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CIRCULAR INNOVATION IN THE CONSTRUCTION SECTOR

A STUDY ON THE INSTITUTIONAL FACTORS INFLUENCING CIRCULAR INNOVATION AND THE CONDITIONS FOR SUCCESS

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Preface

The past few years, contributing to a sustainable society has become an important goal in my life. That is why I was eager to write my master's thesis about a relevant and topical subject. And I did. Although at first I felt like a newbie in the construction sector, I now have the feeling that I can find my way in this complex world, but not just that. I developed a true passion for the interesting challenges that the construction industry faces and I am happy that I was given the chance to make a contribution to solving those challenges.

Therefore, I would like to express my personal gratitude to my internship organization Cirkelstad, and especially to Rutger Büch. We met once a week and in these meetings, he gave me all kinds of advice and took the time to brainstorm with me about how to improve my research even more. The fact that he had faith in me and ensured me that my research was valuable, gave an extra boost.

I would also like to thank the whole Cirkelstad team for giving me loads of inspiration. I gained a lot of valuable knowledge, not only for enhancing the content of my thesis but also knowledge that I will carry with me in my future career.

Likewise, I am very grateful to all the 20 respondents that took the time and effort to tell me every ins and outs about their experiences with circular innovation. The conversations were really interesting and I hope that with this research I could contribute to their efforts for transitioning to a circular economy.

Last but not least, I would like to thank my supervisor Mark Wiering, for believing in me and giving me both constructive and positive feedback. This feedback was very useful and helped me to lift my thesis to a higher level. I am very proud of the result.

I hope that you will enjoy reading it as much as I enjoyed writing it.

Britte Rijk Utrecht, June 2020

Abstract

Transitioning to a circular economy exposes great challenges to the construction sector. This traditional sector produces a lot of waste and is very polluting. In response to this, the circular ambition is more and more being formulated in construction projects. Besides, there are a lot of initiatives for circular innovative products. However, in practice those ambitions are too often not becoming reality. One theory explaining this difficulty of innovating is sociological institutionalism, defining institutions as formal and informal rules and norms. This research aims to explain the gap between ambition and implementation by looking at the institutional factors that influence the implementation of innovative, circular ambitions. The factors could be either barriers or accelerators. Furthermore, it aims to identify conditions for overcoming the barriers.

By combining different studies, a framework was created. This framework is empirically examined, by doing interviews with experts from the field. Furthermore, two projects, one very successful and the other less successful, are used as practical illustrations to show what barriers and accelerators are actually encountered in practice and what conditions were needed there. The most important conclusions of this research are, first of all, that the construction sector is stuck in traditional processes and routines and that letting those go is considered risky and scary. An important accelerator that helps to combat this barrier, is having a proactive client that really supports the circular ambition, fosters taking risks and experimenting and initiates consortia instead of traditional tendering. Besides, the ambiguity of the concept of circular innovation causes a lot of mental barriers. Intrinsic motivation and environmental concern is an accelerator for actually taking action. Furthermore, it was concluded that the most important conditions to overcome the barriers are: top-down control from the government, showing that circular innovation will be a decisive business advantage, enough demand and supply, education, awareness and facilitation.

This research has some limitations, one of which being the broad span. However, this research has contributed to the existing literature on institutional barriers to innovation by creating a broad conceptual framework of factors and conditions. Besides, the conditions provide some concrete tools for accelerating the circular transition in practice and therefore this research contributes by making the society more sustainable.

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1. Introduction

1.1 Developments in the climate debate

Over the past years, one of the subjects that has been dominating public debate is climate change. Since there is almost complete scientific consensus on the fact that the natural world around us is changing (Oreskes, 2004), the debate experienced a certain shift from the question *if* we should change, to the questions *what, how* and *to what degree* we should change. Different efforts are already made in order to discuss those questions and to combat climate change: several climate conferences, some more successful than others, are held (UNFCCC, n.d.); policy measures in various sizes and to different degrees are already taken (Lim, Spanger-Siegfried, Burton, Malone & Huq, 2005); and more and more citizens are willing to make an effort themselves to contribute to a more sustainable world, for instance by joining local initiatives (Nerlich, Koteyko & Brown, 2010). Although real change is coming slowly (IPCC, 2019), there is a rising level of awareness.

Because of these debates and trends, the demand for new business models and policies is increasing (Tiossi, Simon & Milan, 2019). The term sustainable development is often coined as a possible solution to the climate issue (Robinson, 2004), referring to "meeting the needs of current generations without compromising the ability of future generation to meet their own needs" (WCED, 1987). However, this is still a very broad concept. A more concrete form of new, sustainable ways of organizing societies, is the circular economy (D'Amato et al., 2017). As defined by MacArthur (2013), a circular economy "replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models" (MacArthur, 2013, p. 7). In other words, waste doesn't exist and waste from one product is, in a sustainable way, used as raw material for another product, without any loss of quality. This way, the unsustainable take-make-dispose pattern of the current linear economy could be overcome.

1.2 Impact on construction sector

One of the industries that is greatly affected by this new way of thinking, is the construction sector. In the Netherlands, the construction sector produces by far the most waste: around 25% of the total output of the construction sector is waste (Central Bureau for Statistics, 2019). From another perspective, half of total waste produced in the Netherlands is derived from the construction sector. Besides, the construction sector is responsible for a large part (around 40%) of the total use of materials, like wood, steel, glass and concrete (Geldermans, Luscuere, Jansen & Tenpierik, 2016). Currently, in the Netherlands, 29% of all the materials used is recycled, which is a lot compared to other European countries (Central Bureau for Statistics, 2019), but still quite low compared to the total amount of waste produced. Moreover, the use of recycled materials unfortunately is often accompanied by a considerable loss of quality (Geldermans et al., 2016). On top of that, the construction sector is very energy-intensive, because of extraction of materials, processing, manufacturing and transportation (Treloar, Gupta, Love & Nguyen, 2003) and therefore it is a sector with a huge amount of CO₂ emissions. By adding all these reasons together, it becomes clear that organizations in the construction industry need to become more sustainable and take responsibility for combating the effects they have on the environment. They need to move towards a circular way of working.

In accordance to this realization, two important developments could be noticed. The first is that more and more (local) governments and other clients like private companies are venturing into circular procurement (Europa Decentraal, n.d.a). The Dutch government, provinces and municipalities are showing their ambitions to become circular and to procure circular projects and materials (Green Deal Circulair Inkopen, n.d.). In addition to this circular ambition, another development is the emergence of circular initiatives in the construction sector (Bastein, Roelofs, Rietveld & Hoogendoorn, 2013). Different innovations concerning circular materials are present in the market. In some construction projects, the ambition to build circularly has become reality and circular material has been used, for example in the reconstruction of the head quarter of Alliander (Witman, 2016). In this project, 80% of the materials from the old building, are used for the new building. Both the outside construction, and the materials used inside are made from recycled materials. Another example is Circl, a circular constructed pavilion from ABN-AMRO. This building can be disassembled and a lot of old materials has been used, for example old jeans of employees for the use of isolation (Lachmeijer, 2017).

1.3 Problem statement

To stimulate this circular innovation in the construction sector, the national cooperation Cirkelstad was founded (Cirkelstad, n.d.). They connect actors with each other that both have the ambition to contribute to this circular construction sector and they facilitate knowledge sharing. What they see, however, in contrast to the aforementioned positive developments, is that, although the supply side of circular materials exists and although the ambition is there, circular plans are too often not becoming reality (Cirkelstad, 2019, p. 6; van Bueren & Priemus, 2002). The possible contractors are asked to demonstrate their vision and the products they want to use in their tenders. However, when this tender is chosen, the question remains whether those products are actually procured or not. The barriers for innovating and purchasing circular materials often beat the ambitions. Circular plans are eventually not implemented and instead, it is opted for conservative, linear materials. The majority of today's construction projects are still carried out in traditional ways: short-term is favored over long-term (Gluch, Gustaffson & Thuvander, 2009). This leads to the question: why is it so difficult to actually realize those circular ambitions? Therefore, Cirkelstad facilitates this research internship, of which the aim is to find out why this is the case and how this problem can be solved.

Different studies around this topic already have been done. However, those studies focus on the technical, financial or practical barriers (e.g. Economisch Instituut voor de Bouw, 2017). Barriers to innovation in the construction sector are found to arise from practical constraints of tenders, lack of financial benefits etcetera. However, even when those kind of barriers are non-existent, it still seems difficult to purchase the innovative, circular materials (Gluch et al., 2009).

One of the answers found in the literature regarding this difficulty to innovate, relates to institutionalism which tries to explain organizations' struggles to innovate (Lowrey, 2011). The concept of institutional theory and what definition is used in this research, will be explained in greater detail in the theoretical chapter. In short, sociological institutionalism refers to the fact that organizations and societies are often trapped in their own history of norms, values and institutions, hence these organizations and societies face difficulties innovating their way of thinking and working (Vermeulen, 2011). This is also what scientists Van Bueren and Priemus (2002) discovered. They observed that the support towards sustainable constructing was still quite low back then. The norms and values reflected in the behavior of all parties involved in the decision-making, leaned more towards the familiar, unsustainable way of working instead of the innovative, sustainable way. They concluded that institutional changes were needed. External environmental breakthroughs, for example, could help to change values and strengthen support towards sustainable innovation.

However, the research of Van Bueren and Priemus stems from 2002 and since then, we have seen a lot of environmental break-throughs. Besides, they are particularly focused on the decision-making process. As already showed, in the recent years the ambition to make the construction sector circular seems to be there. The question that still seems to be unanswered, is therefore not why decisions regarding sustainable construction don't get off the ground, but why, *in spite of circular decisions*, and *in spite of the existing circular initiatives*, the circular plans often fail to become reality.

1.4 Research aim and - questions

Therefore, the aim of this research is to explain challenges and opportunities for the implementation of circular innovations in the construction sector and to explain the gap between plan and reality, by looking for institutional factors that influence the implementation of innovative, circular ambitions.

The second aim is to design practical recommendations by looking for conditions that positively influence those factors.

This brings us to the following research question:

Which institutional factors influence the implementation of innovative circular ambitions in the construction sector and what are the conditions for overcoming the negative factors?

In order to achieve the aim of the research, the research question is divided in the following subquestions.

- 1. Which institutional factors influence the implementation of circular innovations in the construction sector?
- 2. When are those factors preventing circular ambitions from becoming reality?
- 3. When are those factors accelerating circular ambitions to become reality?
- 4. What are the conditions for those factors for overcoming the barriers?

First, the sub-questions will be answered by using insights of existing theories, provided by different scholars. Then, the findings of the literature review will function as a guideline for doing the empirical research in order to formulate a final answer on those questions.

1.5 Scientific, societal and practical relevance

The findings of this research contribute to the scientific body of knowledge regarding sociological institutionalism in the construction sector. In the last few years, a lot of research has been done on the concept of circular economy, and therefore also about the barriers and drivers. However, a lot of this literature is about the barriers and drivers in general (Ritzén & Sandström, 2017; De Jesus & Mendonça, 2018). These studies conclude with a set of barriers and drivers, of which institutional barriers and drivers are just one category. Little research has been done about this institutional area only. For example, Ranta, Aarikka-Stenroos, Ritala and Mäkinen (2018) concluded that support from the normative and cultural-cognitive pillars in the institutional environment are very important in realizing a circular economy. Those researches still remain very broad, as there is no set of concrete barriers and conditions and it does not focus on one sector. Besides, there is no framework of the institutional factors and conditions influencing either innovation, a circular economy or both. Regarding the construction sector, some quantitative studies have been done on the institutional support for the circular economy (Adams, Osmani, Thorpe & Thornback, 2017). No qualitative research has been done yet on the institutional barriers, accelerators and conditions in the construction sector. The current research will bridge this gap and construct a conceptual framework for the institutional factors influencing circular innovation and the conditions needed for overcoming the barriers. By the specific focus on circular innovation in the construction sector, more concrete factors could be identified. This way, this research adds on and improves the existing theory on sociological institutional factors influencing innovation. The framework is initially focused on the construction sector, but could be examined in other sectors as well.

Moreover, this research is also relevant from a societal perspective. Many conditions for the construction sector to become circular are present: for example, both the supply side and the demand side exist. However, to be fully efficient and to make a positive impact on the environment, people should act in accordance to their ambitions. An important note is that this is not only the case in the construction sector. These kind of situations, in which people are willing to act sustainable, but still find it difficult to innovate, occur in every segment of society. Investigating why people currently do not always act in accordance to the existing ambitions in the construction sector and how we could eventually make this happen, will be very valuable in combating climate change, not only in the construction sector, but on a higher level. This way, this research will contribute to creating a sustainable and circular economy.

On top of that, this research also serves a practical aim and therefore also has a practical relevance. A lot of construction organizations are indicating that there are too many barriers for becoming circular or for drawing attention of other actors to their circular products. By mapping out what is needed to overcome those barriers, those organizations could get a boost with concrete tools. The results of this research will help to organize events to facilitate innovation and to facilitate the cooperation between actors in their circular ambitions. This is the exact goal of Cirkelstad and therefore it will help to strengthen the potential of Cirkelstad even more.

1.6 Reading guide

The research report starts with a short introduction of the relevant context, which is the construction sector, the current policies on circular construction and the internship organization, Cirkelstad. After this, relevant theories that help to answer the research questions are identified. This literature review ends in a conceptual framework and translation to the construction sector, which is the operationalization. Next, the methodological choices of this research will be elaborated on. Subsequently, the results of the research will be analyzed and linked to the theory. The report ends with a conclusion and discussion.

2. Context

Before diving into the literature, it is useful to know how the construction sector works in the case of innovative and circular procurement. Therefore, this process is outlined and it is shown what actors are involved. Furthermore, the existing policies on circular innovation in the construction sector are discussed. Last, it is useful to learn a bit more about Cirkelstad and how Cirkelstad is organized. The aim of this chapter is to give an impression of the context in which this research is conducted.

2.1 Construction sector

In construction projects, a lot of different actors are involved. In this paragraph, the most visible actors are discussed. In a traditional construction project, the stakeholder that first enters the stage, is the client. Clients could be individuals, but also organizations (which will be the focus in this research), which could be both public and private. Common organizational clients are governmental institutions, both national, regional and local governments, and housing associations. The client has a request for something to be build and asks an architect to design the project (Bouwkunde online, n.d.). Part of this request could be that the building or infrastructure should be circular. One example of the role of architects in designing circular buildings is to make sure that the building could be disassembled. After the design is made, the client invites tenders for this assignment (Bouwkunde online, n.d.). Then, different contractors could submit tenders with their vision and the products they want to procure (Bouwkunde online, n.d.). In those tenders they have the possibility to demonstrate their circular intentions and ideas. The hired contractor is the team that is actually going to build the object. Lastly, suppliers are needed. Those are the actors supplying the products that will be procured and could also be the producers of those products (Bouwkunde online, n.d.). This usual, traditional process is how it happens most of the time. However, there is another strategy that is used more and more for circular projects. Instead of inviting tenders, a consortium is composed at forehand (PIANOo, n.d.), which is a group of actors (e.g. client, contractor, architect etc.) that found each other by having the same ambition, instead of by inviting tenders.

