THE ROLE OF PARTNERING IN THE TRANSITION TO A CIRCULAR ECONOMY IN THE DUTCH INFRASTRUCTURE SECTOR

- A case study to the InnovA58 -

Master Thesis
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THESIS

Delft University of Technology
Civil Engineering and Geosciences
Construction Management and Engineering
December 2018

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PREFACE

Seven years ago, I started my student career at the faculty of Industrial Design Engineering, not aware of the fact that today, I would hand in this thesis as the finalization of the Master program Construction Management and Engineering. However, deciding to switch to another faculty and dedicate an extra year to the bridging program to Civil Engineering was an excellent decision.

My personal interest in (the current lack of) sustainability in the construction and infrastructure sector has eventually led me to the execution of this research to the role of partnering in the transition to a circular economy. This topic has kept me fascinated for the past eight months, and will probably always will. Of course, this would not have been possible without several people, who were of great help to the execution of this study.

First of all, I would like to thank Marcel Hertogh for not only being my chair, but also for teaming me up with Daan and Ingrid, which was all the beginning of this thesis. Your always positive and enthusiastic attitude were of great value to me.

Daan, being my first supervisor, you have invested a lot of time in me. Despite your very busy schedule you would always find time to help me out, whether it was in your office, at another faculty, in the train, at the train station, at the office of Witteveen+Bos or at AMS institute. I believe you greatly helped me to achieve the result I proudly present in this report. Thanks for your flexibility and the metaphors I didn't always get at first, but eventually helped me out in some way or another.

Martijn; we haven't had too much contact, since I just didn't find the time to do so. But every time I left your office, I felt I could again make a lot of progress due to your practical feedback. Whenever I felt a bit lost, our meetings helped me to focus on what was important, and your down to earth mentality is something I greatly value. And last but definitely not least, I would express a big thanks to Ingrid, my company supervisor of Witteveen+-Bos. Your enormous enthusiasm for the subject of circular economy is contagious! Thanks for all the help whenever I needed, the "how was your weekend" talks, and of course, thank you for providing me a spot at Witteveen+Bos, I have enjoyed my time here a lot, and this wouldn't have been possible without you as my supervisor. I wish you all the best for your PhD, and hope we stay in touch on how this process continues.

And of course, my direct colleagues contributed to the environment at the office of Witteveen+Bos a lot, walking around the Malieveld, eating cake whenever we had something to celebrate and providing me with feedback to my work. As most of you also recently graduated, you know how graduating works, and this helped me out quite a few times. Thanks!

Lastly, I would like to thank my family and friends for the much-needed breaks, weekends away, coffee's, beers and their patience with me, always talking about circular economy. Sorry not sorry.

I hope you enjoy reading this report!

Annemieke Vlaming

EXECUTIVE SUMMARY

Due to growing prosperity in the world, together with the trend of urbanization, more and more natural resources are needed. However, the earth cannot keep providing us these materials, since many of them are depleting. Furthermore, we are dealing with the ever more problematic effects of climate change, as these challenges are interlinked. The concept of circular economy is seen as an opportunity to tackle the problem of depleting resources, as the concept of 'waste' is not present in this concept (Ellen MacArthur Foundation, 2013). Since all waste is used as a resource again, much fewer virgin resources are needed to produce our goods and services. This is contrary to the 'take-make-dispose' economy we live in nowadays, as we are used to landfill our products after use.

The construction- and infrastructure sector is currently responsible for 30% of all waste generated worldwide and the use of 40% of the virgin resources produced on earth. Furthermore, only 2030% of the resources in this sector are being recycled (Abarca-Guerrero, Maas, & van Twillert, 2017; Akinade et al., 2018). Therefore, transitioning to a circular economy in the construction and infrastructure sector will have a great impact, to the benefit of our planet.

However, the transition to a circular economy is, like any other transition, a complicated mission to achieve. The uncertainties during the long and continuous process of the transition, together with the fact a transition has no definite end stage, makes a transition a challenging task. Th fact that the construction and infrastructure is a very conservative and risk aversive sector makes it even more complex (Kemp, Loorbach, & Rotmans, 2007; Kim, 2009; Loorbach & Rotmans, 2010; Ritzén & Sandström, 2017; Xue, Zhang, Yang, & Dai, 2014).

Transition theories state collaboration between stakeholders is the most important factor to transition successfully, and within the construction and infrastructure sector, partnering is seen as the ultimate form of collaboration (Hughes, Williams, & Ren, 2012; Rotmans, Kemp, & van Asselt, 2001). The essence of partnering is '[the] determination to move from adversarialism and litigation and to resolve problems jointly and informally through more effective forms of inter-firm collaboration' which is explained by Bresnen & Marshall (2010).

Therefore, the formation of (multilateral) partnerships have a relation with the transition to a circular economy in the construction and infrastructure sector. However, this relation has never been studied. This is why this research will focus on the following research question:

> **"WHAT IS THE ROLE OF PARTNERING IN THE TRANSITION TO A CIRCULAR ECONOMY IN A DUTCH INFRASTRUCTURE PROJECT WITH MULTIPLE STAKEHOLDERS WHICH HAS A CIRCULAR ECONOMIC AMBITION?"**

In this study, a highway alteration project (the InnovA58), will be studied to provide an answer to this research question. This is a unique case, as it is the first project in its kind to try and implement the ideas of a circular economy in a project of this size. Therefore, it is a unique chance to study this case first-hand. As the project is currently in the early phase, since the draft route decision is currently set up, this study will focus on the pre-contractual phase of this project.

Transition theories are frequently used to describe and analyse transitions. In this study, the theory of functions of Technological Innovation System (fTIS) is chosen to analyse the transition to a circular economy within the case study of the InnovA58 (Hekkert, Suurs, Negro, Kuhlmann, & Smits, 2007). This transition theory consists of six consecutive steps, which are sequentially executed in this research. The focus lies on the third and fourth step, as within those steps, the transition in question can be analysed on the basis of seven transition functions: (1) Entrepreneurial Activities, (2) Knowledge Development, (3) Knowledge Diffusion Through Networks, (4) Guidance of the Search, (5) Market Formation, (6) Resources Mobilization, and (7) Creation of Legitimacy/Counteract Resistance to Change. Those functions assess the performance of a transition.

