trust and it changes the perception of value.

What challenges do you experience when applying the concept of circular economy?

Removing the segmentation in the market will be a challenge in the transition to a circular economy. The demolisher and contractor have to work together in the future because just as in NewHorizon is urban mining becoming important.

The type of ownership is also a challenge because on the long term a building will be cheaper if it is bought instead of leasing because of lease fees and low interest rates for clients.

Handout 2, transition and innovative orientated procurement

Points to discuss:

- Attitude of innovation
- Current status of the transition to a circular economy
- 3 elements and 7 subjects of innovative orientated procurement

Subject 3, Circular orientated procurement

Which choices should clients make before a project that has the goal to contribute to the transition to a circular economy before it should be tendered?

- It is important that a contractor have the opportunities to apply more sustainable solutions. To realize this option cooperation is required that starts in initiative phase of the project. This cooperation should be transparent and be based on equality.
- The seize of the contract should be at least design and construct to realize that circular strategies can be applied. Finance and maintenance provides opportunities but this is not mandatory.

What are the consequences of the choices on the procurement process?

- The consequence of cooperating that starts in an early stage of the construction process has the consequence that the specification can only be limited and has to be limited to functional demands and not technical.
- The cooperation also has the consequence that risks has to be shared. The organization that has influence on events also have to be responsible for the risks.
- Starting with the cooperating in the initiative phase of the project has the consequence that the award criteria should be focused on soft criteria because no technical demands are present. Award criteria should be based on the vision of the tender.
- The capabilities of the procuring need to have knowledge as well in the boundary conditions and in the award criteria because for preparation and awarding knowledge is required to assess the bids objectively. This knowledge also results in equality which is vital for cooperation. If the capabilities of the procurer are there than the will to implement circular economy will also be there.

Based on the table, how should the procurement process be designed based on these decisions and consequences?

- The management of IPR is not really an issue in the construction industry especially not in the transition to a circular economy. However, the information with regard to products, components and materials is for the owner of the materials, component or product. The information systems will become more and more important in determining circular strategies.

Comments

Every building project is not just a building project but also and environmental project because it can realize effects in the surrounding as well. The tender costs have to be limited. To realize limited tender costs, the tender will have to change from competition to finding a partner.

Roelofs Robby van den Broek	Boundary conditions (POR/PVE)	Selection criteria	Award criteria
Cooperation	Initiative phase Working together from confidence	Consortium	Award on vision, cooperation, environmental management
Specification	Functional	-	-
Capabilities of the procurer	Has to be aware of the relevance of circular economy	-	The procurer has to have the knowledge to assess the bids
Risks	Share the risks Budget for risks	-	Use the knowledge of the partner
Desire to implement circular economy	Has to be aware of the relevance of circular economy	-	-
Magnitude of the contract	Design and build Remove the separate budgets	-	Award on vision, cooperation, environmental management
Management of IPR	Contract could results in IPR		Award on what the partner is going to do to attain this IPR

Transcript interview

Stimulating the transition to a circular economy by using procurement processes

Interviewee	Robby van den Broek
Organization	Roelofs
Function	Head kenniscluser Energie en Mileu
Date	20 April 2018
Location	Roelofs, Den Ham

Objective of the interview

The objective of this interview is to determine which chooses are relevant and how the procurement process should be designed to ensure that the market responses and moves to a transition to a circular economy. These answers as based on the business model for circular economy and on the conclusions of innovative orientated procurement. The handouts are used to ensure that the interviewee has the desired knowledge of research question (subject)1 and 2

Subject 1, Knowledge with regard to circular economy

What is your experience with circular economy in the construction industry?

Roelofs has formed circular economy based on their Roelofs Kompas in which seven subjects are placed that are relevant for a sustainable future. Next to this. Roelofs also have experience with circular economy because of the project Apeldoorn de Parken in which circular economy has an primarily role. Most of the companies and clients have no idea what circular economy realize is. An example is given with regard to asphalt. Reusing asphalt is not necessarily circular which means that the current market is frozen by their own habits. Next to that, the circular economy starts with the purchaser because they are still focus on lowest price. This has to change in order to move to the circular economy.

What are actions that directly contribute to transition to a circular economy?

Clients should adjust their purchasing strategy in order to realize that it is not only about describing a certain product. We should think big but smart with small successes on material, components and product level. The budgets within the organization of a client has to be combined in order to create additional options in the executions phase. Combining budgets should not only focus on the civil engineering aspect but also take social aspects into account.

What is now required to realize a circular construction industry in 2050?

The dare to procure circular and combining budgets.

Handout 1, business model circular economy

Points to discuss:

- Circular strategies
- Layering based on life cycles
- Change of ownership.

Subject 2, What does this knowledge change

With this knowledge, what are actions that directly contribute to a transition to a circular economy?

Focus on total costs of ownership instead of buildings costs. This requires guts to contribute to the circular economy.

What challenges do you experience when applying the concept of circular economy?

Changing the type of ownership in infrastructure project is currently a step to much because there are too many aspects involved in this change of ownership. Switching to total costs of ownership should become the standard instead of focusing on lowest building costs. Removing budgets is crucial in this transition.

Handout 2, transition and innovative orientated procurement

Points to discuss:

- Attitude of innovation
- Current status of the transition to a circular economy
- 3 elements and 7 subjects of innovative orientated procurement

Subject 3, Circular orientated procurement

Which choices should clients make before a project that has the goal to contribute to the transition to a circular economy before it should be tendered?

- Make sure that the procurement process is based on trust and confidence. Each contractor can realize an infra project. The next step is focus the project in a cooperative effort that start in the initiative phase of the project. Construction companies can show their strengths and are selected on these strengths which realizes that still some form of competition is present.
- Maintaining the construction objects is a major part of realizing the circular economy but it does not have to be part of the contract. As long as design and building is put out to tender in which maintenance plays a crucial role by a design led approach.
- Select the partner based on past performance, company culture and make sure that a consortium participates in the tender.

What are the consequences of the choices on the procurement process?

- A consequence of selecting a partner based on cooperation in an early stage of the process has the consequence that this also has to have a place in the award criteria. A partner should be chosen on his vision and how client and contractor work together in combination with how environmental management is applied.
- Functional demands are required because of awarding in an early stage of the process because there is no clear scope. Because of this lack of scope, no options are possible in the selection and award criteria with respect to specification.
- The capabilities of the procuring organization has the boundary condition that it is aware of the importance of circular economy. The next step is to use this vision and cooperation in the award criteria in order to realize synergy between the partner. This motivation also applies for the desire to apply circular economy.
- The cooperation and function specifications requires that risks are divided between client and contractor in the boundary conditions. This will require a budget for risks for both parties (7F).
- An opportunity is that a company is scored on a risk management plan which provides risk management of the project and an opportunity for private parties to have competition among each other.

Based on the table, how should the procurement process be designed based on these decisions and consequences?

- Removing the segmentation in budgets providing possibilities in the award criteria. Clients can use budgets from the social project to involve people that have disabilities to apply circular strategies without increasing costs. This approach realizes that circular economy is applied in a broader sense.
- Managing the intellectual property rights is part of the procurement process. Client can provide IPR to contractors if the boundary conditions is that they are awarded on this process. This is an opportunity in the boundary conditions and awarding private parties on what innovation is expected can also be award of the award criteria.

Comments

Make sure that total costs of ownership based on cooperation is dominant instead of lowest construction costs.