2.2 Governance circular innovation in the construction sector

Since 2015, the European Union has launched an action plan to accelerate the transition towards a circular economy (Europa Decentraal, n.d.b). These measures focus on seven aspects: product design, production processes, consumption, waste management, recycling, specific product types and innovation. Financial support, by doing investments and granting subsidies, is an important instrument to realize the transition (Europa Decentraal, n.d.b). Examples of these subsidies are the Horizon 2020 and INTERREG subsidy. However, the Horizon 2020 subsidy is only available for businesses producing innovative products or researches, and the INTERREG supports businesses in enhancing their policy instruments. Both subsidies are not focused on giving subsidies to businesses that try to apply sustainable innovations. Another EU instrument is the creation of Innovation Deals, which has the goal to connect innovators, authorities and the European Commission to identify regulation barriers to innovation.

The action plan has identified five priority sectors, one of which is the construction sector (Europa Decentraal, n.d.c). One important directive of the EU in relation to the construction sector, is that member states should recycle 70% of the raw materials from waste of construction and demolition. However, no specifications are added on how to reuse those materials. Many member states are achieving (or have already achieved) this 70% goal, however, the materials are often reused in a low grade way, for example to raise the asphalt (Europa Decentraal, n.d.c). Another shortcoming of the European Union regulations and directives regarding circular construction, is that they are often considered as complicated (Omgevingswetportaal, 2018). A lot of questions exist with regards to the facilitation of innovations for a circular economy.

In accordance to the European ambition, the Dutch government has the ambition to become fully circular in 2050 (Rijksoverheid, n.d.a). Regarding the construction sector, this ambition falls under the

Ministry of the Interior and Kingdom Relations. For the construction sector the ambition was formulated to be fully circular in 2030. From 2023 on, the government only has to invite circular tenders for construction projects. To make the construction sector circular, the state also created a transition team and agenda especially for the construction industry (Rijksoverheid, n.d.b). This strategy is focused on the stimulation of innovative and circular products and sharing and dissemination of knowledge. One of the most important instruments is the MIA and Vamil regulation, that gives companies financial benefits when they invest in environmental friendly technologies (Rijksdienst voor Ondernemend Nederland, n.d.) However, similar to European Union laws, the instruments are often not used because of the complexity of the measures (Omgevingsportaal, 2018). Furthermore, a large amount of the instruments focuses mostly on the producing side of the circular economy. There seems to be a lack of subsidies and instruments promoting circular economy on the demand side.

One important instrument that the Ministry of the Interior and Kingdom Relations uses to stimulate environmental friendly measures in the construction sector, is the Environmental Performance of Buildings (MPG: *Milieuprestatie Gebouwen* in Dutch). This is a standard which all residential and office construction projects have to meet (Ollongren, 2019). The current standard is set on a score of 1, which means that all projects need to have an Environmental Performance of 1 or less. The higher the number, the higher the environmental damage that is done by that project. It is currently investigated how circularity could be included more in this standard; how and when the standard, set by 1, could be lowered; and if it could be extended to other construction projects, and not only the residential and office construction projects.

Besides the ministry, there are a lot of other organizations trying to accelerate the circular transition in the construction sector, for example consultancies and financial institutions. Another organization that focuses on connecting actors, is Cirkelstad.

2.3 Cirkelstad

As already mentioned, Cirkelstad is a national cooperation in the Netherlands, functioning as a network for public and private actors (Cirkelstad, n.d.). Their mission is to create inclusive cities without waste. In more concrete terms, this means that the aim of Cirkelstad is to accelerate the transition to a circular economy in the construction sector. This is done by focusing on the frontrunners in the circular construction. Frontrunners of all types of actors are linked to Cirkelstad. Because of this commitment, other organizations that are not yet leading in this field, but do have the ambition to contribute to a circular construction sector, can learn from the frontrunners. This way of collaborating is meant to support and facilitate the willingness to innovate.

Cirkelstad is organized around three types of actors (Scheuer, 2019). The first is the managing director, being responsible for the national organization of Cirkelstad. Second, there are spinners. Those are individuals from other organizations that devote a percentage of their time to be responsible for a local Cirkelstad. For example, Cirkelstad Utrecht has a spinner, and Cirkelstad Apeldoorn has another spinner. Those spinners are responsible for organizing local meetings with partners, which are the third type of actors. A partner is a public or private company that is willing to contribute to the circular economy in the construction sector, and wants to share knowledge with other partners.

Currently, Cirkelstad has around 200 partners in 25 cities (Cirkelstad, n.d.). Cirkelstad is eager to extend its range and to have a larger reach. However, the ultimate goal of Cirkelstad is to end to exist. When all construction organizations have integrated circular principles in their businesses, Cirkelstad is redundant.

3. Theoretical framework

To find an answer on the research question using theoretical insights, it is useful to first define circularity and circular construction. This leads to a better understanding of the challenge that circular construction poses. In this challenge, certain institutional factors are involved that influence the implementation of circular innovations. To understand those factors, sociological institutionalism will be introduced. Then, general institutional factors affecting the implementation of innovations will be discussed. These factors could function both as barriers and accelerators. After indicating those factors, theories will be discussed regarding deinstitutionalizing, and thus overcoming institutional barriers. Finally, as an operationalization, the introduced factors and conditions will be translated to the construction sector.

3.1 The circular economy

The concept of circular economy has already been explained in the introduction, but will be explained here in a bit more detail. The circular economy is a reaction on and counterpart of the linear economy (MacArthur, 2013). In a linear economy, a take-make-waste pattern is at center: companies take raw materials, produce products, sell them to consumers, who use the products and then throw them away. This not only creates a lot of waste (MacArthur, 2013), but also causes high and volatile prices of resource extraction. Therefore, there is not only an incentive for society to get rid of this linear approach, but also for companies.

As mentioned, in a circular economy this take-make-waste pattern is discarded and the core of the economy is to design out waste (MacArthur, 2013). Another characteristic is that the circular economy exists of both redesigning material waste and returning biological ingredients to the biosphere. The last core value is that the energy used in producing new products should also be renewable.

The figure below is from the MacArthur (2013) Foundation and is a clear visualization of the circular economy.



Figure 1 – The biological and technical loop of the Circular Economy (Ellen MacArthur 2013)

3.2 Circularity in the construction sector

The concept of circular construction corresponds a lot with the definition of circular economy in general. It can be defined as "designing, constructing and demolishing the built environment in such a way that, besides the high-quality deployment and reuse of materials, and an adaptive and future-proof design, sustainability ambitions regarding energy, water, biodiversity and ecosystems are taken into account as well" (Ten Dam, 2018). Therefore, circularity is not the same as recycling. One big difference between recycling and circularity is that the quality of circular materials remains high.

In line with this definition, there are six strategic principles that should be adhered to in order to actually accomplish circularity in the construction sector (Verbrugge, 2016, p. 21). The first principle is that we should try to use as much renewable materials as possible. Therefore, products should be of higher quality so that it lasts longer. However, this contradicts the current economic system, in which producers want to sell as many of their products as possible. A possible solution could be the idea of 'use instead of possession' (Peters, 2011): producers sell their services, but they themselves still possess the products. This should trigger them to make as high quality products as possible. The second principle is a passport for commodities (Verbrugge, 2016): when a product is at the end of its life, it should be able to use the raw materials again to make new products. Therefore, it should be possible to know of which raw materials the product consists. This could translate in the idea of a commodity passport. In the past years, such a commodity passport has been developed and launched (Joosse, 2019). It is not obligatory yet, but grants from the government are stimulating the purchase of it. The third principle (Verbrugge, 2016) is that raw materials should have a high value in order to be reused. A suggested solution is the protection of certain types of raw materials, just like the protection of nature reserves, for example by paying taxes for using the raw materials. The fourth principle is called the 'LEGOlisation' of products (Verbrugge, 2016). This reference to the building blocks of Lego is meant to call for designing products in such a way that they can be disassembled, moved and replaced like Lego stones (De Ridder, 2011). The fifth principle (Verbrugge, 2016) calls for a collective platform on which products, raw materials can be exchanged between actors. The last principle is that the building should not be seen as a static object, but as a dynamic commodity warehouse: the materials used in the building are known and could be used and exchanged efficiently (Verbrugge, 2016). The figure on the next page summarizes the six principles in order to come to circular construction.

3.3 Institutional theory

As already shortly mentioned in the introduction, institutionalismtries to explain society's behavior by looking at deeper and more resilient aspects of social structure, called institutions (Scott, 2005). However, institutionalism is a very broad theory, representing different positions. The first distinction is the one between old institutionalism and new institutionalism (Rutherford, 1995). Old institutionalism is mostly an economic approach, having the rational economic actor as its focus. New institutionalism extends this exclusive economic focus. According to Hall and Taylor (1996), there are three schools of thoughts within new institutionalism: historical institutionalism, rational choice institutionalism and sociological institutionalism. Historical institutionalism focuses mostly on polity and the political economy (Hall & Taylor, 1996). In general, historical institutionalists consider institutionalists focus on the theory that actors use institutions to maximize their utility (Hall & Taylor, 1996), for example the construction of institutions in order to reduce transaction costs. On the other hand, institutions could also constrain the maximization of utility.



Figure 2 – Principles of circular construction

The last approach of new institutionalism is sociological institutionalism (Hall & Taylor, 1996), which tries to explain why organizations behave the way they do and why they take on specific forms. Sociological institutionalism defines institutions more broadly then the other two types, not only referring to formal rules and norms, but also to informal ones, like symbols, cognitive and moral templates and culture. Another important feature of the sociological institutionalist view is that significant attention is paid to the origin of those institutions and how these could change (Hall & Taylor, 1996).

In this research, a sociological institutionalist approach is adopted. It is ought to find explanations for the choices that organizations and sectors make and both formal and informal institutions are taken into account. In this research 'institutions' refer to formal and informal rules, norms and routines (Scott, 2005). These structures are functioning as 'rules of the game': the guidelines for social behavior, both for individuals and for organizations (consisting of individuals). Therefore, human interactions could be seen as products of institutions, but institutions are also products of human interactions (Buttoud, Kouplevastskaya-Buttoud, Slee & Weis, 2011, p. 2). Scott (2013) also states that organizations should conform to those institutional structures in order to survive; conformity is a tool for protecting and enhancing legitimacy. This could hamper the drive for innovation. Besides, ingrained habits are difficult to change. But what, then, are the specific institutional factors that influence the implementation of innovations?

3.3.1 Barriers to innovation

Different scholars have done research on institutional factors preventing successful implementation, which are called barriers (D'Este, lammarino, Savona & Von Tunzelmann, 2012; Mackay, 2014; Vermeulen, 2010; Rolfstam et al., 2011; Jantarasami, Lawler & Thomas, 2010). There is variety of possible factors, so in this paragraph it is tried to give a clear overview of the different barriers.

One of the most mentioned factors that hampers change or innovation within organizations is the notion of *path dependency* and, subsequently, *lock-in* (D'Este et al., 2012). Path dependency arises from mechanisms that reinforce the direction of the organization on a certain path, because of

increasing gains for members (North, 1990). This means that if a certain practice seems to work, it is likeable that an organization wants to continue on that path. Once chosen, this path is difficult to change, because of, among others, learning effects, expectations and coordination effects (Wiering, Liefferink & Crabbé, 2018). The latter refers to the fact that the division of responsibilities is accepted and difficult to transform. Besides, organizational inertia and structured routines can lead to the inability to identify new opportunities and to adapt to changes in the environment (D'Este et al., 2012). Moreover, it can also lead to resistance to change: changing competencies and existing habits and products that were once successful might be seen as a 'bad practice'. Thus, in order to avoid cannibalization of the once successful routines, the possibility of radical innovation is ignored. This mechanism of 'remembering the old' often goes hand in hand with another mechanism implying resistance to change, which is 'forgetting the new' (Mackay, 2014). For example, innovations like new rules and structures may often be adjusted in such a way that they are reincorporated in old paths. This way, instead of serving the actual goal of the innovation, challenging the status quo, the current structures stay intact. This could be processes of active neglect of new rules, but also passive drift. Both suggest that the introduction of new formal rules or procedures don't work if they don't match the informal norms (Mackay, 2014, p. 565).

This corresponds with one of the three types of forces that Vermeulen (2010) points out. Vermeulen (2010) mainly looks at the internal forces, since his goal is to understand how the deep structures within organizations influence the ability to innovate. According to Vermeulen (2010) there are three institutional forces within organizations that are obstacles to innovation. The first one relates in some way to the path dependency notion mentioned above: the *internal regulatory forces* (Vermeulen, 2010, p. 24). These are the organizational structures and procedures determining the tasks and behavior of members of the organization. These formal structures and procedures should match the required innovation, but sometimes this isn't the case because it is hard to change existing structures.

The second force refers to the importance of values and norms within an organization: the *internal normative forces* (Vermeulen, 2010, p. 24). These norms and values are often linked to the tasks and roles that people are expected to fulfill. Adhering to these expectations will lead to appreciation. Therefore, taking on a new role and changing tasks or goals might be scary. Innovation will lead to risks and uncertainties of new expectations among members. They are not assured anymore of the appreciation they are used to, which makes it more difficult to actually change.

The last type of forces that Vermeulen (2010, p. 24) mentions, are *the internal cultural-cognitive forces*. This type of forces indicates that interactions between actors lead to shared frames. Frames are used to understand events and the environment. Individuals influence each other through their interactions, which often lead to a shared frame within a business unit, a company or even within a sector. This frame absorbs all information and events that are fitting in the frame; however, information that doesn't fit the frame, is ignored or suppressed. This way, innovation will be harder to achieve.

Rolfstam et al. (2011) have made a different distinction of institutional barriers to change. They distinguish between nine, more concrete, possible factors. There are a few factors that won't be taken into account in this research. The first is *getting into the supply chain*. Products available in the existing supply systems are preferred instead of new products, not yet available in the supply systems. Since this barrier is an overarching barrier, not explaining why existing products are preferred over new products (in contrast to the other barriers), this barrier is not taken into account. The second barrier is the *absence of innovation champions* (Rolfstam et al., 2011). This is the presence of powerful leaders or organizations promoting the innovation. However, in this research, this factor is not taken into account as barrier, but included in the framework of the conditions. Other barriers refer to the *prices*, *budgeting* and *de-spending*. Often, the investments that should be made don't have short term benefits; only in the long run the benefits are visible. Most of the times, products and procedures that are cheaper on the short-term are preferred over the most beneficial options on the long-term (*prices*).

Related to this is that the benefits that do occur, often aren't visible in the same budget that bore the costs (*budgeting*). This makes it harder to invest in innovation. Moreover, it seems hard to decide what should be cut from the budget to be able to implement the innovation (*de-spending*). These financial factors are not included in the definition of sociological institutional theory in this research, and therefore not taken into account. However, price is not completely excluded in this research. The dilemma of price versus sustainability certainly plays a role in the aforementioned cultural forces. The last barrier of Rolfstam et al. (2011) that won't be taken into account, is that there could be *problems with demonstrating the value of innovation*. Because the innovation might be new and never tried out before, it is hard to get convinced of the value of the innovation. This barrier seems as a legitimate, practical factor, since the buildings have to be safe and of good quality and those standards exist with a reason. Therefore, this factor is left out of this research.

However, some of the barriers mentioned by Rolfstam et al. (2011) are valuable for this research. First of all, it is assumed that staff and management require a high level of proof before they adopt an innovation. This is called *organized skepticism*. In this research, this barrier will be linked to the internal cognitive forces, referring to norms values of people in the sector (Vermeulen, 2010). Furthermore, a *centralized decision structure* can also play a role. A centrally made decision for radical change may not necessarily lead to adoption in other departments of the organization. The last institutional barrier mentioned by Rolfstam et al. (2011), refers to the *existing agreements with suppliers of current technology*. The sudden termination of existing contracts might be difficult or impossible.