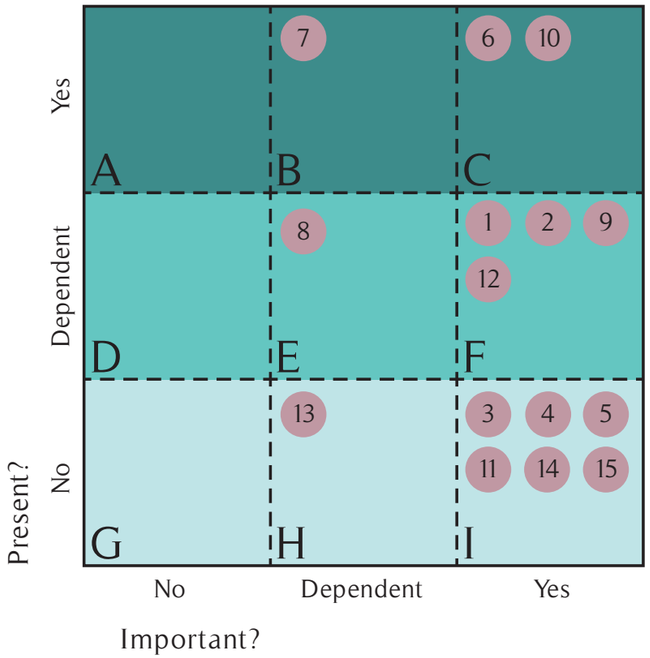
As the role of partnering in the transition is at the heart of this study, a list of fifteen elements of partnering is derived from Hosseini, Wondimu, Klakegg, Andersen & Laedre (2018). These fifteen elements together describe a 'perfect partnering project'. The role of these elements of partnering can thereafter be evaluated for the seven functions of fTIS, to find the relation between partnering and the transition to a circular economy in the Dutch infrastructure sector.

By the means of a literature study and a case study to the InnovA58, the answer to the research question was found. A literature study to the available transition theories resulted in the application of fTIS to the case study. The literature study also provided the list of elements of partnering, which were used as a guideline for the interviews conducted in the case study.

The case study itself consisted of 10 interviews with 11 respondents, which were all involved in the project of the InnovA58, together with a document analysis. The interviews provided the primary source of data, as partnering is a form of interaction, thus data considering partnering was not abundantly provided by project documentation. All interviews were transcribed and analysed in three consecutive steps. First of all, the transcripts were coded by hand (open coding), where after the software program ATLAS.ti was used for the second round of coding (selective coding). The third step was executed using Excel, in which all the relevant quotes from the interviews were collected, summarized and analysed based on the seven functions of fTIS. This was the basis for the findings and discussion regarding the role of partnering on the transition to a circular economy within the InnovA58. As a validation, a document analysis was executed to validate the findings from the interviews.

In Figure 1, the perceived presence and importance of the elements of partnering in the InnovA58 can be seen. As can be seen, no element of partnering is seen as unimportant, according to the respondents. However, the presence in the InnovA58 sketches a different picture, as most of the elements are only present to some extent, or even not at all. This indicates the InnovA58 is currently far from a perfect example of a partnering project, and much room for improvement is there. The presence and importance of the elements of partnering need to be held in mind for the further analysis of the data, since this influences the outcomes of the found role of partnering on the functions of TIS. The colour coding of the presence of the elements of partnering correspond to Table 1 on page ix.

In 34 out of the 105 possible relations between the elements of partnering and the functions of TIS, a role of partnering was found. This only applies to the InnovA58, as studying another case might provide different answers. Therefore, only a conclusion can be drawn on the presence of these elements in the transition to a circular economy, no conclusions can be drawn on the absence of the other 71 possible relations.



1. Trust
2. Common Understanding
3. Collaborative Contractual Clauses
4. Early Involvement of Suppliers
5. Incentives, Pain/Gain Share
6. Common Goals
7. Team Building Activities
8. Structured Meetings/Workshop
9. Facilitator
10. Committed Participants
11. Conflict Resolution
12. Open and Effective Communication
13. Open-Book Economy
14. Continuous Improvement
15. Continuous Joint Evaluation

▲ Figure 1: ***Importance and presence of the elements of Partnering in the InnovA58***

The majority of these relations were found in the first four functions of the TIS theory, only three of them were found in functions five to seven, see Table 1. This was already predicted, as literature stated the first four functions are highly important in the early phase of a transition, in which the transition to a circular economy finds itself (Luo et al., 2012).

The influence of the elements of partnering could be perceived to be positive (+), negative (-), or neutral. It was found that the majority of the elements of partnering which were found present in the InnovA58 contributed to the first four functions of the TIS, thus positively influencing the transition to a circular economy. The elements of partnering which were not present in the InnovA58 were found to negatively impact the functions of the transition theory. As the latter three functions of the TIS are not yet fulfilled within the InnovA58, the found role of the elements of partnering in those functions were all negative of nature, thus hampering the transition to a circular economy. Furthermore, it was found that four out of the fifteen elements of partnering were not visibly shown in the case study of the InnovA58. The absence of these elements can partly be explained by the fact the InnovA58 is, at the time of writing, in the pre-contractual phase. Hence, several elements of partnering were not yet present in the case study. Because of this absence, no role of that element could be found regarding the transition to a circular economy.

The first four functions of the TIS together trigger a motor of change, thus multiplying the effect of the functions on the acceleration of the transition to a circular economy. More effort in the performance of the elements of partnering thus have a multiplier effect on the transition to a circular economy through this cumulative causation.

Partnering within a Dutch infrastructure project thus has a role in the transition to a circular economy directly and indirectly. Directly through the positive or negative influence on the functions of TIS, indirectly by cumulative causation caused by the motor of change triggered by the first four functions.

▼ Table 1: ***Summary of the role of Partnering on the functions of TIS for the InnovA58***

Elements of Partnering	Functions of Technological Innovation System: 1. Entrepre-neur-ial Activities	2. Knowledge Develop-ment	3. Knowledge Diffusion Through Networks	4. Guidance of the Search	5. Market For-mation	6. Resources Mobilization	7. Creation of Legitimacy	Present in InnovA58?
1. Trust	-	O	O	-				Dependent
2. Common Understanding	-	+	-	-				Dependent
3. Collaborative Contractual Clauses								No
4. Early Involvement of Suppliers	-	O	O	-				No
5. Incentives, Pain/Gain Share								No
6. Common Goals	+	+		+				Yes
7. Team Building Activities			+					Yes
8. Structured Meetings/ Workshop				O				Dependent
9. Facilitator		O	O	O				Dependent
10. Committed participants	+	+	+				-	Yes
11. Conflict Resolution								No
12. Open and Effective Communication		+	O	+		-	-	Dependent
13. Open-Book Economy								No
14. Continuous Improvement	O	+	O					No
15. Continuous Joint Evaluation			+	+				No

It is recommended for project team members, both of the InnovA58 and of future projects, to take note of the benefits partnering can bring. Therefore, expertise in the concept of partnering is a prerequisite. To be able to benefit from partnering, the elements of partnering do need to be fulfilled in the process of the project, thus, project team members must pay attention to which elements to focus on in the different stages of a project, as not all elements can be fulfilled in every stage of the project. It is advised the project team members focus firstly on (1) trust, (2) common understanding, (10) committed participants, and (12) open and effective communication, as those elements can create the biggest impact on the transition to a circular economy.

There is a serious threat of the focus on the Iron Triangle on the implementation of circular economy innovations in the InnovA58. Higher management of the InnovA58 must take not of the opportunities the circular economy can bring, and act accordingly. Therefore, a change in mindset is needed regarding the Iron Triangle, as Rijkswaterstaat must recognize the success of a project is influenced by more elements that just the three of the Iron Triangle.
Finally, the human factor in collaboration must not be underestimated, as personal motivation and enthusiasm is highly important to bring about the change which is needed in the infrastructure sector, and transition to a circular economy.