All barriers mentioned are internal institutional barriers to innovation. However, there are also external institutional barriers: factors from outside organizations that hamper change or innovation (Jantarasami et al., 2010). Often those external barriers refer to (governmental) *laws and regulations*. The current policies of the European Union and the Dutch government were summarized chapter 2. Those policies refer to regulations intended to support the transition towards a circular construction sector. However, there are also regulations that hinder innovation. Research shows that stringent regulation has a negative effect on innovation intensity (Barbosa & Faria, 2011). In the Netherlands, there are existing regulations that can have negative effects on implementing innovations as well (De Lange, 2012).

Other external institutional barriers could be culture, norms and values from society. However, since culture, norms and values of workers within organizations are often shaped by culture, norms and values from society (Achterbergh & Vriens, 2019), it is not needed to include those as external barrier.

After reviewing the existing literature about institutional barriers to innovation, it is possible to distinguish the different barriers between three categories (figure 3, on the next page). The first category refers to *legal factors*. This factor refers to legal institutions influencing the possibility of innovating. Secondly, *organizational factors* seem to be important for innovating. This category includes path dependency (and lock in), internal regulatory forces, centralized decision structures and existing agreements with supplier of current technology. These barriers are all processes embedded in the processes of the organization. The third category forces. These institutions refer to norms and values embedded in the mind of and between organizational workers, or inter-sectoral communications, influencing interactions and behavior.

All categories mentioned are now considered as factors negatively influencing the implementation of innovations, so called barriers. However, if those factors lean to the opposite of the spectrum, those factors could also positively influence successful implementation. If the regulations (legal factors) are flexible and stimulating innovation, this could be a factor of success and accelerator for innovating. Besides, if organizational factors are designed in such a way that innovation is embraced and if there are no constantly repeated routines, there will be less path dependency and lock-in (Achterbergh & Vriens, 2019). Last, values of workers could be focused on social responsibility instead of efficiency or turnover. This will accelerate instead of hamper circular innovation.



Figure 3 - Categorization of factors influencing innovation

3.3.2. Barriers to circularity

Not much research is done yet on the concrete institutional barriers of circularity, but in this case it is possible to use the literature on value-action gaps and on the barriers to pro-environmental behavior. Kollmuss and Agyeman (2002) identify some barriers to acting consciously in favor of the environment. The mentioned barriers are both social and cultural factors, like already mentioned in the previous paragraph, as well as the *absence of infrastructure*. There should be services and facilitations, like a platform, as mentioned in paragraph 3.2, that enable the ambition of acting in an environmental friendly way. Although this is an important possible barrier, it won't be taken into account, as it is not considered as institutional factor. However, it is taken into account in the paragraph on conditions. The *absence of emotional connection to the natural environment and environmental concern*, however, are important institutional barriers of acting environmentally friendly. This factor could be merged with the internal normative forces introduced earlier.

However, sometimes these environmental values may be in place, and yet people don't act according to these values. Giddens (1984) found that this could be explained by *routine behavior*, also called 'practical consciousness'. Because some habits are so much embedded in our daily and working life and almost automated, it is difficult to change that habit. This factor could be linked to the aforementioned path dependency and lock-in.

Again, the factors mentioned are framed as negative influencers. However, those factors could also help to accelerate the successful implementation of circular innovations if they work in the opposite way. If the emotional connection to the natural environment and environmental concern are present, members are more likely to act pro-environmentally (Kollmuss & Agyeman, 2002). The same goes for *routine behavior*. As already mentioned, there could be organizations in which there are less repeated routines and more room for development and innovation.

Overall, the factors found for influencing people and organizations acting in accordance to circular values or not, are mostly similar to and can be fitted in the proposed categorization of factors influencing innovation in general. This leads to the first part of the conceptual framework (figure 4).



Figure 4 - The factors influencing the implementation of circular ambitions

3.4 Conditions for overcoming the barriers

Despite the main focus on the negative influence of those factors, it doesn't mean that those barriers cannot be overcome and eventually changed into accelerators instead of barriers. In order to find out what is needed for those factors to positively influence the implementation of innovations and accelerate the process, it is useful to look at the conditions to change institutions and path breaking environmental pressures.

In this research, conditions are seen as both forces for deinstitutionalization, as well as forces that are needed for organizations to be able or willing to adapt to the environment. The first type of forces that are needed for deinstitutionalization is stemming from Oliver (1992), and the second type about adaptability is derived from Dolata (2009). Those two forces are combined and in this research they are referred to with conditions, as they are needed for accelerating the transition and overcoming the barriers.

According to Oliver (1992) there are three mechanisms that put pressure on institutionalized norms or practices: functional, political and social pressures. *Functional pressures* derive from perceived problems in the performance or utility of activities and resources. Changes in the environment are a good example for this kind of pressures, for example when competition for resources is intensified (Tina Dacin, Goodstein & Scott, 2002). This kind of change or trend raises doubts about the value of the institutionalized practice. In response, a new practice that may enhance the performance and strengthen the negative perception of the institutionalized practice, provides a fertile ground for deinstitutionalization (i.e. letting go of the institutionalized practices) (Oliver, 1992).

The second type of pressure that Oliver (1992) introduces, are *social pressures*. Members of organizations or societies should consciously decide to discard institutional practices. What is needed for this, are "disruptions to the historical continuity of organizations and breakdowns in the unanimity of normative agreement" (Tina Dacin et al., 2002). A change in the workforce may cause this disruption: a new leader or new members with different backgrounds and experiences than the incumbent members can bring about change in the shared frames, norms and values. Additionally, important for a single organization is therefore to have close connections with other organizations and

to be open to cultures and practices of other organizations and sectors. In short, social pressures arise from the mix of different cultures and the openness of organizations for those other cultures.

The last set of pressures according to Oliver (1992) are *political pressures* and refers to shifts in the interests and underlying power distributions, both in society and in the organization's field. If the political agreement on the value and validity of an institutional practice is eroded, an organization may be stimulated to adopt innovative practices. Besides, there are also environmental changes causing the organization to rethink the necessity or appropriateness of the traditional practices. Political dissensus opens the way for challenging the existing practices. However, this required dissensus does not only arise from political crises. Important, powerful stakeholders or visionary entrepreneurs can also have a huge influence on disrupting the institutionalized practices. If powerful leaders or entrepreneurs are promoting circular innovations, this will help actors to let go of their regular habits (Rolfstam et al., 2011; Oliver, 1992).

Other scholars, like Dolata (2009), speak of another division of mechanisms underlying sectoral adaptability, which refers to the adaptability of a sector when challenges confront the sector. There are three levels of sectoral adaptability. The first is the *organizational level*. This concerns the ability to identify, communicate and adopt the challenges and to adjust established routines and strategies. On the second level (Dolata, 2009), the *institutional level*, is the flexibility and openness to renew the rules of the game. This applies to a broader scale than just the routines and strategies. It's about the norms and shared beliefs of the actors involved. The last level is the *structural level* (Dolata, 2009), which is basically about market conditions: it is the permeability of production, market and demand conditions in supporting new innovations. This structural level includes the outside pressure of consumers and society (demand), and the availability of supply.

The categorizations of conditions of institutional innovations of Oliver (1992) and Dolata (2009) can be combined. Organizational level and functional pressures both refer to required changes in strategy and routines because of changes in performance, causing challenges. For the sake of clarity, to make sure that we are talking about conditions for change, we call this first category *functional conditions*. Moreover, the institutional level corresponds with the social pressures. For both definitions, openness to other cultures, norms and values is very important. In this research, they are called *social-cultural conditions*. The structural level does not correspond with any of the pressures mentioned by Oliver (1992), yet it seems to be important if a sector is open to listen to developments and changes in demand and supply. To remain consistent, we call this *structural conditions*. That leaves the political pressures: the presence of powerful actors and dissensus in the political field and the organization regarding the traditional way of working. This will be referred to as *political conditions*.

However, if those four conditions are present, but the actors aren't aware of it, or aren't facilitated in making the required change, it won't be effective. Therefore, *awareness* and *facilitation* are two important conditions that are needed to make sure the above mentioned conditions (functional, social-cultural, structural and political) work.

Awareness is an important indirect condition to overcome acting through 'practical consciousness', leading to value-action gaps. To actively act according to values, one should act with 'discursive consciousness' (Giddens, 1984). To bridge the gap between values and action and to make discursive consciousness of stronger influence than practical consciousness, awareness of what is needed and how to change behavior should be present (Chung & Leung, 2007).

Moreover, *Facilitation* is an important deinstitutionalizing condition, since the absence of infrastructure could be considered as a barrier to circular construction, albeit not institutional (Kollmuss & Agyeman, 2002). For companies to change their business models to circular business models, they should in some way feel facilitated to make it easier to take the step. This facilitation could be considered as an indirect condition, just like awareness. This not only includes platforms, but also regulations and laws that facilitate innovation and circularity. A remarkable finding is that a

considerable part of these conditions are actually external, for example the political conditions, the performance of an organization due to changes in the environment or the presence of infrastructure. However, the crux of these conditions is that the organization or sector should be aware of those developments and acknowledge those developments, allowing them to change their routines. Here, again, awareness is key.

After identifying both barriers and conditions to overcome the barriers for circular innovation, the following conceptual model could be designed (figure 5).



Figure 5 – Conceptual framework: the factors influencing the implementation of circular ambitions and the conditions for those factors to become accelerating factors.

3.5 Operationalization: factors and conditions in the circular construction sector

The factors and conditions found in the literature are still described very broadly. In order to be able to measure these concepts in the relevant field, it is useful to translate them briefly to the factors and conditions for circular construction.

3.5.1 Factors in the construction sector

Legal factors

The first category of possible institutional factors influencing the implementation of innovations, are the legal factors. In the construction sector, some research has been done on regulations inhibiting innovation. The constructions sector is a highly regulated sector because of security risks (Economisch Instituut voor de Bouw, 2017). On their own, building regulations are not really functioning as barriers for innovation, but according to some, the lack of flexibility in applying those rules are (Economisch Instituut voor de Bouw, 2017). However, there are also all kinds of regulations that try to stimulate innovations (Rijksoverheid, n.d.c.), mentioned in chapter 2. Therefore, it could also function as an accelerator of circular innovation.

Organizational factors

The second category, the organizational factors, refers to routines and structures, the organization's way of dealing with innovations, the decision structure and existing agreements with supplier of current technology.

First of all, the construction sector is often described as a conservative industry (Eijkelkamp, 2018), so the routines and structures are important barriers for change in this sector. The same goes for path

dependency. Since certain choices and practices in the past seemed to be successful, like working with traditional bricks and cement, it is difficult and considered risky to let go of the old way of constructing and adopt something new. On the other hand, there could be a construction workers less stuck to routines and structures, which could positively influence circular innovation.

Regarding the decision structure, things seem to work a bit differently in the construction sector. Besides a centralized decision making process, the construction sector is highly fragmented (Dainty, Bryman & Price, 2002), meaning that for one project, a lot of different actors are involved. This process fragmentation makes the construction sector one of the most complex industries and this fragmentation could function as an important barrier.

Besides, existing agreements with suppliers of current technologies could be an significant barrier in the construction sector. The contractors of construction projects could have long-term contracts with suppliers (Bloomfield & Ahern, 2011), often because long-term relationships lead to trust (Eriksson & Laan, 2007). However, these kind of long-term contracting agreements could also be an important barrier to innovation, since the contractors are not always able to terminate the agreements.

Value-related factors

Factors regarding values of workers include the attitude of workers towards changing habits, the dominating cultural frame and environmental concern.

People in the construction sector may find it scary to change their tasks and roles (Vermeulen, 2010). They know that there are certain expectations of their tasks and roles (Vermeulen, 2010). Doing something unfamiliar might be scary because they do not know if it will be appreciated. On the other hand, a positive attitude towards change could be an accelerator for circular construction.

Lack of environmental concern is an important barrier in the construction sector. On average this environmental concern is greatly absent in construction companies (Sakr, Sherif & El-Haggar, 2010; Holland & Gibbon, 1997; Abidin, 2010). If this concern is present, people are more willing to act and this will accelerate the implementation of circular innovations.

On the same note, the shared frames between workers could be developed in such a way that all decisions made are not based on innovation and environmental topics. For instance, a structural frame may be dominating in construction companies, placing most focus on efficiency and performance (Bolman & Deal, 2017). However, little research on existing cultural frames within construction sector is done yet, so this is only an assumption.

3.5.2 Conditions in the constructions sector

Functional conditions

Functional conditions in the construction sector could derive when organizations notice a decrease in their performances (Oliver, 1992). This could be due to a deficit in raw materials, or when there is an increase in competition for resources, causing organizations having to think about changing their business model.

Social-cultural conditions

Social-cultural conditions could deinstitutionalize the institutions functioning as barriers, if more diversity is brought to the organizational culture. The construction sector is considered as a sector with low diversity in work force. This lack of diversity could cause a constraint in picking up and absorbing new ideas (Powell & Sang, 2013). Therefore, the construction sector should have an open attitude towards and close connections with other sectors and organizations in order to take note of their cultures and their practices.

Structural conditions

Structural conditions simply refer to demand and supply. There is an increasing demand for sustainable constructs (Europa Decentraal, n.d.a). These developments in demand are destabilizing traditional

assumptions. However, not only the demand should be sufficient, but also the supply side of circular innovations in the construction sector.

Political conditions

There are two types of political conditions (Oliver, 1992). The first is the political dissensus in society and organizational field. In the Netherlands, there is an ambition to become completely circular (Rijksoverheid, n.d.a), but different political stakeholders still disagree about the priority of this ambition. In the organizational field of the construction sector, this circular view is extending, but still very submissive. The second type of political conditions is about the presence of powerful stakeholders and visionary entrepreneurs promoting circular innovations (Oliver, 1992; Rolfstam et al., 2011). If those people are present and acknowledged by the sector, it will be a motivation for organizations to innovate.

Awareness

The indirect condition awareness refers to the awareness needed to come to circular innovations in the construction sectors, refers to knowing what the environmental challenges are, what the contribution is of the construction sector in causing these problems and how the construction sector could contribute to the solutions of these challenges.

Facilitation

Last, as mentioned, another indirect condition is that it is important that the organizations or sectors feel facilitated in innovating. The right infrastructure in the circular construction field means that instruments should be in place that facilitate and support workers in innovating and changing towards circular modes of working. This could be in the form of practical platforms (Verbrugge, 2016), but facilitation could also stem from information, financial support from external organizations or regulations.

3.6 Summarizing paragraph

After identifying all possible institutional factors and conditions for circular construction according to the existing literature, it should be noted that the single conditions do not refer to single factors. Instead, the conditions could sometimes help to overcome multiple negative factors. Therefore, the factors and conditions are not one on one linked to each other. Table 1 and 2 on the next page summarize the theoretical findings.

In this research, the expectation is that if the factors are considered as barriers, they will negatively influence the implementation of circular innovations in the construction sector. If the factors are considered as accelerators, it is expected that they will positively influence innovation. Therefore, the factors could be seen as independent variables and the implementation of innovation is the dependent variable.

Furthermore, the conditions should be present in order to overcome the barriers. In this setting, the conditions are the independent variables and the factors are the dependent variables.

In short, there are two relationships that will be investigated. The two different relationships are also shown in the conceptual framework (figure 5). Both relationships carry certain expectations.

1. Factors influence circular innovation

Expectation: the factors could have a negative influence on the implementation of innovations if they are considered as barriers, and a positive influence on the implementation of innovations if they are considered as accelerators.

2. Conditions influence factors

Expectation: if the conditions are present, they will influence the factors in such a way that the barriers are overcome and eventually turn into accelerators. The functional, social-cultural, structural and

political conditions have a direct influence, and awareness and facilitation are important indirect conditions.

Factors	Barriers	Accelerators
Legal factors	Inflexible regulations hindering innovation	Flexible regulations stimulating innovations
Organizational factors	Trapped in existing routines and structure	Few routines and loose structures
	Remembering the old & forgetting the new	Organizational focus on innovations
	Complex & hierarchical decision structure	Simple & horizontal decision structure
	Existing agreements with suppliers	No long-term agreements with suppliers
Value-related factors	Scared of changing roles	Open culture
	Lack of environmental concern	Environmental concern
	Dominating frame (e.g. efficiency)	Dominating frame (e.g. social responsibility)

Table 1 - Factors influencing circular construction

Conditions		
Functional conditions	 Adaptability of sector to: → Decrease in resources available → Decrease in performance results 	
Social-cultural conditions	 Open attitude towards other organizational cultures Close connections with other sectors 	
Structural conditions	 Adaptability of sector to: → Developments in demand for and supply of circular innovations 	
Political conditions	 Adaptability of sector to: → Political shifts in society and organizational field towards circular ambitions → Powerful stakeholders and visionary entrepreneurs advocating for innovation 	
Awareness	 Awareness of environmental challenges Awareness of contribution construction sector Awareness of possible ways of improving 	
Facilitation	- The recognition of certain instruments facilitating the circular transition	

Table 2 - Conditions for overcoming the barriers

4. Methodology

To be able to answer the research question, empirical research has been done. In this chapter it becomes clear which methods are used for collecting and analyzing data. First, the research strategy is discussed. This is followed by an explanation of (1) how the data is collected, and (2) how the data is analyzed. Finally, the reliability, validity and ethical choices of the research are addressed.

4.1 Research strategy

4.1.1 Research philosophy

This research is underpinned by a post-positivist view. Regarding the ontology – 'what is reality and what is there that can be known about?' (Guba & Lincoln, 1994) – of this research, it is assumed that there is one reality, but it is acknowledged that this reality cannot be understood perfectly. The aim of this research is to find influencing factors and conditions that can be generalized for almost every (circular) innovation project in the construction sector. However, it is recognized that there are constraints in getting insight in the real reality. Regarding the epistemology – 'what is the nature of the relationship between the researcher and research subject?' (Guba & Lincoln, 1994) –, again it is acknowledged that it is impossible to remain completely objective, but this is being pursued. Lastly, regarding the methodology – 'how can the researcher acquire his/her believed reality?' (Guba & Lincoln, 1994) –, this research uses qualitative data, which are then objectified to find patterns. This also corresponds with the post-positivist view (Guba & Lincoln, 1994).

4.1.2 Research design

As mentioned, the research is of qualitative nature. A qualitative research design seemed most appropriate (Jones, 1995), since the goal of this research is to find reasons for why innovations in the construction sector most of the times fail, and other times appear to be successful. These factors and conditions would be difficult to find using quantitative data, especially when looking at institutional factors and conditions. These are sometimes hard to fathom, and therefore qualitative methods could help, for example by asking for explanations of certain statements. This fits the explanatory nature of this research.

The search for qualitative data is based on the literature review, which makes it a deductive study (Van Thiel, 2014, p. 38). The existing literature and the conceptual framework based thereon, functioned as a guide for the empirical research. However, when other institutional factors and conditions not found in the literature presented themselves, they were not ignored. Those are seen as important findings supplementing the existing body of theory.

Furthermore, this research could present itself as an embedded case study. This means that the research is centered around one single instance, of which different units are analyzed and expert respondents are interviewed. The bigger, overarching case that is being studied, is the construction sector. Within this sector, several respondents are interviewed and two projects are studied as units of analysis. The selection of those will be covered in the next section.

4.2 Data collection

4.2.1 Respondents and case selection

The construction sector has been selected as case since this is a sector that is very relevant for reacting on environmental developments. As discussed in the introduction, most waste in the Netherlands is produced by the construction sector (Central Bureau for Statistics, 2019) and on top of that the extraction of resources is very energy intensive (Treloar, Gupta, Love & Nguyen, 2003). Therefore, innovation is needed in the construction sector. However, this process of innovating often fails, in spite of the existence of the circular demand and supply side. This makes the construction sector an interesting one to research.

Within this broader case, experts from the field, which are actors involved in construction projects, are interviewed. Besides those expert-interviews, two projects are studied. Below, first, the choices regarding the experts are elaborated on and after that, the two projects are introduced.

4.2.1.1 Experts from the field

There are four main actors relevant in the construction of new buildings. The first relevant actor is the client, that has the ambition to let something be built circularly and invites tenders. The second is the architect, that makes the design for the project, already keeping in mind what kind of materials have to be used. Then the contractors enter the stage. They execute the construction and make the final choice of what products are being purchased. The last relevant type of actor is the producer, who makes a circular product.

Per type of actor, two or three respondents are interviewed. All respondents (and their organizations) have the ambition to construct circularly. That is also one of the reasons why those organizations are chosen, because they could point out the obstacles or factors of success they encounter.

For the clients, two different types of organizations are interviewed. The first respondent that is interviewed is an area manager of the municipality of Utrecht. The second interviewed organization is a housing association: Woonbedrijf. This way, both public and private organizations are analyzed.

For the architects, two different organizations are interviewed as well. The first is one of the biggest architectural bureaus of the Netherlands, named Inbo. For Inbo, circularity is not a core business, but it is considered important. In contrast to Inbo, one small architect organization, Orga, that has circular design as its core business is interviewed.

Three big contractor companies in the Netherlands that all try to innovate, are interviewed: Dura Vermeer, VolkerWessels and Van Wijnen. They are involved in a lot of projects in the Netherlands and also show the willingness to contribute to a circular construction sector.

Last, three producers of circular materials are interviewed. The chosen organizations all have experience in whether or not being procured in construction projects. Therefore, those producers are useful experts to do interviews with. The first is a respondent from EKOTEX, which is specialized in the field of circular wall finishing systems, like paint and wallpaper. The second producer is Leadax, a company that produces a circular, non-toxic type of lead. Last, a respondent from ODS Kloeckner is interviewed. This company is specialized in steel, which could be unlimitedly reused and recycled. Besides the normal steel products, they also try to make business in a steel construction product that can be disassembled and reconnected. They do not sell this product, but keep ownership during a lease construction.

Besides those experts from the practical field of the construction sector, some interviews are also conducted with organizations that try to stimulate and instigate the transition towards a circular construction industry. Those organizations are referred to with 'instigators'. These interviews provide more insight in the successful conditions for implementation of circular innovations. The first instigator that is interviewed, is the Ministry of the Interior and Kingdom relations. The stimulating role of the state will be made clear in this interview. Furthermore, Rabobank is interviewed, since this is a financial institution placing great value on innovations. Last, Copper8, which is a consultancy in the field of the circular economy and the construction sector, is interviewed to gain insight in how they encounter the barriers and what they do to overcome those barriers.

4.2.1.2 Projects

Two projects are used to illustrate real-life situations and as addition to the general expert interviews. Those projects both included a circular ambition, but the execution of this ambition is different in both cases. Due to ethical reasons, those projects will remain anonymous. However, they will be introduced here briefly in order to gain some more insight into the context of those projects.

The first project (from now on: Project 1) that is analyzed, is one in which a lot of difficulties were encountered during the execution of the circular ambitions. It concerns the construction of a new office building. This case mostly helps to get insight in the factors negatively influencing the implementation of circular innovations. Furthermore, the interviewed respondents could point out what they think was needed to overcome those barriers.

The second project (from now on: Project 2) is one that is seen as a very successful circular building. In this project, the circular ambition became reality and therefore it is a good example of a successful circular project. It is a renovation project of an old building into a circular hub and it is an ever-going-process. This project helps to get insight in the factors positively influencing the implementation of circular innovations.

For both projects, three to four respondents are interviewed, that were all involved during the execution of the construction project.

4.2.1.3 Respondent codes

A code is given to every interviewed respondent. Because it is ought to find general patterns, the codes are assigned randomly. A distinction is made between the type of actors, but not between the different respondents within that type of actor.

Respondent	Code
Clients (Municipality of Utrecht & Woonbedrijf	Client 1
– random order)	Client 2
Construction companies (Dura Vermeer,	Contractor 1
VolkerWessels & Van Wijnen – random order)	Contractor 2
	Contractor 3
Architectural firms (Inbo & Orga – random	Architect 1
order)	Architect 2
Producers of circular products (EKOTEX, Leadax	Producer 1
& ODS Kloecker – random order)	Producer 2
	Producer 3
Organizations stimulating circular construction	Instigator 1
(Ministry of Interior and Kingdom relations,	Instigator 2
Rabobank & Copper8 – random order)	Instigator 3
Project 1 respondents	Respondent 1A
	Respondent 1B
	Respondent 1C
Project 2 respondents	Respondent 2A
	Respondent 2B
	Respondent 2C
	Respondent 2D

Table 3 - Respondent codes

4.2.2 Methods

First of all, desk research has been done to get a more comprehensive understanding of the construction sector and circular construction, and to find out the answers of the existing literature on the topic. After this, the main method used in this research was conducting 20 semi-structured interviews. In the interviews with the field experts, they were asked what institutional factors they experience as barriers or accelerators of implementation of circular plans, and what conditions are needed for successful circular construction projects. These factors and conditions are general, so not in particular about one project.

Additional to the interviews with the actors, three interviews are conducted with instigators: organizations that stimulate the circular transition in the construction sector. Those instigators are

asked what kind of conditions they create to stimulate the implementation of innovations and what they think is additionally needed to change the rules of the games within conservative sectors.

For every project, three to four respondents are interviewed as well. Different involved actors are asked how they view the progress made for those project with regards to the innovation and what they think were the barriers or success factors of the project.

	Method	Goal
Step 1	Desk research	Gain overview of the existing theoretical insights for answering the research questions
Step 2	Conduct interviews with experts from the field	Gain understanding of what institutional factors are influencing the implementation and what conditions are needed to overcome the barriers.
Step 3	Conduct interviews with actors of projects	Observe in practical cases what institutional factors and encountered and what conditions are needed

The table below summarizes what methods are used to gain what information.

Table 4 - methods

4.2.3 Operationalization

To conduct the interviews in a reliable way, the factors and conditions are defined and operationalized. This has been done in chapter 3, and an overview can be found in the last paragraph of that chapter (3.5). By conducting semi-structures interviews, certain themes are discussed. Therefore, the operationalization did not have to be specified to concrete interview questions, but to broad themes. In table 5, on the next page, the list of topics for the expert respondents and project respondents can be found. In table 6, the list of topics for the instigators can be found. The topics addressed in those interviews are more broad and focused on the conditions that they create and the change they think is needed.

4.3 Data analysis

4.3.1 Methods and coding

All interviews are transcribed: every detail is written down. Those transcripts are coded, by using the computer program Atlas.ti. This is done on the basis of a scheme of codes. This scheme is initially based upon the themes found in the literature and operationalized. However, the concept of open coding is also partially used (Van Thiel, 2014). If there were other institutional factors or conditions found in the empirical research, a new code was added to the coding scheme.

Furthermore, the coding process consisted of two parts. First, the transcripts and notes were coded exhaustively; secondly, axial coding was used to find patterns in the codes and to order them.

The coding scheme is added in the appendices (Appendix A)

4.4 Reliability and validity

The quality of a scientific research is often measured by its reliability and its validity. For qualitative studies, this is translated into the comprehensibility (reliability), referring to whether it can be repeated, the transferability (external validity), which means that the results can be generalized, and the plausibility (internal validity), which refers to the question if the researcher measured what he/she wanted to measure (Van Thiel, 2014, p. 150).

For a research to be comprehensible, the concepts should be used consistently and the research has to be executed objectively (Bryman, 2016, p. 157). In this research, the institutional factors and

List of interview topics - experts & projects

Theme 1: General

- Barriers to innovation
- Factors of success
- Conditions needed to overcome barriers

Theme 2: Regulations

- Presence
- Influence on circular innovation
- How come/change

Theme 3: Routines and structures

- Presence
- Influence on circular innovation
- How come/change

Theme 4: Innovation versus old success

- Importance
- Influence on circular innovation
- How come/change

Theme 5: Decision structure

- What does it look like
- Influence on circular innovation
- How come/change

Theme 6: Contract suppliers

- Presence
- Influence on circular innovation
- How come/change

Theme 7: Attitude towards change

- What does it look like
- Influence on circular innovation
- How come/change

Theme 8: Environmental concern

- Presence
- Influence on circular innovation
- How come/change

Theme 9: Frame

- Dominating lens
- Influence on circular innovation
- How come/change

Theme 10: Proof skepticism

- Required proof in relation to traditional materials
- Influence on circular innovation
- How come/change

Theme 11: Role model

- Importance
- Influence on circular innovation
- How come/change

Table 5 - List of topics experts and projects

List of interview topics – Stimulating organizations

- Theme 1: Current regulations and incentives
- What are they
- How do they work

Theme 2: Real trends/necessary conditions

- What are the barriers and success factors
- How come/change
- Role of organization

Table 6 - List of topics instigators

conditions are extensively covered and explained in the literature review, which prevents interpretation errors or differences. A topic list is constructed to be consistent in conducting interviews. Moreover, the interviews are transcribed, which leaves little room for own interpretations.

This research attempts to generate generalizable outcomes, enhancing the transferability of the research. It is acknowledged that the institutional factors found, won't occur in every construction project and that the conditions won't be needed in every construction project. Every project contains different techniques, (human) resources and other important factors. However, the factors and conditions that are found in this research, could for every circular project be a possible issue or solution. The outcomes of this research contribute to the acceleration of circular innovations in every construction project (with the ambition of using circular materials). Therefore, the transferability of this research is high.

The plausibility is the last criterion measuring the validity of this research. The aim of this research is to explain the route from plan to reality for the implementation of circular ambitions. It has been chosen to look at institutional explanations. This has several drawbacks. The first is that other factors, like technological, financial or practical barriers, are disregarded. However, a lot of research has been done on why institutions in the construction sector fail with regard to their technological, financial and practical aspects. Little research has been done on the institutional barriers, and therefore this research does not take other factors into account. The second drawback could be that in conducting the interviews, respondents could often try to explain the gaps by looking at those other factors, instead of looking at the constraints of certain routines and behaviors. They also might point to other actors and blame other actors, to make sure every actor is covered. However, it could limit the insights that people could have given by reflecting on themselves.

Overall, the research has a high level of comprehensibility and transferability. The plausibility is high as well, but there are certain threats to the internal validity of this research.

4.5 Ethical implications

To conduct an ethical research, researchers have to adhere to five guidelines (Van Thiel, 2014, p. 154). The first is that the research should have a positive aim and contribute to existing knowledge or to a solution. It should not do any harm. This research is intended to find the conditions under which the barriers could be overcome. Therefore, the research has a positive aim. The second guideline is that the research should not be misleading (Van Thiel, 2014, p. 154). This research tries to be as truthful and transparent as possible. Thirdly, the respondents should be able to call on their privacy (Van Thiel, 2014, p. 155). In this study, respondents were able to refuse participation and they were not forced to answer on all questions. The fourth guideline, confidentiality (Van Thiel, 2014, p. 155), is also adhered to. Before interviewing, the respondents were told that the data was going to be processed anonymously and that the voice recording was only intended for the researcher herself. The last guideline refers to informed consent (Van Thiel, 2014, p. 155), meaning that the respondent should give permission to carry out the study and publish the results. Although the respondents in this study were not explicitly asked for their permission, they were all informed about the fact that it would be published by Cirkelstad. None of the respondents objected.