CONTENTS

CHAPTER 1

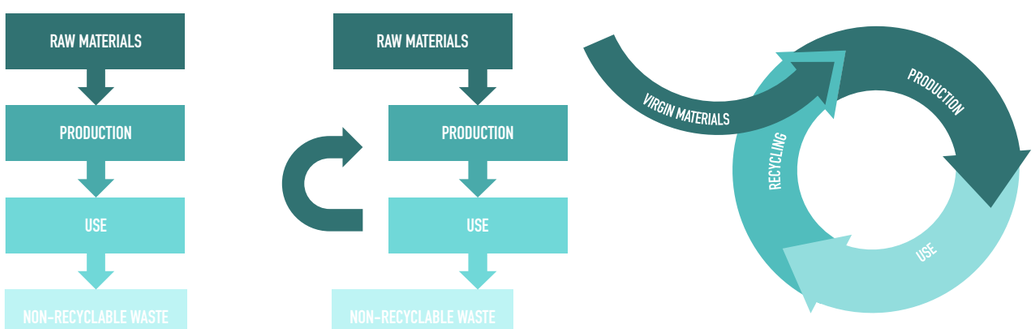
Introduction

1 INTRODUCTION

The world population is growing fast; research estimates the population on earth will increase to 9 billion inhabitants in 2050 and 10.1 billion in 2100 (United Nations, 2017). To support the needs of this growing population and the accompanying growing prosperity, more and more natural resources are needed. However, the earth cannot keep providing us these materials, since many of them are depleting. Another trend that is observed in the last few decades is urbanization, as more and more people are migrating to urbanized areas (United Nations, 2018; Woetzel, Garemo, Mischke, Kamra, & Palter, 2017). These two developments together cause the demand of natural resources and raw materials to rise exponentially. Due to this increasing demand, the prices of virgin resources are rising with alarming rates since 2010 (McKinsey Global Institute, 2011).

Furthermore, we are dealing with the challenge of climate change, as the far-reaching consequences are starting to unfold. For instance, floods are occurring more frequently, and sea level is rising as the average temperature on earth steadily increases (Dutzik & Willcox, 2010). These challenges are interlinked, as the extraction of virgin resources and the use of carbon fuels puts a burden on the environment.

The concept of circular economy is seen as an opportunity to tackle the problem of depleting resources, as the concept of 'waste' is not present in this concept (Ellen MacArthur Foundation, 2013). The idea of the circular economy is that it replaces the 'end-of-life' concept with reducing, reusing, recycling and recovering materials in the production, distribution and consumption process (Kirchherr et al., 2017). Also, a circular economy aims to keep products, components and materials at their highest value as possible (Ellen McArthur Foundation, 2013). In an ultimate form of a circular economy, new natural resources are hardly needed anymore, since all resources originate from earlier produced goods. This is contradictory to the linear 'take-make-dispose' economy, where waste is landfilled after use, and new resources are extracted from the earth to produce new goods and services (Michelini, Moraes, Cunha, Costa, & Ometto, 2017). The differences between a fully linear, a reuse and a fully circular economy is visualized in Figure 2.



▲ Figure 2: ***The Linear, Re-Use and Circular Economy (own illustration, derived from Dutch Ministry of Infrastructure and the Environment & Ministry of Economic Affairs, 2016)***

1.1 MAKING A CHANGE

Within every sector of the market, a shift is needed from a linear to a circular economy, to reverse the negative environmental effects on the environment caused in the last centuries. Researchers and practitioners are becoming aware of the importance of understanding and implementing the ideas of the circular economy (Shi, Peng, Liu, & Zhong, 2017; Du Pisani, 2007). Small initiatives on recycling and upcycling are seen more frequently, and the general public is slowly but steadily made aware of the fact we cannot sustain the way of living as we are currently doing (Climate Policy Watcher, 2018).

The transition in the construction and infrastructure sector

Also in the construction industry, awareness is slowly increasing, and the first circular initiatives in the built environment are a fact (Leising, 2016). However, the implementation is still lagging behind in the infrastructure sector due to several reasons.

The transition to a fully circular economy in the infrastructure sector is a challenge, as any transition is radical change and disruptive in nature (Ritzén & Sandström, 2017). It is a long and continuous process of change, as well as has no definite end stage which needs to be reached (Kemp et al., 2007). Also, during a transition, the industry has to deal with a lot of uncertainties, which makes the challenge even bigger (Loorbach & Rotmans, 2010). Furthermore, the infrastructure sector is very conservative and rarely innovates, as well as is very risk aversive. (Kim, 2009; Xue et al., 2014). These characteristics explain the difficulties which are faced when implementing the circular economy in the infrastructure sector and explain why it is not yet embraced in infrastructural projects.

The impact of the change

However, within the construction and infrastructure sector, the implementation of a circular economy can have a big impact. The construction- and infrastructure sector owns a big share in resource depletion and environmental damage. It is currently responsible for 30% of all waste which is generated annually worldwide (Akinade et al., 2018). Moreover, the construction industry is responsible for the use of 40% of all virgin materials produced on earth, of which only an estimated 2030% being recycled or reused (Abarca-Guerrero et al., 2017).

Sustainable changes in the construction and infrastructure sector

Next to the implementation of the ideas of a circular economy in the construction and infrastructure sector, another transition, is taking place within this industry; the energy transition. The energy transition focusses on changing the way we produce and consume energy. The use of fossil fuels must be banned and exchanged for green energy sources such as wind and solar energy (Morris, 2018). The energy transition is already in progress and receiving considerable attention from both practitioners and academics. The circular economic transition however is still in its infancy, especially in the infrastructure sector in the Netherlands. The Dutch Environmental Assessment Agency (Planbureau voor de Leefomgeving) published the first publication about the energy transition in 2010, the first publication about circular economy was presented four years later, in 2014. So, the practical knowledge about the energy transition is substantially bigger that the knowledge available about the circular economy transition.

The challenges described above regarding depleting resources, the use of fossil fuels, and global warming can be linked to the mindset the human race has adopted during the second industrial revolution. During this revolution, which took place from approximately 1870 to the beginning of the first world war, society made it its priority to industrialize the world around us (Engelman, 2015). Prosperity and fast economic growth were the positive results, however, the negative impact on the environment was not addressed, since the effects were still unclear. The third industrial revolution, which is currently ongoing, is marked as the digital revolution. It focusses on the transition from a mechanical and analogue technology to digital and 'smart' electronics, as well as on reversing the effects of the second industrial revolution (Rifkin, 2011). This is done by changing our system from a take-make-dispose economy to a service economy (Moretti, 2017). The Third Industrial Revolution builds on 'sustainability transitions; long-term, multi-dimensional and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption' (Markard et al., 2012). Those sustainable transitions have been getting increased attention from the academic world in the last 15-20 years, and Rifkin explained the relationship between the sustainable transitions trend and the third industrial revolution.