5. Analysis

In this chapter, the findings are presented and linked to the previous theoretical insights. First, the findings of the expert interviews are elaborated on. Second, a separate paragraph is dedicated to the instigators. Last, those findings of the interviews with experts of the field are added on by an illustration and analysis of the two projects.

5.1 Factors

5.1.1 Legal factors

Regarding the question if there were legal barriers or accelerators for circular construction, there were a lot of different opinions. Of the people who did find the regulations restricting, one of the most mentioned regulations was the Dutch Building Code. It comes with a lot of rules that stakeholders need to adhere to. However, the restrictions for circular construction are mostly related to very small elements. An often mentioned example refers to the reuse of doors:

"If you look at door height, that used to be 2.10 meters, and I think nowadays that's even 2.30 or 2.40. [...] But if you want to reuse doors from buildings, they are still 2.10 or lower. And that would work fine, so to speak, but the building regulations that have been laid down, do not allow you to reuse such a door. If you look, for example, in offices where sometimes hundreds of doors come out that can still move to a new place, than that's of course a great shame." – Contractor 3

Others feel like the building regulations are being piled up and boarded up, because of the newness of the concept of circular construction. However, most respondents don't think this is a good solution. Contractor 1 agrees with this vision. Contractor 1 mentions that regulators tend to board it up and make new standards because it is still quite unknown, but that this only works in a restrictive way.

Despite these restrictions, a lot of respondents acknowledge the added value of the building regulations. Its function is to ensure for example fire safety, natural lighting and soundproofing.

"I think building regulations exist with a reason. You just have to respect them." - Producer 3

Besides, there was also a part of the respondents that didn't find the regulations restrictive at all. They knew that it should be possible to construct circular buildings despite of the building regulations. The rules should be interpreted creatively and you have to be willing to read between the lines. According to Client 2, this free space within those regulations should still be discovered. Instigator 3 says the following about this, with regards to the procurement law:

"The statement that it is restricting, no, it doesn't have to be. [...] If you read it straight-forward, it could be restricting. But if you look for the grey areas, you can do a lot. So it has to do with attitude and culture instead of the content of that law." – Instigator 3

Another contrasting view on regulations is that they are not ambitious enough. Both clients, architect, contractors and producers believed that the norm for the Environmental Performance of Buildings (MPG) could be stricter, more ambitious and broader implemented. Currently, the MPG is only active in the construction of houses and offices and it imposes a maximum score of 1.0. This maximum should be lowered and the range should be broadened, according to most respondents.

"It actually has to be lowered to 0. The state imposes a maximum of 1 in the Building Code, but you meet that fairly quickly." – Client 1

Conclusion

The results correspond with the theory with regards to the fact that the construction sector is highly regulated, because it has to guarantee important things like safety. In the literature review it was said that these rules don't have to be restricting, but the flexibility within those rule is important (Economisch Instituut voor de Bouw, 2017). This is similar to what some of the respondents said. However, in the literature it is pointed only to the flexibility of those rules, whereas the respondents

also point to the actors' capability to read between the lines. Furthermore, an important addition is that the rules could sometimes be restricting, but this requires a flexible attitude of the people working in the project. In other words, sometimes flexibility within the rules has to be sought, and sometimes flexibility within the attitude of the workers. Furthermore, none of the respondents mentioned regulations stimulating circular innovation, whereas in the literature this was mentioned as a possible accelerator. What seems evident is that there are a lot of different views on the impact of regulations on circular innovation.

5.1.2 Organizational factors

Four organizational factors possibly influencing circular innovations were mentioned: routines and structures, risk management, decision structure and agreements with suppliers.

Routines and structures

Every respondent acknowledged the fact that the construction sector is a very traditional one and that it is stuck in a lot of routines and structures. Everything has been happening the same way for a long time and construction workers are holding on to those routines. As Contractor 2 puts it: they don't ask themselves why they build houses with bricks and why they use cement to brick them together. They are used to those routines.

"The construction sector is seen as a very traditional sector and I think that that's true. Some companies are changing a bit now, but we are constructing in the same way for a long time. So there are a lot of things that we do because we always do them like that." – Contractor 1

The fact that those routines lead to not being critical on certain processes is one thing. Another consequence is that some companies are not even aware of their own processes. Producer 1 mentioned that he/she asked a construction company how they got their own materials and they did not know that. So it seems that as a result of these routines, processes aren't thought through and evaluated any more, which makes it harder to innovate.

Different routines and structures were mentioned. A construction project consists, for example, of very strict phases and schedules. The process of designing exists of the path from initiative, to sketch design, to provisional design, to final design. According to Contractor 3, most of the times the construction methodology is discussed at the end, whilst if you want to construct in a circular way, this should already be taken into account at the beginning. Furthermore, new, unknown products disturb traditional schedules and processes.

"The schedules that you make are on the basis of data that you have from the past, from knowledge of the past. And, for example, sustainable concrete takes longer to apply and to harden, which is at the cost of your traditional construction schedule." – Contractor 3

Other structures that were brought up multiple times were: the traditional form of tendering, which is price-driven; the fact that constructors are very busy and have little time to figure new things out; the focus on traditional business models, causing little room for lease models; and the BREEAM certificates, which are seen as stimulating, but also slowing down circular innovation. This is because contractors lose their motivation after they have reached a certain goal. Producer 2 said the following about that:

"With BREEAM it is a matter of checking off points. If the contractor has got enough points, he then loses his interest in using sustainable products." – Producer 2

One important structure that has a lot of impact on the possibility to innovate, is the Product Requirement Document, containing all requirements of a certain project, made up by the client and architect. A lot of respondents stated that it is important that the circular requirements are formulated clearly in this document. A contractor bases his price on this document. It costs extra money to change products, once the contractor has taken up other products in his price.

"[The construction worker] is used to: 'this is my task, this is the requirement document, this is what I have to build, oh this was not in the requirement document, so I have to order this and that will cost you more, here you go client'" – Instigator 3

Risk management

One reason was coined very often to explain the lack of circular innovation in the construction sector, which is that the contractors don't want to take risks. Traditional materials are easy to use, because it has been proofed a lot of time that it works. New, circular materials are seen as scary. The fact that the contractor bears the risks, makes it uninviting for them to innovate. When the building is completed and something goes wrong in the years after, the contractor is still responsible.

"We also feel responsible for the moment that it is handed over. We are not going to apply something of which we doesn't know, well maybe in two years the resident has a problem or it doesn't look good anymore, or it no longer insulates [...]. We have to be sure that it is correct on all those points." – Contractor 1

Producers also consider this as one of the reasons why their products aren't chosen sometimes. They see that contractors don't want to get claims afterwards. Also, when they do take the risk, they see that contractors will charge more to hedge the risk.

The reason why contractors often don't dare to take risks, is because construction companies have very low margins, which is also recognized by some respondents. Making little profit influences the possibility for innovating.

"So if you can't have more margin on a project, there is little financial room to innovate. [...] When you know at the end of the race I will 10% profit left, for example, you will move less convulsively than when you know I only got 2% profit. If something little goes wrong, the project will cost me money instead of make money." – Contractor 3

The contractor is not the only actor feeling responsible for what happens to the building after completion: clients often remain administrators of the building and therefore are also cautious with innovating.

"For us it's a big risk as well. Because we keep stewardship over those houses and if that goes wrong... so at some points we are thoughtfully innovative." – Client 2

Decision structure

The decision structure within construction project seems to be a very important factor influencing circular innovation, for different reasons. The first reason is its complexity and the fact that so many different actors are involved in one project. One of the respondents compares it with a game:

"I feel that, you sometimes see a little quiz on TV, in which one person has to pass on a certain sentence to another person, and then that person again.. And after the fifth time the whole sentence isn't correct anymore. You could compare [the construction sector] with that." – Producer 2

Another important factor in the decision structure is that currently most tenders are done on the basis of price. According to Client 1, tendering is a way to stimulate innovation, by asking for certain visions and circular plans. However, according to most other respondents, tendering is inhibiting innovation, because the submission with the lowest price is always chosen. Moreover, the contracts for projects are often being boarded up completely: the clients write down exactly how they want to have the final acceptance of the project. Contractors feel that because of this, there is no room for innovation or for a good conversation between contractor and the client. They feel that there is no trust between them.

"And at least you don't do that by writing a contract in which everything is boarded up. Because then you actually say: 'I don't trust you, I'd rather write it down" – Contractor 3

Furthermore, besides the complexity of the construction sector and the lack of trust within contracts, another dominating view within the sector is influencing the willingness to build circularly. According to some respondents, the thought of 'what's in it for me?', instead of 'what's in it for us?', comes at the expense of fruitful collaborations. Instigator 1 says that people still think in boxes and they only want what's best for their own company. Producer 3 adds:

"How many are really willing to share knowledge? [...] It is still a race to be the best, to come out of the game as the only victor. And to not create the group feeling." – Producer 3

This group feeling and those fruitful collaborations are, according to almost every respondent, the most important accelerators to come to a circular construction sector. There seems to be a crave for working in consortia, based on trust and openness, instead of based on tenders. Reasons for the positive opinions about this, are that all actors are able to think along and, and according to Architect 1, both clients and contractors can indicate the risks they see. Furthermore, it works positively because at the beginning of such collaborations, it is made sure that there is an equal ambition between the actors.

"If you know each other's interests, you will collectively take the decisions that work good for each other. But for achieving this, you have to sit down together and talk." – Contractor 3

In this conversation, not only the ambitions and interests should be discussed, but according to some respondents it is really important to have conversations about questions like: who pays the additional costs and what is a fair distribution of bearing the risks? Currently, this conversation is not conducted enough.

"The most important thing is that a fair conversation about the additional costs is conducted. If we, all together, think that it's important to build circularly, who is going to pay the initial investments?" – Contractor 2

In such collaborations, it seems to be important that the client takes a very active role. A lot of the respondents indicated that an actively involved client can be seen as one of the important accelerators for circular innovation. Part of this role is that the client formulates the circular ambition clearly and right at the beginning. On the question why one of their projects was built successfully circular, Client 2 answered that they immediately put the ambition on the table. The architects, contractors and producers all agreed with this.

"If a client asks it that explicitly, you see that it happens." – Producer 2

Even in traditional tender procedures, the role of the client is important. Respondents claimed that clients should reward the architects and contractors that have circular ambitions, by choosing them instead of the cheapest one.

Agreements with suppliers

There are various results regarding the influence of agreements with suppliers on circular innovation. Clients and contractors do have some framework contracts as agreements, but not for all of their products. There are different opinions about those framework contracts. Contractor 1 thinks long-term agreements with suppliers make sure that you trust each other and therefore increase the chance to look for innovations together. However, Client 1 acknowledges that if a framework contract doesn't go as you like, you can't get out. This may inhibit innovation. This is contradicted by, among others, Architect 1 and Instigator 3:

"As private [construction] party you can choose whoever you like. Always. And of course you will sometimes have long-term agreements with a supplier, but if you don't like that you can always get out." – Instigator 3

However, still some producers encounter problems due to agreements between construction wholesalers or contractors and suppliers. Those problems are mostly related to (financial) benefits due to long-term collaborations or bonus agreements.

"I know that at the bigger construction companies, but also at the smaller ones, they have benefits when they buy their products at the same wholesaler again and again. So, I don't know if that has to do with long-term contracts, but they are kept on the hook." – Producer 1

Conclusion

The findings are for the most part similar to the concepts from the literature, but new insights arise. The findings of first concept, structures and routines, are as expected. When path dependencies arise, it is difficult to let go of certain routines (D'este et al., 2012). Eijkelkamp (2018) mentioned that the construction sector is very traditional. Therefore, routines are even more difficult to change. This is also what is found in the interviews with the respondents. The second topic that is dealt with, risk management, could be linked to the focus on old successes instead of trying out new things (D'este et al., 2012). Traditional ways have proofed to be successful, and therefore aren't appealing to change, because of the risks it brings. For the decision structure, findings have opened new doors. Nothing is said about hierarchical structures inhibiting innovation (Rolfstam et al., 2011). However, the fragmentation and complexity of the sector is mentioned as barrier (Dainty et al., 2002). What is added, and not found in the literature, is that collaborations, based on trust, are very important accelerators for circular innovation, as well as the active role of the client. The last topic relates to the agreements with suppliers. Both views that were brought up in the literature, are mentioned. Agreements with suppliers could be accelerators since they lead to trust (Eriksson & Laan, 2007), but sometimes those agreements seem difficult to end, which could hamper innovation (Rolfstam et al., 2011). However, some respondents said that those agreements could always be terminated, but financial benefits seem to play a role.

5.1.3 Value-related factors

Three factors related to the values of people in the construction sector were pointed to: the attitude towards change, the presence or absence of environmental concern and the sector-based culture.

Attitude towards change

The attitude that people in the construction sector have towards changing their habits, is mostly negative. Producer 1 summarizes it well by saying that he/she thinks that the people in the construction industry are not very willing to change. Other respondents agree and point to the fact that they are used to their routines and habits, and they want to stick to these habits.

"I notice that people in the workplace would like to hold on to things they are familiar with." – Client 2

Contractor 2 recognizes this and mentions the lack of support for innovative measures that comes with it. Decision makers always pay attention to the level of support when making decisions about new investments. If there is no support from people in the workplace, it's difficult to make those innovative decisions.

One of the reasons why this attitude towards change is negative, coincides with the part on risk management in paragraph 5.1.2: new things are scary and could have more risks. Other reasons for this attitude are found in the argument that changing costs time and effort. The construction sector is currently a very busy sector and this is often used as an argument for not innovating, according to the producers. Producer 2 mentions the time that it will costs the contractors to inform their workers and prescribe new products. Producer 3 agrees:

" And they just don't do it. Because they're all too busy with the regular stuff they get on their plates every day. [...] They want to. We say: 'Then do it'. 'Yes, but it's so much effort! And it costs time.' What I see, is a bit of procrastination." – Producer 3 This lack of time and the negative attitude towards circular construction also comes from the fact that a few years ago, the construction sector 'suddenly' had to pay attention to the energy transition. What, among others, Instigator 1 sees, is that the construction sector feels like the concept of circular construction comes on top of the energy transition and asks for more investments in time, money and effort again. However, according to Instigator 1, the thought that it will cost more money if you want to apply circular innovations is often a premature thought and does not have to be true.

Environmental concern

Almost all respondents mentioned that people in the construction sector often acknowledge the need for circular innovations more and more, but the 'how' is still unclear to most of them. Contactor 1 notices that everybody knows it now, but to actually implement it in your daily job still seems difficult. Architect 2 agrees and says the following.

"If they don't realize that, I don't know where they've been all that time. [...] Only the perspective to come to action is still missing. We are not able yet to translate it to action, I think." – Architect 2

Another remarkable finding is that most of the respondents do not speak of environmental concern, but of intrinsic motivation, although those two are intertwined. Intrinsic motivation is mentioned by almost all actors as one of the accelerators. If there are motivated people on the project, it often works out.

"I think that the biggest factor of success is the involvement and effort of people in the field of circular construction." – Instigator 1

From another point of view, some respondents add to this that if people are on the project who are not interested in circular innovation, you can get away with everything.

"Because people don't have the knowledge, and if people don't care, you get away with bullshit. If a government says 'we have to build circularly, but they don't really care, you'll get away with a half solution." – Contractor 2

Sector-based culture

Almost all respondents were unanimous about the currently dominating frame in the construction sector: a financial frame. According to them, most choices in tenders and procurements are made on the basis of costs and risks. Two examples of this statement, are the following.

"Money. I think that is still the factor. Time and money. Not the soft values." – Architect 2

"In the end it is price, price, price. Price and ease." – Producer 1

Producer 3 adds that it is a race to the bottom, in which every actor in the construction sector is involved.

"Of course I can point the finger to contractors, but we also have to become faster and cheaper, and even more fast and cheap. Until we think, well, actually it isn't possible to become even faster and cheaper. But we still do it. Let's cut some more costs. Maybe we can cut a bit here, and there, until we see, oh, we can't cut anymore. So everybody is in that same downward spiral." – Producer 3

Besides the focus on money, in the construction of housing there is also a focus on efficiency. It has to be build fast and cheap. Fast, because the pressure on the housing construction is very big, and cheap, because social renting housing cannot be too expensive, according to, for example, Client 2.

"The pressure on the housing construction is very big, I believe that, and many people have to accommodate. But that makes things like circularity subordinate." – Client 1

Another attitude dominating in the construction sector, is the no-nonsense culture. Construction workers are committed to the practical side of construction. Contractor 2 puts it as follows:

"The construction [industry] is also very no-nonsense. So: 'Isn't my task simply just to build a house?' That is firmly anchored in the culture, not to solve a climate issue." – Contractor 2

What needs to be added is that the focus on money and efficiency makes more and more way for things like sustainability and circularity. This is a development that some respondents notice.

"Still money. Budgets. That's logical. But what you see is that, let's say by looking back 10 years, it was 99% budgets and the rest maybe quality and sustainability. And now you see that changing a bit. No idea exactly, but you could say that nowadays the percentage is increasing to 10-15%, that people more consciously say: 'Well, then a little less, but more sustainability'. And the goal is of course that that will increase even more and that, finally, you get everybody along." – Architect 1

Conclusion

In the literature it was mentioned that shared frames, i.e. culture, could hamper innovation because people are trapped in a certain frame (Vermeulen, 2011). The findings are endorsing this statement, although a clear relation between the culture and innovation is not explicitly given. However, the race to the bottom gives a good picture of the culture that the construction sector is in. The focus on money, which is a structural frame according to Bolman and Deal (2017), is a lot bigger than the focus on sustainability and circularity. When this is the dominating frame throughout the whole sector, it is more difficult for one actor to step out of this frame, knowing that you will be judged on your price.

5.1.4 Concept-related factors

On the basis of the interviews, a new category is added, relating to the definition of the circular economy and circular construction. Two interrelated themes seem to be important: the ambiguity of the concept and the importance of making the concept concrete and tangible.

Ambiguity of the concept

Circularity is a relative new concept in the construction sector, which seems to be one of the reasons why actors think it is hard to apply. For example, according to Instigator 2, people don't know where to start because of the ambiguity of circularity in the construction sector. Architect 2 expresses the feeling that it is not clear what materials are circular and what materials are not, because of this ambiguity. Another consequence of the ambiguity is that clients try to formulate their circular ambition without really knowing what they mean by it.

"So you suddenly see circularity in many requests, while clients sometimes don't even know what exactly they want." – Contractor 3

The ambiguity of the concept translates to many different definitions of circular construction. Some of the respondents valued the reuse of materials, while others thought more attention should be paid to the use of products, in the sense of leasing. One of the respondents valued co-creation with residents as circular construction, while another respondent prioritized the health of materials. The variety in definitions makes that some people can't see the wood for the trees anymore.

"Everybody shapes it a bit differently. So I think, if you put six projects side by side, that they make different choices in some areas, but with the same intention to build circularly. And I hope that we learn so much from each other that we also understand those and that at one point we achieve consensus about what circular construction is." – Client 2

However, it is also acknowledged that the concept of circular construction should not too much be pinned down.

"If you make one definition, you might exclude other initiatives, while those are really good as well." – Instigator 2

Another consequence of not having one clear definition is the act of greenwashing. According to Contractor 2, controlling sustainable or circular claims is happening too little. Suddenly, many

organizations say they are working circularly or have included it in their slogan. This kind of practices could be a disadvantage for producers that truly are circular and are trying to win a spot in the market.

"Products that are not sustainable at all, but what is called greenwashing, they say: 'We are 100% biobased'. But then it turns out that the binder is 100% biobased, but the binder makes up 5% of the total of the product, so 95% is still the same composition and not biobased at all. That is something we are dealing with" – Producer 2

Making it tangible

The ambiguity translates in the fact that it is a very vague concept. In the construction sector, however, there is a strong need for tangibility and concreteness. This could be done, according to Contractor 1 and Instigator 2, by stimulating small changes instead of whole projects, which makes it a more realistic change. Client 1 agrees with this and says the following:

"Especially keeping it real, so not saying we should immediately change the whole world because then you could antagonize many people." – Client 1

Besides starting small, making it visible is also an important need, according to some respondents. This could be interpreted in two ways. Client 2 refers to the fact that circular measures have to be visible from outside. Contractor 3 interprets it in another way, referring to making the impact of measures visible and tangible:

"Provide insight in what such an improvement can mean for the project. Sometimes that would be with sustainability figures, for example that you have less CO2 emissions or a lower MPG. But sometimes it could also be in euros. We still don't know that some sustainable solutions make sure you have lower costs." – Contractor 3

Conclusion

In conclusion, a whole new category of factors influencing circular innovation is added, which was not mentioned in the literature review. This category relates to the newness and ambiguity of circularity in the construction sector. The vagueness creates uncertainty in the question where to start and how to do it. The construction sector seems to have a demand for making the circular challenge small, concrete and tangible.

5.2 Conditions

5.2.1 Functional conditions

An important condition, according to a lot of the respondents, is financial pressure. If businesses financially feel the pressure that they have to innovate to be able to remain profitable, they will do it. Many respondents agree that in time, ignoring the circular transition will be a decisive business disadvantage.

"And finally, when he will feel it in his pockets, so that turnover is decreasing because nobody wants to build with him because he is not sustainable, so he won't receive any construction orders anymore, or no subsidies." – Producer 1

"Stagnation means decline." - Architect 1

This also translates in the fact that producers feel that their products have to be financially profitable. As Producer 3 puts it, nobody will buy his product if it's too expensive and it doesn't yield anything.

As a proof that financial pressure works to get businesses to innovate, the crisis in 2008 was often recalled. In that time, construction businesses started to wonder how they could remain profitable. Some respondents mentioned it as an incentive to change their businesses.

"At the height of the crisis we said: how is our future looking and what do we have to change? In our company we agree that we can't go on as how we used to." – Contractor 1

However, not only this negative side of financial pressure was mentioned as an incentive. Especially the story that it brings opportunities was valued by the respondents. The mentioned opportunities vary from direct financial benefits, to improving the image of the company, causing commercial benefits, and to the proud feeling that it gives when you have accomplished a circular goal.

"That shows that it pays off. And that should become the anecdote or slogan: that circularity or sustainability, that it pays off." – Producer 2

According to some respondents, clients are important in stimulating these (financial) benefits. They should make their decision which contractor to choose not on the basis of price, but on the basis of circularity.

"Rewarding and motivating by the client, in most cases the government. [...] That you get the project if you build circularly." – Contractor 2

The government was not only pointed to regarding its client role, but also in another way. A lot of respondents mentioned that raising taxes on unsustainable products or granting subsidies on sustainable ways of working would be the solution. Another solution that was mentioned very often, was switching from taxes on labor to taxes on raw materials. This would give a boost to a circular construction sector, since that is very labor-intensive instead of resource-intensive.

"Incentives to promote the use of circular construction materials or circular construction. Or the use of sustainable materials. There should be financial incentives to do that." – Producer 1

Conclusion

In the literature review, functional pressures were introduced as deriving from perceived problems in the performance or utility of activities and resources (Oliver, 1992). In the construction sector, this was linked to being aware of a deficit in raw materials or of a decrease in performance of the company. The findings support this viewpoint. It is mentioned that some companies rethought their way of working in the crisis and started to innovate. The feeling that building circularly will be a decisive business advantage also seems important to change traditional ways of working. However, in the literature the focus was on negatively framed financial pressures, while the respondents mentioned that the positive framing of the opportunities is important to get people along.

5.2.2 Social-cultural conditions

Collaboration was often mentioned by the respondents as a condition to overcome the barriers. This was also mentioned as accelerator in paragraph 5.1.2 under decision structure. However, the required collaborations mentioned are mostly between like-minded actors within the construction sector. Collaborations in which everyone has the same goal and ambition: integrating circularity in a construction project or in the sector.

However, according to Architect 2, we need to look more broad and search for more inter-sectoral collaborations. A building is not just a building: it has an effect on the environment, on the people living in and around it and on other sectors.

"And I think that, in the Netherlands we are organized very sectoral [...]. It isn't viewed in its entirety, integrally." – Architect 2

Besides the inter-organizational collaborations and this one comment on integrality, the social-cultural conditions were not often mentioned as condition to overcome the barriers. Only a single respondent brought up the lack of diversity in the construction sector, and that more diversity is needed to overcome the barriers for circular innovation, because that comes with different views, possibly contradicting the dominating, traditional view.

"The old generation will slowly be replaced by a younger generation and they are all open for it. That is something you can't accelerate. The big, white, blue-suited men that are up in the boards of the construction sector, you could bring some diversity in there, so some more young people, some more women. People with different backgrounds." – Architect 1

Conclusion

The respondents find it important to work with like-minded people that also have a circular ambition. However, this is the opposite of what was stated in the literature, which is that diversity, a change in workforce or close connections with other organizational cultures is needed (Tina Dacin et al., 2002; Powell & Sang, 2013). The need for integrality and more diversity were only mentioned twice. This leads to two assumptions. The first is, reductively, that if all like-minded people with the circular ambition collaborate with each other, there is no one with intrinsic motivation left that is going to change the mindsets of not like-minded people. Secondly, social-cultural conditions might still be needed, but people do not realize it.

5.2.3 Structural conditions

According to most respondents, people should not be able to ignore the need to build circularly anymore, because the market asks for it. Developments in the markets should show that it is time to change.

One side of the market is the demand side. A lot of respondents indicated that the demand should increase in order to overcome the barriers of circular construction. This is related to the role of clients in, for example, formulating their tenders, which was mentioned before. However, also the contractors should increase their demand for circular products.

"One and a half year ago we visited our clients*, and the general trend was that there was no demand." – Producer 2 (*clients = wholesalers)

Demand could also be translated to demand from society and the feeling that you have to change in order to feel accepted by society. For example, some of the respondents mentioned that their incentive to change was that their companies found it important to contribute to societal challenges and that this societal involvement of companies was the reason for putting effort in the circular transition.

"We feel sincerely connected to the societal themes that.., we think that we have to actively work on sustainability, digitalization and innovation." – Contractor 2

Some of the respondents also mentioned that not only the demand side is important, but also the availability of enough possibilities in the supply side, so that contractors are able to choose. If there is only one option, the contractor won't make that switch easily because they cannot choose between different qualities or companies. Besides, the more alternatives available, the cheaper the innovations will become.

"There are enough alternatives. That is an important one, I think. If companies make the switch, if they want to take the risk, there must be sufficient alternatives, enough choices." – Producer 1

Conclusion

In the literature review, structural conditions were introduced as developments in market conditions, i.e. demand and supply (Dolata, 2009). The need for an increase in demand and supply mentioned in the interviews correspond with the literature. The demand side from both clients and contractors seems to be an important factor for overcoming the barriers, as well as the feeling of contributing to solutions of societal problems, which could be seen as a demand side from society. The supply side was also mentioned, like in the literature (Dolata, 2009). If there aren't enough alternatives of innovations available, it could be more scary for contractors to purchase it.

5.2.4 Political conditions

Regarding the political conditions, three different levels were discussed by the respondents: the governance level, the management level and the entrepreneurial level.

On the governance level, most respondents advocated for a more ambitious government on the field of circularity, both on national and EU level. A top-down control with more stricter rules and incentives was mentioned as part of the solution by some of the respondents.

"The government must formulate policies and increase the pressure on this, like 'this is what we have to do'. You already see it happening with energy, there is already national legislation and on European level legislation is now also being deployed. So that's been going on there a bit. But it also has to happen on a circular level." – Client 1

Besides this top-down governance, according to a lot of the respondents, the government also has an important exemplary role that she has to show.

"I think that the government, if you talk about circular construction, also has a pioneering role [...] and she must lead by example. So they can just look at their procurement in their government buildings. I don't think that always happens in the right way either." – Producer 1

The second level refers to the managing boards within organizations. Most of the respondents mention the importance of getting your managing board along. When the managing board is advocating for circular innovation, this will slowly become part of the DNA of the organization.

"So there should be more focus on the motivation. Because when it becomes more difficult, innovations will always take a path with a few bumps. And then you have to be motivated by your managing board." – Contractor 3

This is not only the case within construction companies, but also for the companies/organizations of the clients and the companies of producers, when they are part of a bigger company.

The last level is the entrepreneurial level. People within the company that are intrinsically motivated, are by almost all respondents being valued as important entrepreneurs, stimulating the circular transition. The next step is to get other people behind them.

"And the second point, and that's how it works in every company, is that, in our company there are some people, and I am one of them myself, I think, I hope, who fanatically believe in circularity [...]. And the more support that kind of people get, the more circular a company will be. Personal level is very important." – Contractor 2

Conclusion

Political conditions were described as twofold: political dissensus and the presence of powerful stakeholders and visionary entrepreneurs (Oliver, 1992). The first level described in the analysis, referring to the top-down control of national and EU government, could be linked to the political dissensus. If some of the political players will advocate for more radical measurements, political dissensus could have influence on the current policies. Secondly, the managing board level corresponds with the importance of having powerful stakeholders supporting your vision. Last, the intrinsically motivated workers could be seen as visionary entrepreneurs and could be able to break through the current practices by gaining support.

5.2.5 Educational conditions

Although it wasn't mentioned in the literature review, the educational aspect of circular construction seems to be an important condition for removing the barriers. One of the most evident ways of education within this challenge is knowledge sharing. There are a lot of organizations and initiatives that work on this, like Cirkelstad, but also from the respondents' organizations themselves.

"That's why we established a foundation in which all those players come together. And they will see their interests being served. And they might ask some research questions, like: 'we don't know how to bring this product to the market, etc.'" – Producer 3 However, one of the respondents made a fair point about the craftsmen in the construction sector. They often prefer action instead of talking.

"And that suits a technical construction company more. They don't want to talk, but they prefer actually doing it." – Contractor 3

This hands-on mentality is also what other respondents think is what is needed. By just doing it and by experimenting, you will learn from your own experiences.

"And eventually, I think it's worth it that we try because in the end we learn a lot from it. And you can always make a better or more realistic choice after trying." – Client 2

An important educational condition that is needed, is the presence of example projects. Example projects are important conditions by functioning as a proof that it is possible and doesn't have to be more expensive, and as a way to learn from each other's successful projects. Besides, by showing example projects, frontrunners also want to contribute to this transition.