1.2 PARTNERING AS AN ANSWER TO A TRANSITION

As stated, any transition is a challenging task; the transition to a circular economy within the Dutch infrastructure sector will be no different. Transition theories like 'Transition Management', as introduced by Prof. dr. ir. J. Rotmans, are used to analyse transitions. Following these transition theories, collaboration between stakeholders involved in a transition is of high importance (Rotmans, 2017; Rotmans et al., 2001). It is seen as the most important factor to transition successfully. For example, close collaboration brings opportunities for all involved stakeholders, as collaboration is the basis of creating trust between stakeholders in projects. Trust is seen an important factor for achieving mutually successful outcomes in a project (Zheng, Roehrich, & Lewis, 2008).

Within the construction and infrastructure sector, the concept of partnering is seen as the ultimate form of collaboration, as close collaboration is at the heart of forming partnerships (Hughes, Williams, & Ren, 2012). The essence of partnering is '[the] determination to move from adversarialism and litigation and to resolve problems jointly and informally through more effective forms of inter-firm collaboration' which is explained by Bresnen & Marshall (2010, p. 230). Furthermore, it refers to "long-term agreements between companies to co-operate to an unusually high degree to achieve separate yet complementary objectives" (Construction Industry Institute, 1991, p. iv). Kumaraswamy, Love, Dulaimi and Rahman (2004) explain that effective cooperative relationships are a prerequisite for successful innovation within projects. Therefore, forming (multilateral) partnerships in the infrastructure sector has a relation with the implementation of radical changes or transitions. However, the relation between multilateral partnering and the transition to a circular economy in the infrastructure sector has never been studied before. Therefore, this study will contribute to the scientific knowledge on the role of partnering in the transition to a circular economy within the infrastructure sector.

1.3 CONCEPT EXPLANATION – THE CIRCULAR ECONOMY

The main focus of this study is the role of partnering in the transition to a circular economy. As the circular economic transition will be focussed on, the concept of circular economy will be shortly explained. First, the history and the explanation of the concept itself will be elaborated upon. Thereafter, with the help of some examples of projects which have already incorporated circular economy ideas in the Netherlands, the current state of the art in this field of expertise is shown regarding the construction and infrastructure sector.

1.3.1 THE ORIGIN AND RISE OF THE CONCEPT OF CIRCULAR ECONOMY

The concept of circular economy cannot be traced back to a specific date or a single author, as it originates from several concepts which together formed the basis of the concept of circular economy. In the 1970's, the ideas of sustainability and the precursors of circular economy were led by a small number of academics and businesses (Ellen MacArthur Foundation, 2013). German chemist and visionary Michael Braungart and architect Bill McDonough were two of those academics, as they introduced the concept of 'Cradle to Cradle'. This concept consists of three from nature derived principles about not seeing resources as waste, the use of clean and renewable energy and having respect for natural diversity (McDonough, & Braungart, 2002). The concept of Cradle to Cradle is seen as the predecessor of the circular economy (Murray, Skene, & Haynes, 2017).

Because the origin of the concept circular economy is undefined, the definition of circular economy was also of evolutionary nature. Kirchherr, Reike and Hekkert (2017) devoted a review article on the analysis of 114 definitions of the circular economy and concluded that the circular economy: 'replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes.' They also explained the level on which circular economy operates (micro-, meso- and macro-level), and the aim of the circular economy, namely sustainable development, environmental quality, economic prosperity and social equity.

As time progressed, attention given to the overarching goal of circular economy, sustainability, grew year after year. But only in 1987, the publication of the Brundtland Report made the topic of sustainability gain momentum (Brundtland, 1987). This report stressed the "tension between economic growth and environmental protection", (Du Pisani, 2006, p. 92). Since then, the correlation between excessive economic growth and ecological disasters became apparent, and the impact of the use of finite resources on the environment became known to the general public. Now, in 2018, the topic of circular economy is more present than ever, with an increasing amount of academics publishing articles about the concept, as well as the attention it gets in world-wide news (Perchard, 2018). Circular economy has now become a buzzword and more and more attention is paid to the need to change our system from linear to circular.

The transition to a circular economy, both in the infrastructure sector as well as in the entire Dutch economy, will be a process which spans over several decades, as for this process, the entire system in the infrastructure sector needs to be changed. For this to happen, our mindset must change into a way of thinking which will, next to economic growth, involve environmental and social aspects (Raworth, 2017).

1.3.2 CIRCULAR ECONOMY IN THE CONSTRUCTION AND INFRASTRUCTURE SECTOR

Also within the construction- and infrastructure sector, more attention is given to the concept of circular economy in recent years. There is a significant amount of research done on circular economy in the construction- and infrastructure sector, however, there are three main categories to which these studies can be assigned to. These categories can be roughly described as the barriers and drivers to adopting circular economy in construction and demolition waste management (Ghisellini, Ripa, & Ulgiati, 2018; Huang et al., 2018; Mahpour, 2018; Tingley, Cooper, & Cullen, 2017), Green Public Procurement (Cheng, Appolloni, D'Amato, & Zhu, 2018; Lundberg & Marklund, 2018; Milios, 2018; Rainville, 2018; Testa, Annunziata, Iraldo, & Frey, 2016) and tools and methods to quantify circularity in the construction sector (Berardi, 2012; Ding, 2008; Ugwu & Haupt, 2007). This division in three main categories results in the remarkable observation that the research area of the implementation of the circular economy within the infrastructure is still underexposed, whereas it is researched in more depth in the construction and demolition waste (C&DW) industry as well as in the construction sector but specified to the built environment.

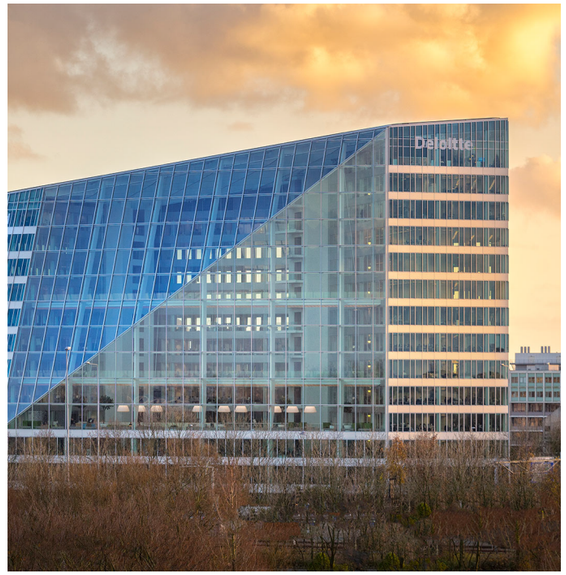
1.3.3 FIRST STEPS TOWARDS CIRCULARITY

The government of the Netherlands, as well as the Dutch Ministry of Infrastructure and Water Management (Rijkswaterstaat), have set themselves ambitious goals regarding circular economy. Circular infrastructure projects in the Netherlands are still non-existent. In the building industry however, several so-called 'circular buildings' are already in use in the Netherlands. Although these building are still rare, some examples can be given, showing the potential of the use of circular economy ideas in practise. See Figure 3.