"What we try is to show that it is possible. Than the discussion has become unnecessary. Because yes, you've showed that it's possible. Gone, discussion." – Architect 1

However, one of the respondents notices that there is a scarcity of those big example projects. There are a lot of small example projects, but Instigator 3 is wondering when there will be more of the big, voluminous example projects.

"What worries me, is that the example projects that we have in the Netherlands, that we still talk about the same projects as five years ago, with the exception of Circl coming along. [...] In the crisis construction companies had to innovate because they had less work. And for the work that they had, they really had to put effort in it. And all of these example projects have their origin in the crisis." – Instigator 3

The role of the crisis was already mentioned in paragraph 5.2.1 on functional conditions.

Another important issue is about training and education. Architect 2 mentions that it is important to start the knowledge of circular construction in the education of students. Furthermore, one of their contractors offers their workers a compulsory training that relates to waste management, in order to make them more aware.

"Currently, we have a project in which we put people to work with a change process. They all attend a training [...], and for this they have to go through a circuit of change. The assignment is to do it all with a waste project." – Contractor 1

Conclusion

In the literature review, educational pressures were not mentioned as a condition for breaking through institutions. However, the respondents reveal that it certainly is important. This could be in the form of knowledge sharing, but learning by doing and educational activities, like training, are valued even more. Example projects are considered very important.

5.2.6 Awareness

Almost all respondents mentioned the importance of raising awareness among workers in the construction sector. It should be in the basis of our thinking.

"Getting people motivated to understand what sustainability is, why it's important and how circular construction can contribute to a more sustainable world." – Instigator 3

The opinions about the degree of the current awareness differentiated. According to some respondents, the awareness should be increased. Producer 2 mentions that this process of awareness

raising is taking a long time and that this should be stimulated top-down. By making it the norm in the demand of the government, this would raise awareness of other stakeholders.

"I think [awareness] is created by the request made by the government, to match that more to sustainable initiatives. [...] And the moment that you can articulate that it is okay if it costs a bit more [if you can demonstrate that you are really sustainable] and you still win the tender, it would lead to more awareness." – Producer 2

However, most of the respondents mentioned that the awareness is already there, but the perspective to action is still missing (already mentioned in paragraph 5.1.3 under environmental concern).

"We are now at a point at which we don't have to explain ourselves, but that people come to us with questions: 'I want to, and we have to, because it is important, but I don't know how." – Contractor 1

To create this perspective to action, the activity of circular construction should be made concrete and tangible (see paragraph 5.1.4).

Conclusion

In the literature review it was stated that awareness is a very important indirect condition to break with existing practices (Giddens, 1984). This would be the key to bridging the gap between environmental values and action (Chun & Leung, 2007). The interviews show that this awareness is indeed considered very relevant. However, awareness of what is needed is not enough. Awareness of how to do it and how to change behavior is currently needed to bridge the value-action gap. This was also mentioned in the literature review.

5.2.7 Facilitation

In the interviews it seemed to be the case that not everybody felt facilitated in some cases. There were different causes for this. Some of them will be elaborated on here. If people are more facilitated in those cases, it can be an important condition for overcoming the barriers.

The first matter in which respondents want to be facilitated more, is in seeking the flexibility in regulations. Some people don't know how to maneuver between the building regulations when constructing circularly. This is something that people need support with.

Moreover, in reusing materials, respondents want to be more facilitated in knowing which materials are released when and when can they be used for their building project.

"What you encounter is a matchings problem. What material do you need when and where is that available?" – Architect 2

Another important condition is that people should be facilitated in having conversations about who bears the risk and who should pay for the investment costs, both regarding the production and the use of circular innovations. In paragraph 5.1.2 under decision structure this element is already discussed in more detail.

"So I think what has to change first, are the conditions for the construction sector [...] and to really have a conversation about a good distribution of risk between client and contractor." – Instigator 3

Conclusion

Having the right infrastructure in place and companies knowing about that infrastructure, was considered in the literature review as an important indirect condition for circular innovation (Kollmuss & Agyeman, 2002). The respondents sometimes mention some areas in which they don't feel facilitated enough yet, like seeking the circular possibilities within regulations, matching material demand to released supply, having conversations about a fair risk- and cost distribution and financial incentives for circular innovations. This matches the expectations of the literature review, but it doesn't seem to be the most important condition.

5.3 Instigators and the conditions

Although the interviews with the instigators are not different from the other experts in the findings of what they think are barriers, accelerators and important conditions, there is a difference in responding to those conditions. The instigators have the intention to stimulate the circular transition. In this paragraph it is analyzed to what degree their measures respond to the aforementioned conditions.

Regarding the functional conditions, there are some financial incentives. The Ministry of the Interior and Kingdom Relations has some subsidy regulations to get more attention for circular construction, executed by the Netherlands Enterprise Agency. These are for example regulations for environmental investment deduction. The Rabobank has a circular impact loan, which is a kind of discount on interest. However, those regulations are more incentives then real financial measures. The experts in the field ask for revisions in the tax systems and for winning tenders on the basis of circularity instead of money.

For the social-cultural conditions, all the instigators interviewed are trying to stimulate collaborations between different actors. For example, the Ministry of Interior and Kingdom Relations is organizing buyer-groups, in which different actors on the procurement side are collaborating in the development and implementation of policies regarding circular procurement. However, those collaborations are inter-organizational instead of inter-sectoral. Also, there are no measures on enhancing the diversity within the sector and bringing not like-minded people together.

As a response to the structural conditions, Copper8 tries to stimulate the circular transition by looking at the demand of clients and trying to formulate different requests. Also, the aforementioned subsidies are intended to stimulate the supply side of circular innovations. However, there is little focus on the demand side of contractors, which is the party that has to purchase the innovations.

In accordance to the political conditions, all experts demand a more dominant role of the government and the EU. The Ministry of the Interior and Kingdom Relations is currently investigating the extension and sharpening of the Environmental Performance of Buildings (MPG) in order to impose stricter rules. However, the role of the government must be evaluated since the respondents have a need for more top-down control.

There is a quite good focus on the educational conditions. For example, one of the pillars of the Ministry of the Interior and Kingdom Relations is sharing knowledge and example projects in order to not having to reinvent the wheel again and again. Rabobank works with a circular business challenge and a course called Circularity in one day, in which participants will be informed and showed what they are capable of. However, maybe more focus could be placed on the offering of courses and trainings within construction companies and the programs on educational institutions

Awareness is tried to be raised by Rabobank by having lecturers and other instruments on what circular construction is and how it could contribute to a more sustainable world. However, more attention should be paid to creating a perspective for action. Copper8 tries to help with actually coming to action.

The last condition, facilitation, could be a summary of all measures mentioned above. Other ways of facilitating are for example Rabobank that serves a circular enterprise helpdesk, to which customers can call when they have questions about circular entrepreneurship. However, a lot can be improved in the field of facilitation, and not only by those three instigators. Other actors are needed as well.

5.4 Projects

On the next two pages, you will find Box 1 and Box 2 in which the projects are analyzed. Project 1 is the project of the new office building in which there was an ambition to implement circular innovations in the construction of the building, but in which it did not work out entirely. In Box 1, the results of the interviews regarding this project are shown. This project functions as an illustration of what barriers are encountered in practice when having the ambition of implementing circular innovations.

In Box 2, Project 2 is analyzed. Project 2 is a renovation project that is considered an example for other projects that have the ambition to construct circularly. In this case the circular ambition is being executed without any compromises in circularity. This project functions as an illustration of the accelerators and factors of success in practice, for projects in which the circular ambition is achieved.

In the next paragraph, a comparison of the projects is given.

5.4.1 Comparison project 1 and 2

Project 1 and Project 2 are in many ways each other's opposites . The importance of the ambition and the role of the client is the first big difference. In Project 1, the ambition was added later on in the project. Since the process in Project 1 was very traditional and steered by fixed phases, there was no room for changes afterwards. The client was not that much attached to the circular goal and dropped some of the plans. In contrast, in Project 2, circularity is the mission of the client. There is no other option. Since the client is very determined to achieving this goal, all actors involved have to follow this ambition. An important conclusion here is that in construction projects, the client really has to have a circular ambition in order to successfully achieve a circular building.

This ambition of the client in Project 2 led to the fact that if actors had struggles with the other kind of processes that circular construction brings, they felt like they had to accept this change and find their way in it. In Project 1, the struggle with the new kind of process was the cause of falling back to old routines and structures. There was no pressure from the client to hold on to the ambition.

Another important difference is that in Project 1, the quality of materials and the esthetical look of the building had to be guaranteed. The risk of trying out new things, like circular innovations, was not taken because often it wasn't known if the quality could be guaranteed. In Project 2, another view dominated. Project 2 is seen as an experimental hub and a testing ground. Their view is that if you don't experiment, you will never know if it works, which will have the consequence that you will always be stuck in traditional ways of working.

One thing in which both projects are a bit similar, is in their financial drive. However, this drive works out differently for both cases. In Project 1, some innovations were not applied because it would cost more money. This was due to the fact that changes had to be made in the Product Requirement Document, since the circular ambition was added later. In Project 2, money plays an important role in a different way. Besides the fact that the money isn't there, they also want to show that a project in which a lot of circular innovations are used, doesn't have to be more expensive than traditional projects.

Box 1 – Project 1: analysis

What is very obvious in project 1, is that the formulation of the circular ambition brought up some stumbling blocks. The circular ambition was not formulated yet at the beginning, which is why it was considered too late to change the plans and schedules of some components of the building. According to some respondents, the ambition was formulated too late.

"And unfortunately we were already in a phase that it would have had too much implications for the rest of the building. So it wasn't possible anymore for ordering and buying [other materials]" – Respondent 1B

Another point regarding the formulation of the circular ambition, is mentioned by Respondent 1C. It often happens, in this case as well, that the client doesn't really know what constructing circularly means. They don't realize that traditional routines and schedules need to change when switching to circular processes. If the aim is to work with materials that are released in the demolishing of other buildings, you cannot know in advance what the final design will look like. According Respondent 1C, this is one of the reasons why traditional processes were preferred instead. Respondent 1A and 1B agreed and said that it is difficult to know what materials are released when. In circular processes, people have less control over the sourcing, planning and execution and it is hard to let this go.

Another reason why traditional materials were often preferred over circular innovations in this project, is that the minimalizing of risks was considered very important. If the quality could not 100% be guaranteed, the risk was not taken.

"We are not going to experiment here with very new stuff, that has to be proven that it works. Otherwise you will have a problem during the exploitation phase." – Respondent 1A

An important success factor for this project for the innovations that were applied, was the fact that it had direct benefits. The delivery of direct benefits, like a healthier working climate, energy and profit seems to be an important trigger to make use of innovations.

"It is going to be a building in which a lot of work will be done. So every measure that was going to be taken had to generate direct added value for working in that building." – Respondent 1A

Another condition that would have been helpful in achieving the circular ambition, was, according to respondents, having someone from top-down that would really support the idea. In this project, different people from the managing board being responsible for the project were alternated. One of them really supported the idea, but was not involved when the ambition was formulated nor later on in the project. This is possibly one of the reasons why the circular ambition was not achieved.

"We definitely needed someone from the managing board that really supported the idea and was not afraid to do such a project." – Respondent 1B

Conclusion

What this case teaches us is that a circular ambition has to be formulated clearly at the beginning of a project and that the implications of this ambition has to be understood by the client. This corresponds with the active role of the client in the decision structure (mentioned in paragraph 5.1.2) and the definition of circular construction (mentioned in paragraph 5.1.4). Those two factors were not explicitly found in the literature review, but already appeared to be important barriers in the previous part of the analysis. In contrast, the tendency to hold on to traditional processes and routines and not daring to take risks for the sake of guaranteeing quality, are covered in the literature review as barriers stemming from path dependency and lock in, under the category of organizational factors (D'este et al., 2012). This case shows us that this is also what happens in practice. What would have been needed in this project to overcome those barriers, were functional conditions (Oliver, 1992), referring to seeing the direct benefits of the innovations; political conditions (Oliver, 1992), in this case meaning a more clear top-down management supporting the circular ambition; and feeling more supported in handling the challenge of having no control in the sourcing of materials, which could be linked to the condition of facilitation (Kollmuss & Agyeman, 2002).

Box 2 - Project 2: analysis

One of the important reasons why Project 2 became such a successful project, is, according to the respondents, that all the actors involved have the same interest and the same goal, referring to the circular ambition. In other words: all the involved actors speak the same language.

"And even more important [...] is that they are able to connect actors to them that want the same thing. So they have the right partners, and those are all in it together[...] and they are fighting the same fight." – Respondent 2D

However, this does not mean that new partners are not having trouble at the beginning of the collaboration with adjusting to the new way of working. New partners often fall back on their old routines and habits because they are not used to a circular process.

"Because this construction process is very different, since you cannot plan everything in advance because you are not sure what material you are going to use. So it's a reversed process. [...] And the people that actually do the executing job are used to doing something in a certain way for years, and suddenly they are asked to move away from that. [...] – Respondent 2A

However, since the client of this project really has the circular ambition and is really pushing for it, those partners are able to let go of their old routines and learn more and more to deal with the new process. Therefore, it seems to be an important accelerator of this project that the client is really holding on to the ambition.

"They want to, 100%. So, if they don't get that, they won't pay for it." - Respondent 2B

And this determination is not the only factor that distinguishes this client from other clients. All the respondents call this client an a-typical client, since they do not board up their contracts with the partners. Rather they have open conversations with them and let them think along. Furthermore, another reason why this client is a-typical since they place great value on experimenting and innovating, instead of mitigating risks. Respondent 2C mentions that Project 2 is also a kind of testing ground.

"And what is very important, is that they are willing to experiment. [...] In traditional projects, we know everything. That isn't the case here. So if the knowledge and skills aren't there, you have to be willing to experiment. And that's what they do." – Respondent 2D

The reason that the people in Project 2 are willing to do this, is, among others, that they have the intrinsic motivation to contribute to a greener construction industry.

"They want to change the construction chain, together with the construction chain. But I don't see it as lunatic greenies, but as tough business." – Respondent 2C

However, besides the environmental motivation, some respondents think that Project 2 is also driven by financial motivations. Purchasing second-hand circular materials is often cheaper than buying new materials. With the low budget that Project 2 has, a lot of decisions are made on the basis of money. However, they make sure that this is not at the expense of their circular ambitions. By showing that constructing circularly doesn't have to be more expensive than constructing traditionally, Project 2 has become a showcase.

"And I think it is good that the budget of Project 2 is that low, because that way you can demonstrate that there is an alternative. That it doesn't have to be much more expensive by default." – Respondent 2B

Conclusion

In this project, the circular ambition is firmly propagated by the client. The proactive role of the client again seems to be an important accelerator. Collaboration between actors having the same goal and interests, which was also mentioned in the analysis as part of the decision structure, is one of the reasons why this project is successful. Furthermore the actors are not steered by the will to guarantee quality, but by the will to experiment and innovate, which corresponds with literature about the organizational processes, which is that if old successes are not leading factors, but the organization is open for new ideas, innovation will be achieved more easy (Mackay, 2014; Vermeulen, 2010).

6. Conclusion and discussion

6.1 Conclusion

After analyzing the findings it is possible to formulate an answer on the research question. The research question was: *"Which institutional factors influence the implementation of innovative circular ambitions in the construction sector and what are the conditions for overcoming the negative factors?"* In order to answer the research question, the question is divided into two parts, relating to the two-folded aim of the research. In figure 6, the conclusion is visualized: the marked text shows you what has been changed in the conceptual framework after empirical research.