CIRCL, see Figure 5, the new building of the Dutch bank ABN-AMRO, was recently completed in September 2017 and is located in the Zuidas region in Amsterdam. This pavilion is not only an extension of the headquarters to facilitate meetings, but also a public space to share knowledge about the circular economy, the lessons learned from the planning and construction of this building and in addition to that, Circl wants to act as a Living Lab, where ideas and plans about sustainability and circular economy can grow. Also, the building is partly publicly accessible, to add to the open environment of the building and share knowledge and the ideas and benefits of a circular economy (Circl, 2017).

▲ Figure 3: ***CIRCL (ABN AMRO, 2017)***

Another recent example is 'The Edge', see Figure 4, the new head office of Deloitte, also located at the Zuidas in Amsterdam and completed in 2014. Although second hand material usage and building to dismantle or flexible design were not the main aims of this building, it is still a good example of a building in which circular economy was important. This is because the aim of this project was to optimize energy usage and sustainability according to BREEAM standards. BREEAM is a sustainability assessment method for master planning projects, buildings and infrastructure. It calculates a 'sustainability score' from 1 to 100 based on the entire lie cycle of the asset (BREEAM, n.d.). The edge was the first building in the Netherlands to receive a BREEAM certificate with a score of 'Outstanding', the highest possible score (OVG Real Estate, 2014).



▲ Figure 4: ***The Edge (Delta Development Group, n.d.)***

A development on a larger scale values is Park 20|20, see Figure 5; a park situated in the Haarlemmermeer, consisting of 13 offices, a café, a hotel, a greenhouse and several pavilions and other facilities. It embraces the cradle-to-cradle principles, on which the current circular economic principles are based. For instance, the office area closes its water, waste and energy cycles, as well as delivers a material passport for all buildings. This material passport makes it easier to value the materials present when the building is disassembled in the future, making the materials more attractive to use again. This dismantling is also made easy by the use of the principle 'design for dismantling'. Furthermore, where possible, the ownership of materials or products use in the office part remain at the supplier with the help of leasing contracts, pushing them to think about assembly and disassembly, and making them responsible for maintenance of the products or materials (Park20|20, n.d.).

▲ Figure 5: ***Park 20|20 (Randall, 2015)***

As can be concluded from the examples on these pages, the ideas of circular economy are slowly becoming embraced in the building sector. Successful projects like these examples are completed and a lot of public attention is gained by these projects. However, the amount of circular buildings is still low. Interesting is that the infrastructure sector in the Netherlands is lagging behind even more (Leising, Quist, & Bocken, 2018). The project of InnovA58 is the first large scale infrastructure project in the Netherlands in which the principles of circular economy are implemented. Thus, a great amount of progress can still be made in this sector.

1.4 EMPIRICAL KNOWLEDGE

As mentioned, the role of partnering in the transition to a circular economy has not been studied before, although the theoretical benefits of partnering to enhance a transition are clear. Therefore, this study tries to fill in this knowledge gap by presenting empirical knowledge on this topic. Empirical data to create this scientific knowledge will be obtained by performing a case study.

1.4.1 THE INNOVA58

This case study will focus on the project of the InnnovA58, a highway alteration project in the Netherlands. This case has been chosen due to the unique characteristics of this project. Due to the following unique characteristics, this case can provide much highly useful knowledge:

First project with high CE ambitions: The Dutch government has set the goal to become circular in 2050, the Ministry of Infrastructure and Water Management is even more ambitious by setting this goal for 2030. The InnovA58 is the first large scale project initiated by the Ministry of Infrastructure and Water Management which has high circular economy ambitions. Therefore, the conclusions drawn from this case study will be valuable for accelerating the transition to a circular economy, as the goal must be reached in a relatively short time span.

Size of the project: Circularity is not entirely new in the construction and infrastructure industry, as pilot projects have been taken place before. However, lessons learnt from a pilot project are not applicable to a project on a larger scale, as regulations are more flexible and less strict for pilot projects. Therefore, the InnovA58 will provide relevant insights to use in future large-scale construction or infrastructure projects

Many large projects are on the horizon: As our economy is rapidly growing, the demand of mobility is growing as well (Ministerie van Infrastructuur en Waterstaat, Ministerie van Economische Zaken en Klimaat, & Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2018). This means we are facing a challenge in the upcoming decades to make our infrastructure fit for the future, as alterations to the current network are continuously needed. The recommendations resulting from this study can benefit projects in the near future.

1.4.2 SINGLE CASE STUDY

This study will derive its knowledge from one single case study; the InnovA58. In this type of case study, the researcher "focusses on an issue or concern, and then selects one bounded case to illustrate this issue" (Creswell, 2007, p. 74). The reason why this study uses one case is practical of nature; the InnovA58 is the first large infrastructural project in the Netherlands in which the circular economy ambitions are of a high level. In history, practitioners stated that one cannot generalize from one single case study, as no comparison can be made to other cases. Therefore, no lessons can be learnt from a single case study (Giddens, 1984). However, Flyvbjerg (2006) recently stated that one can in fact generalize from a single case study, although "It depends on the case one is speaking of and how it is chosen" (Flyvbjerg, 2006, p. 225). Although the conclusions drawn from this study could be generalized to other projects, some things do have to be considered. First of all, this study will be explorative of nature, as this study cannot and will not try find answers to a certain problem. This study is a way to explore the possible problems encountered, which could be the input for further research. Secondly, the conclusions of this research cannot be directly projected on other project cases, as the circumstances of the studied case are unique. This needs to be taken in mind when using conclusions from this study to explain artefacts in other project cases. Thirdly, conclusions based on this research might not be true or relevant for other studies, due to the uniqueness of the case.

1.4.3 EARLY PHASE OF THE PROJECT

As the InnovA58 is the first in its kind to try to use the principles of the circular economy to its full potential, this case will present knowledge about the transition to the circular economy in a very early stage of the transition. However, next to the transition to a circular economy being in its early phase, the case of InnovA58 is also at an early stage. Currently, the draft route decision is created, thus, the project is in its pre-contractual phase. This causes this study to focus only on the stage in which it is now. The insights and conclusions based on the data the case study will provide will thus give empirical knowledge on the transition to a circular economy in the pre-contractual phase of a Dutch infrastructure project.

1.5 PROBLEM DEFINITION

The correct formulation of a problem to solve in a study plays a crucial role in the further course of the research approach, as it directly affects the research design and how the problem-solving tasks are performed (Van de Ven, 2007). This paragraph will therefore present the problem detailed and structured. Central to this study is the problem related to the slow implementation of a circular economy in the Dutch infrastructure sector. To explain the problem definition and statement, first, the context is explained.

Both public and academic knowledge about circular economy is expanding, the number of scientific papers published per year is growing fast, and the willingness to implement circular economy is there (Scopus, 2018; Shi, Peng, Liu, & Zhong, 2017). This willingness is also reflected in the construction sector. However, a surprising difference can be observed when comparing the building sector and the infrastructure sector. The building industry is already some steps ahead. Large scale initiatives are however not yet observed in the infrastructure industry. Therefore, the question rises why the implementation of the circular economy is lagging behind in the infrastructure sector.