6.1.1 Institutional factors influencing circular innovation

The first aim of the research was to explain challenges and opportunities for the implementation of circular innovations in the construction sector and to explain the gap between plan and reality, by looking for institutional factors that influence the implementation of innovative, circular ambitions.

In the literature review, three different categories of factors were distinguished: legal, organizational and value-related factors. There are different views on the legal factors. Laws and regulations in the construction sector exist with a reason. However, sometimes the regulations make it a bit harder to innovate. One should seek for flexibility within those regulations, but also within his/her own attitude towards these regulations. Another important point is that some of the existing regulations should be stricter and more ambitious, in order to accelerate the circular transition.

The organizational factors have a very clear influence on circular innovation. The construction sector is attached to many routines and structures, like strict schedules and processes that work like this for years. People find it hard to let go of these routines and structures because it might be risky and the quality cannot be guaranteed in the same way as with the traditional processes. In the construction sector there is not enough (financial) room to take these risks. The decision structure could be an important accelerator and a good solution for coping with this issue. If there is a client that really has the ambition for 100% to create a circular building, other actors will have to let go of their routines and structures and take more risks. Furthermore, working in a consortium, based on trust instead of based on tenders and money, seems to be an important accelerator. This way you can have conversations about each other's interests and struggles and help each other. Last, the assumption that existing agreements with suppliers would be an important barrier for circular innovation has turned out not to play an important role.

When looking at the value-related factors, not daring to try new things also seems to be a personal matter, because people prefer to work with materials and processes that they are familiar with because they know what to expect. If people have intrinsic motivation to apply circular innovations, they won't mind the unknown practices. However, the dominating culture in the construction sector is still very much financially driven, causing a race to the bottom. Tenders and purchases are based on the most cheap options, instead of the most sustainable or circular ones.

One important factor that was not found in the literature is related to the concept of circularity and circular construction. Since it is a very ambiguous concept and there is not one definition, people don't know where to start and how to start. What seems to work as an accelerator, is if the concept is made concrete and tangible.

6.1.2 Conditions for overcoming the barriers

The second aim was to design practical recommendations by looking for conditions that were needed to overcome the barriers, i.e. the factors negatively influencing circular innovation, and to eventually change those barriers to accelerators. Four types of conditions were identified in the literature: functional, social-cultural, structural and political conditions. Two underlying conditions were found to be awareness and facilitation.

The empirical research shows that one important condition to overcome the barriers to circular innovation is that people have to feel financially that they need to change (functional conditions). Working with circular innovations has to become a decisive business advantage. However, also making circular innovations cheaper than traditional material (taxes, subsidies) could be an important condition.

For it to be a decisive business advantage, an increase in demand is needed (structural conditions). Clients have to formulate circularity clearly in their requests and tenders and construction companies need to increase their demand for circular materials. For this, it is also important that there is a sufficient amount of supply of circular innovations.

Moreover, a strong top-down control and a more ambitious policy of the government and the EU is needed to overcome the barriers (political conditions). The government also has an exemplary role: they have to invite tenders circularly themselves or join consortia for circular projects. Besides the government, managing boards of organizations have an important role. They need to support the circular ambition actively in order to get it in the DNA of the organization.

In the literature, social-cultural conditions were mentioned as important conditions, referring to an increase in diversity and the openness towards other sectors. However, in the empirical research it turned out differently. In general, this is not mentioned as an important condition. Instead, there seems to be a longing to work with like-minded people, that all place great value on circularity.

One type of condition that was not mentioned in the literature but turned out to be relevant, were educational conditions. It is considered important to learn from your own experiences (learning by doing), from other exemplary projects and courses. This way, people find out what is already possible and that it isn't that expensive, difficult or un-esthetic as they might think in the beginning.

For all the conditions mentioned above, two other things are needed. The first is awareness. Currently, most people are already aware of the fact that the construction sector needs to change. What is missing, is the awareness of how to change. If this awareness is raised more, it will function as an important condition in accelerating the circular transition. Secondly, facilitation is needed. A circular process is a different process than a traditional one, for example: one cannot know beforehand what the exact design will look like. People need to be facilitated in this process.



Figure 6 - Conclusion

6.2 Discussion

In this final chapter, the results and the conclusion are discussed. First, some of the interesting results are interpreted and non-expected findings are elaborated on. Secondly, the implications for the theory are discussed to explain what those findings mean for the existing literature. Moreover, the implications of the research are reviewed. Finally, both future research- and practical recommendations are given.

6.2.1 Interpretation

Letting go of routines: the role of clients and consortia

A very clear and expected conclusion is that the construction sector is bound to a lot of routines and structures, as it is a very traditional sector (Eijkelkamp, 2018). In this traditional sphere, innovating is often considered as risky and risks are avoided as much as possible. Therefore, a lot of mental obstacles are encountered when the idea arises to switch to new processes or materials.

What seems to be important to overcome these obstacles is the active role of the client. This research shows that an ambitious client, that really encourages the other actors to apply circular innovations, is a clear accelerator. Although the importance of this role was not found in the literature review, behavioral change could indeed be achieved when the project has a leader with a strong vision (Howarth & Rafferty, 2009). However, important to notice is that for it to have an effect, the other actors should trust this leader. Furthermore, although the client can have an important influence in applying circular innovations, it is still important that the other actors support this ambition (Adams, 2017). Therefore, it is necessary to guard against pointing towards the client as only important actor, as it is no legitimate excuse for other actors for not taking action.

One way to get this support, is by working in consortia, which is also an important conclusion in this research. In the literature it was found that the complexity of involved actors in construction projects could function as a barrier for innovating (Dainty et al., 2002). This complexity can be controlled by working in a consortium, as was already stated in the conclusion. Having conversations about interests, ambitions and the distribution of risks and additional costs is important for getting support from all actors. Working in consortia is already being stimulated by different organizations. What this research aims to contribute to this thought, is that we should aim for letting go of the traditional tendering procedures. What is notable, however, is that, according to the results of this research, those consortia mostly seem to work when it is a collaboration between like-minded people. This will be the subject of the next heading.

Being motivated: the importance of governance

The above mentioned like-mindedness is contradicting one of the theoretical assumptions about diversity and integrality, referring to the social-cultural conditions. Projects in which like-minded people (i.e. people having the same circular ambition) collaborate, have a great chance of success. This could indeed be explained by the value-related factor 'environmental concern' (Kollmuss & Agyeman, 2002). However, this like-mindedness implies that actors having a circular ambition, are eager to work with other actors that have the same ambition. This brings up a lot of questions. If this is indeed the case, how could the other actors (i.e. actors not having the circular ambition) find their way into a consortium of a circular project? And how will they eventually be convinced of this circular ambition when all the motivated people are not willing to work with those unmotivated people? The latter might still need social-cultural conditions, such as diversity and integrality, to break through the traditional values (Oliver, 1992). Therefore, we could not exclude this condition with certainty. There are many theories on the importance of integrality for knowledge spillovers and innovation (e.g. Constantini, Crespi, Marin & Paglialunga, 2017). Moreover, not only inter-sectoral collaboration is important, but also multilateral cooperation (Xu, Fenik & Shaner, 2014). Constructing new buildings is something that happens all over the world, especially during a time in which urbanization is a dominating trend. We don't need to invent everything ourselves, but by collaboration between nations we can help each other. Besides the Netherlands, other leading European countries in the circular economy are Belgium, Luxembourg, Finland, France, Germany and Slovenia (Mulders & Pees, 2018).

Possible reasons for the fact that the social-cultural condition was barely mentioned in the interviews, could be the lack of realization that this is actually needed; the lack of priority; or because of one of the limitations of the research (see paragraph 6.2.3).

As becomes clear from the desired like-minded collaborations, intrinsic motivation is very important. However, it isn't shocking that not everybody possesses that intrinsic motivation; and if the unmotivated, routine-bounded actors have little chance to become part of circular consortia, how can they still be encouraged to innovate?

This is why the importance of governance should be discussed. As Steurer (2013) states, there are three spheres in or between which governance could take place: the civil society, the market and the state. Civil society is not yet placing its attention on promoting circularity in the construction sector: the emphasis is currently more on the energy transition. The market, as shown in this research, is trying to switch to circular innovations, but is still having a hard time and takes more of a wait and see approach. This means that there is a huge role for the state in stimulating the circular transition, which is supported by the respondents of this research. They call for a government that formulates stricter and more ambitious rules and that also sets the right example by taking action herself. By taking measures to promote the use of circular innovations, for example subsidies for implementing circular innovations or taxes for using raw materials, the motivation (albeit extrinsic) of all actors will be fueled.

One reason why this stimulation and facilitation is still difficult, is because there is no general, unambiguous definition of circular economy and circular construction. This is also a conclusion that was not found in the literature review. In other words, there is no general discourse on circularity in the construction sector (Pomponi & Moncaster, 2017). There are so many definitions when talking about circular materials or circular processes. One places value on the detachability of materials, another on business models or on reused materials, and so on. This makes it harder to align measures with the concept. Moreover, as was shown in the research, the dominating culture in the construction sector still evolves around money. This culture needs to be revised and the government can play an important role in this challenge, by contributing to making sustainability and circularity the new normal.

Learning by doing: the chicken or the egg

One unexpected type of conditions for overcoming these kind of barriers, like the ambiguity of the concept, are educational conditions. This could be in the form of knowledge-sharing, but since there is a real hands-on mentality in the construction sector, they often feel more for 'learning by doing' and 'seeing is believing' (Tan & Elias, 2000). However, one important point for discussion that arises is related to the chicken or the egg discussion. If learning by doing is an important condition for overcoming barriers for circular construction, how will people actually start doing it? This hands-on mentality should in some way be fueled for trying out circular innovative things.

Therefore, learning by doing cannot not be the only educational condition. Example projects are thus considered very important, because they could help to demonstrate what is already possible on circular innovative level. However, as one of the respondents mentioned, in the last few years, only one important example projects was added. There are a lot of small example projects, but more prominent, big circular projects are needed in order for everybody to take notice of it.

6.2.2 Theoretical implications

In this research, no existing theoretical framework was used. Different literature on sociological institutionalism was combined and a new framework was created. In this framework, different institutional factors that could influence circular innovation in the construction sector were included: legal, organizational and value-related factors. Those factors could both function as barriers, and as

accelerators. The empirical research showed that one category was missing: concept-related factors. The conditions needed for de-institutionalization, and thus to overcome the barriers, were also categorized and supplemented. The conclusion from the literature was that functional, social-cultural, structural and political conditions were needed, and underlying those conditions, awareness and facilitation were also needed. In this research, educational conditions are added as important conditions, and the social-cultural conditions are being questioned.

Therefore, this research has contributed to the existing literature by conducting a framework and expending and questioning the possible influencing factors and conditions. Besides providing a more complete and comprehensive overview, the elements within the factors and conditions were also examined. This research has made some of those elements more nuanced, like the legal factors, and some of them were completely deleted, like the factor existing agreements with suppliers. The final framework (figure 6) could be used for further research (see paragraph 6.2.4).

In short, this research has made a contribution to the literature on sociological institutionalism by providing a clear and accurate overview of possible barriers and accelerators for innovating, and deinstitutionalizing conditions.

6.2.3 Limitations

This research also has some limitations. One of the biggest limitations is the broad span of the research. Sociological institutionalism is a wide concept and the categories of factors and conditions examined in this research are thus quite broad and varied. Because of this broad span, it was hard to apply some focus in the research. The literature review, findings and conclusion had to cover all the different factors and conditions, which required a more superficial analysis instead of a valuable in-depth analysis, focused on only a few factors or conditions. Besides, this broad view also did not provide a prioritization in the factors and conditions.

The second limitation is the fact that the respondents were all people that already place much value on and have interest in a circular construction sector. On the one hand this enhanced the internal validity, because those respondents know what it is like to have the ambition and to encounter barriers or accelerators. On the other hand, this research only focuses on what the people that are already motivated, think is needed to take away the barriers. A huge challenge, however, is to encourage the people on the other side of the spectrum. Interviewing respondents that are not motivated yet for the circular economy, would have been helpful to analyze what those people need.

6.2.4 Recommendations

Despite the limitations of the research, the findings of this research lead to some important recommendations, both for future research and for the practical field. Those recommendations are given in this last paragraph.

Future research

First of all, future research could be conducted to take away some of the limitations of this research. For example, quantitative research could be done to see how the barriers, accelerators and conditions could be prioritized. This would help to gain insight in what should be undertaken first to accelerate the transition. Besides, there are several options for more focused future research topics. For example, the legal factors could be examined more to better understand the dynamics of regulations in the construction sector and the effect that they have on circular innovation. Another research focus could be the social-cultural condition and the need for diversity to overcome institutional barriers, since this condition. To respond to the second limitation, research could be conducted about the still unmotivated people regarding circular construction, to find out what they need to get motivated.

Furthermore, it would be interesting to see how this final framework could be applied to other sectors that try to transition to a circular economy. In this research, the construction sector formed the locus

of the study. However, the framework was constructed around institutional factors and conditions in general. In future research, the framework can be used for other sectors.

Practical recommendations

After conducting this research and reflecting on the results, the most important advice that follows from it, is that clients should not just ask for circularity in their project, but they should support this ambition for 100%. This also means that in the formulation of this goal in the project request, they should know what they mean by circular and they should communicate these expectations towards the other parties.

This also brings us to the next advice, which is that the collaborating parties should sit down with each other, preferably by working in consortia instead of based on traditional tender processes. All involved actors should share the circular ambition and be aware of each other's interests and doubts. This way the actors can motivate and help each other. It is very important that during this collaboration it is also spoken about the distribution of risks, since the avoiding of risks is currently a very important barrier. So if the innovative ambition brings certain risks, who is going to bare those risks and who pays for possible additional costs? These are important questions to answer in those collaborations.

The third recommendation is directed to the government, which should take a more guiding role. By knowing the needs of the people in the sector, the government will be aware that those actors require more top-down control. This should on the one hand be done by formulating stricter and more ambitious regulations, and on the one hand by setting the right example. The government needs to show the sector that they themselves have all hands on deck in achieving a circular society. They could do this by constructing more great circular projects that function as example projects.

However, it is important to keep in mind that the key for transition is not only to be found at the government or the clients. A lot of people in the sector are mentally not ready yet to let go of their old, familiar habits. Those people are really important in fueling the transition. Therefore, we need to find ways to help them change. One of those ways is to actually give them perspective to action to explain them *how* they can change. When circularity is made really concrete and tangible, people in the construction sector tend to be able to work with it more easily. Furthermore, a change in mindset is needed. Experimenting should be appreciated and people should get the space to experiment. This requires different kind of processes in the construction sector: processes in which not everything is known beforehand.

Moreover, mindsets could also be changed by being critical of the language that we use. The word innovation can evoke fear right away, since the word implies newness and unknown consequences. Therefore, we should consider the words that we use when trying to motivate people to switch to more sustainable kind of modes.

The above mentioned recommendations are appropriate next steps to accelerate the circular transition in the construction sector. However, the most important action is the integration of all of these steps. The combination of the recommendations must be considered as one package of actions that are all linked to each other. There are important roles to play for all types of actors. Everyone could make important contributions. Therefore, we should not blame each other for the difficulties that we encounter, but we should go hand in hand to overcome those difficulties, to strive for the achievement of a common goal.

Last but not least, we should be aware of the fact that innovation and circularity are not the ends, but the means. The final aim should not be lost out of sight: to create a more sustainable society.

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Appendices

Appendix A: Scheme of Codes