This can partly be explained by the fact that an infrastructure project is, in comparison to a construction project, much more complex. In construction projects, innovations are easier to implement, and risks are lower in case the implementation of the innovation fails. Therefore, project managers in the infrastructure sector are more reluctant to implement innovations like the circular economy philosophy. A more elaborate explanation of the complexity of an infrastructure project can be found in the grey box at the end of this paragraph.

Though implementation of the circular economy in the infrastructure sector cannot yet be observed, some developments do have an indirect influence, such as the availability of sustainability assessment tools, which create awareness under practitioners in the construction and infrastructure sector, and the material passport, albeit this development still is in the pilot phase (Berardi, 2012; Ding, 2008; Madaster, 2017; Rau & Oberhuber, 2016; Ugwu & Haupt, 2007).

To fully change the infrastructure industry into a circular industry, more radical changes are needed to bring about the systematic change that is needed from the industry (Pigosso, Rodrigues, & McAloone, 2017). However, it is in the nature of human kind to dislike changes (Kanter, 2012; Markard, Raven, & Truffer, 2012). Therefore, societies need to restructure existing systems fundamentally and this can be described by the means of transition theories. Transition theories can be used to describe transitions, or to guide the transition in the right direction.

Known transition theories clearly describe the importance collaboration between stakeholders, partnering is seen as the ultimate form of collaboration in the infrastructure industry. (Hughes et al., 2012; Kemp et al., 2007; Loorbach & Rotmans, 2010; Omar, 2017; Rotmans, 2017; Xue et al., 2018). However, the relation between partnering and the transition to a circular economy has never been studied in the field of infrastructure.

Problem statement

Thus, this study addresses the problem of the slow implementation of ideas of a circular economy in the Dutch infrastructure industry and focuses on the role partnering has in projects that contribute to a greater transition. In this study, the transition to a circular economy will be at the centre of attention.

There are many reasons why construction projects are perceived to be smaller and less complex than infrastructure projects. The main differences can be assigned to: (1) the size of the project measured in land area, (2) the number of stakeholders, (3) the investment involved and (4) the running time of a project. A dwelling, construction, office or other building is located on a plot of land within one municipality, whereas an infrastructure work usually covers multiple regions, municipalities and sometimes even multiple provinces. Also, infrastructure projects also have a direct interface with the public (Agarwal, 2015). Therefore, an infrastructure project is more complex, since it must deal with a higher number of stakeholders (Wood & Ashton, 2010). Also, due to the higher complexity and specificity of an infrastructure project, more specialists need to be involved in the planning, design and execution phases of infrastructure projects. This further increases the complexity of the project since even more stakeholders are involved (Liang, Yu, & Guo, 2017). A large number of stakeholders may lead to ambiguous interpretations in projects, which can obstruct the project and further increase the complexity of this project (Hertogh & Westerveld, 2010). A third difference in size of building and infrastructure projects can be seen in the order of magnitude of the investment needed to execute the project. A higher investment needed for a project brings more risks and uncertainty, which is usually the case in infrastructure projects. These risks and uncertainties are usually avoided in practice, which withholds institutional innovation (Salet, Bertolini, & Giezen, 2013). The last major difference can be assigned to the aspect of time. Usually, infrastructure projects have longer lead times, making it harder to implement innovations, as knowledge gained also takes a long time to obtain (Mingail, 2011). All these characteristics explain the fact that implementing changes in the infrastructure sector are perceived to be more difficult than in building projects.

1.6 RELEVANCE OF THE STUDY

The outcome of this study will be relevant both scientifically and practically. In addition to that, recommendations will be of added value to the further course of the case analysed in this research. The relevance of this study to both fields is explained below.

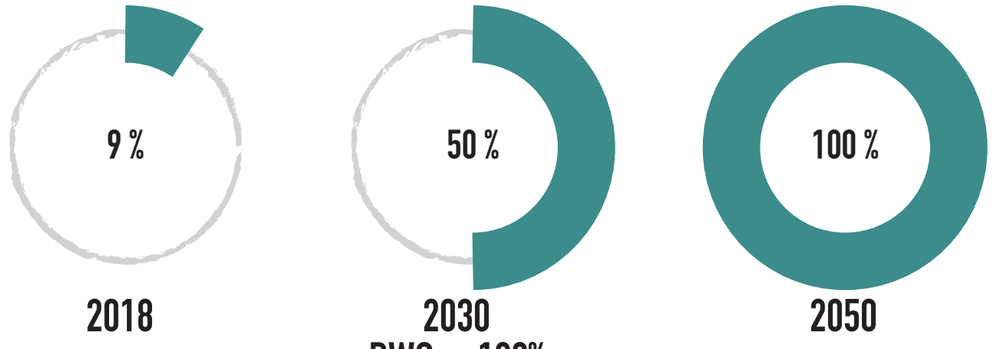
1.6.1 SCIENTIFIC RELEVANCE

From a scientific point of view, the knowledge about circular economy is expanding fast. Many articles are written on the concept and the transition we must go through. However, so far, negligible research has been performed on the relation between partnering and the transition to a circular economy. This is a notable fact since the interest in the circular economy is increasing fast and the knowledge, as well as the positive and the negative characteristics of forming partnerships are well known. This study therefore aims to provide this knowledge by studying the relation between partnering and the transition to a circular economy in the Dutch infrastructure sector.

1.6.2 PRACTICAL RELEVANCE

The transition to a circular economy fits the goals of the Dutch government has set itself, as in September 2016, the Dutch Government presented a government-wide programme called 'A Circular Economy in the Netherlands by 2050' (Dutch Ministry of Infrastructure and the Environment & Ministry of Economic Affairs, 2016). This presented an ambitious plan to reduce the use of primary resources by 50% in 2030, and become 100% circular in 2050. Although there is no explanation on how the Dutch government interprets '100% circular' it is clear that radical changes in the current way of working are needed to come close to the aims of 2030 and 2050. The Dutch Ministry of Infrastructure and Water Management is even more ambitious, by setting the goal of full circularity in 2030. Figure 4 presents the current status of circularity, as well as the ambitions of the Dutch government and Rijkswaterstaat.

Rijkswaterstaat does present an explanation to the definition 'full circularity', as it is described as "[to] work without producing waste" (Rijkswaterstaat, n.d.-b). To reach this goal, the ministry is currently working hard to implement circular economy in several projects. The InnovA58 is one of the first projects in which circular economy plays a big role, as the ministry wants this project to have a 'circular design' (Rijkswaterstaat, n.d.-d). Witteveen+Bos is working together with Rijkswaterstaat and is responsible for the translation of the preferred alternative into a final design as well as for the Environmental Impact Assessment.



▲ Figure 6: ***Ambitions of circularity (own illustration, derived from de Wit, Hoogzaad, Ramkumar, Friedl, & Douma, 2018)***

As this research is conducted at the company Witteveen+Bos and the InnovA58 is the first major project in which circular economy is a key factor in the infrastructure sector in the Netherlands, this case lends itself perfectly for a study about the relationship between partnering and the transition to a circular economy. The lessons learned that will be formulated at the end of this study will both be relevant to Witteveen+Bos as well as the Ministry of Infrastructure and Water Management, as projects with some of the characteristics of the Innova58 project will be initiated again. The Ministry of Infrastructure and Water Management will have a better understanding of how to implement circular economy and its relationship with multilateral partnering, whereas Witteveen+Bos will gain a competitive advantage over competitors as it knows how to deal with circularity within infrastructure projects.

1.6.3 PROJECT RELEVANCE - INNOVA58

The InnovA58 is the first circular economy project for the Ministry of Infrastructure and Water Management. So, experience in the implementation of circular economic principles in an infrastructure projects is not yet available. Thus, the successes and setbacks experienced during the entire project are highly valuable, in order to optimize the process in future projects.

Next to being the first large Dutch infrastructure project in which circular economy is highly valuated, more goals are formulated for this project. Although closely related to the principles of a circular economy, the reduction of the use of energy is seen as a separate and important goal. Furthermore, the project is -like almost every other infrastructure project- on a tight budget. The limited budget puts a strain on the creativity of the project team, as experimental solutions are often costly. The high ambitions for this project as well as the project being the first in its kind, makes the InnovA58 project a unique case. This case will be the first accelerator of the circular economic transition in the Dutch infrastructure sector.

1.7 RESEARCH QUESTIONS

This paragraph will first elaborate upon the main research question stated for this study. Thereafter, the subquestions are formulated to break down the research questions in manageable parts. Those subquestions will be subsequently answered in this study, to finally answer the main research question.

1.7.1 MAIN RESEARCH QUESTION

The main research question this thesis means to provide an answer to is formulated as follows:

"WHAT IS THE ROLE OF PARTNERING IN THE TRANSITION TO A CIRCULAR ECONOMY IN A DUTCH INFRASTRUCTURE PROJECT WITH MULTIPLE STAKEHOLDERS WHICH HAS A CIRCULAR ECONOMIC AMBITION?"

Explanation of definitions

Role (of partnering) – The role will describe the influence of partnering between stakeholders in a project on the transition to a circular economy in an infrastructure project.

Partnering – As partnering is a verb, this is the process of establishing a partnership. A partnership is a collaborative management approach which builds on trust and openness. In the light of this study, partnering can be described as the establishment close relationships and the alignment of activities between stakeholders in a project (Koolwijk, van Oel, Wamelink, & Vrijhoef, 2018).

Transition – The term transition originates from the Latin word transire (go across). The definition of transition according to www.dictionary.com is the "process or a period of time of changing from one state or condition to another". In this study, the implementation of circular economy is the transition from the way we produce goods right now (take-make-dispose) to the way in which we must produce goods without harming the environment (reduce-reuse-recycle).

Circular Economy – There is no unambiguous definition of circular economy, as there are many interpretations possible (Zengwei, Bi, & Moriguichi, 2006). In this report, the following definition of Kirchherr, Reike and Hekkert (2017) will be used: 'The circular economy replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes.'

Infrastructure project – Infrastructure projects can be defined as the fundamental facilities and structures in a country, which are publicly owned.

Multiple stakeholders – In every infrastructure project, many stakeholders are involved. In this study, the partnering will be studied between multiple stakeholders, this can be described as multilateral partnering.

1.7.2 SUBQUESTIONS

To give answer to the main research question, four subquestions are formulated, to break up the research question in manageable parts. Below, the subquestions are presented. The questions are formulated in the order of a theoretical part (SQ1), a methodological part (SQ2), a case study part (SQ3) and the generalization of the found evidence (SQ4).

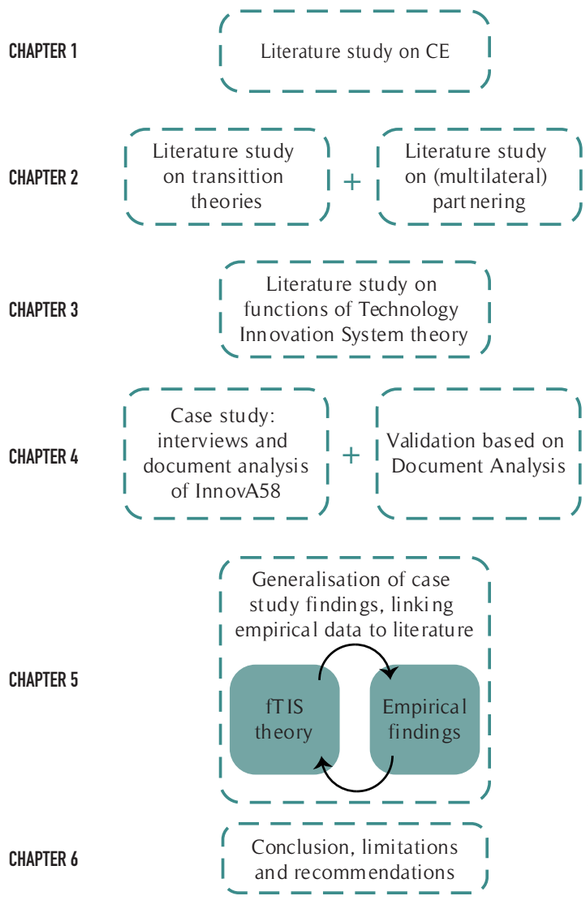
1. What is multilateral partnering and how does it benefit transitions?
2. How can a transition theory be used to study partnering in the early phase of a Dutch infrastructure project?
3. Within the early phase of an infrastructure project, how does partnering relate to the chosen transition theory?
4. How can partnering enhance the transition to a circular economy in a Dutch infrastructure project?

1.8 RESEARCH DESIGN

To find the answers to the questions stated in the previous paragraph, a well set out plan is needed. The knowledge needed to answer the research questions in this study will be found by executing a literature research and a qualitative case study research. In this paragraph, the methodology on how the research questions will be approached is elaborated upon.

1.8.1 RESEARCH STRATEGY

As explained, the four subquestions directly link to four different aspects of this study, which together will provide the answer to the main research question. The strategy which will be followed to answer the subsequent questions is summarized in Figure 5, and explained in the following paragraphs.



◀ Figure 7: ***Research strategy***

Literature study

First of all, corresponding to the first subquestion formulated for this research, a literature review will be conducted. This is done to provide an overview of the current knowledge on the two main concepts of this study, (multilateral) partnering and transitions. First of all, the concept of partnering will be explained in the field of the construction and infrastructure sector. Thereafter, the available transition theories will be elaborated, and the most applicable theory will be chosen which will provide the basis of further research of this study.

The knowledge gained from this literature study acts as the 'glasses' with which the empirical case study will be viewed with (Verschuren & Doorewaard, 2013). The main sources of this literature study are Scopus, ResearchGate and Google Scholar.

Methodology

As in the literature study, all known transition theories will be explained, the chosen transition theory must be translated into a workable methodology on how to approach the case study. The methodology on how to approach the case study will be further elaborated in chapter 3.

Case study

Empirical knowledge is gained by performing a case study. Verschuren and Doorewaard (2013, p. 178) explain a case study as "[A] research strategy in which the researcher tries to gain a profound and full insight into one or several objects or processes that are confined in time and space." This may consider a company, a process within a company or a project. In this study, a single project will provide the empirical knowledge needed to answer the research question. The study will be an in-depth study, qualitative of nature. As this study will focus on one single case study, triangulation is emphasised on, to eliminate chance as much as possible. A challenge lies in the formulation of general conclusions, as these will only be based on the evidence of one case study.

Validation and generalization

As the empirical knowledge is only attained by analysing one case study, no comparison between cases can be made on which to base the generalized conclusions of this research. Hence, a validation is executed by means of document analysis. The found evidence in the document analysis supports the evidence found in the case study. Also, outcomes are validated on the basis of explanations found in literature.

1.8.2 LIMITATIONS OF THE STUDY

As stated in the main research question, this study focusses on the Dutch infrastructure sector. Therefore, it is unknown whether the conclusions from this study will also be applicable in other countries as this is not the scope of this study. Furthermore, as this research is commissioned by Witteveen+Bos, a Dutch engineering company, resources and documents from other companies or institutions could only be analysed when publicly available.

1.9 READER GUIDE

The outline of this thesis will follow the structure of the subsequent subquestions, following by the final conclusions of this research. Thus, chapter 2, which will begin on the following page, will focus on the first subquestion, which will be answered by performing a literature review. In chapter 3, the methodological approach of the empirical case study is focused on, where after the empirical data will be gathered and summarized in chapter 4. In chapter 5, the empirical data will be translated in generalized conclusions on how partnering can enhance the transition to a circular economy in the Dutch infrastructure sector. The information combined of all previous chapters leads to the final conclusions, limitations and recommendations of this study, which can be found in chapter 6.

This report mainly consists of the main body of text. However, sometimes, extra information or examples are shared. This information or examples are not needed in order to follow the line of reasoning in this thesis but is presented as background information for the interested reader. These pieces of text can be found throughout the entire report, and will be presented on a grey background. These background information boxes were already used in paragraphs 1.1 and 1.5.

CHAPTER 2

Literature study

2 PARTNERING IN TRANSITIONS

In this chapter, the first out of four subquestions of this study will be answered. This question states: *"What is multilateral partnering and how can it benefit transitions?"*. To provide the answer to this question, three consecutive steps are taken. First, a theoretical basis is founded regarding the concept of (multilateral) partnering. Because this concept will be studied in a unique case, the InnovaA58, the second step is to elaborate on the criteria which make this case so unique. Thereafter, the available transition theories can be described, and on the basis of the criteria described at the start of this chapter, one transition theory will be chosen, which will be used as a framework to analyse the case. This chapter will thus connect the concepts of partnering and transition theories, a connection that has not yet been made within the construction and infrastructure sector in.

2.1 CONCEPT EXPLANATION - MULTILATERAL PARTNERING

Partnering is the main focus of this study, as the importance of partnering is evident in a transition. However, literature about the use of partnering to transition is very limited (Isaksson & Heikkinen, 2018). Therefore, first, a deeper understanding of the concept of (multilateral) partnering is given. This deeper understanding in the following paragraphs will result in a list of elements on how to recognize partnering in an infrastructure project, as easy recognition will benefit the case study executed.

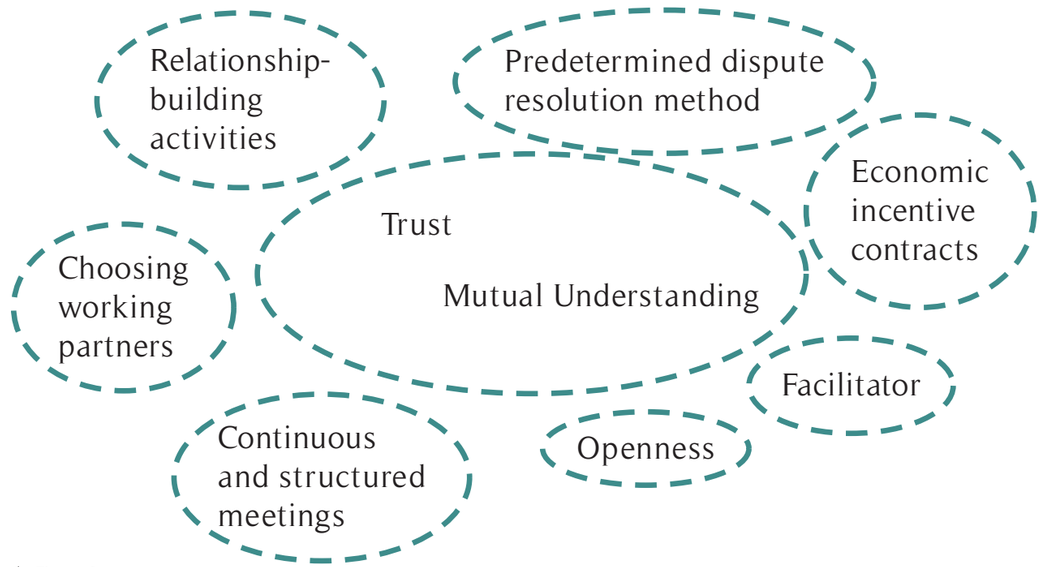
Even though the concept of partnering is already in use for more than three decades, an agreement on the definite definition of the concept of partnering has not yet been made (Bresnen & Marshall, 2010). The lack of having an unambiguous definition might suggest the concept of partnering has not yet reached maturity (Li, Cheng, & Love, 2000; Nyström, 2007). A grasp of the different definitions of the concept of partnering are presented below.

Barlow and Jashapara (1998, p. 88) described partnering as "[the] variety of managerial practices and organisational designs that enhance and maintain collaboration". The Construction Industry Institute (1991, p. 4) explains partnering as "a long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources". In this definition, the difference between partnering and multilateral partnering is also included, as the adjective multilateral describes the fact that partnerships can also be formed by more than two parties. A third definition of partnering is described as follows: "Partnering involves the parties to a construction project working together in an environment of trust and openness to realise the project efficiently and without conflict" (Black, Akintoye, & Fitzgerald, 2000, p. 423).

Nyström (2007), who devoted his dissertation to unfolding the theory of partnering, describes partnering as a 'partnering flower', a visual representation of the concept, presenting all necessary (in the heart of the flower) and non-necessary (represented as the petals of the flower) components. He has explained the concept of partnering as a figure, as he believes the specific definition of partnering is dependent on the environment in which the concept of partnering is used. This representation of the concept thus captures different explanations of the concept, by including or excluding some of the petals of the 'partnering-flower'. The visual definition of this concept can be seen in Figure 8.

In the light of this study, the definition of partnering can be summarized as follows:

MULTILATERAL PARTNERING IS A LONG-TERM COMMITMENT OF MULTIPLE STAKEHOLDERS TO CLOSELY COLLABORATE, IN ORDER TO SUCCESSFULLY COMPLETE A PROJECT OR SPECIFIC BUSINESS OBJECTIVES, BY MAKING MAXIMUM USE OF THE STAKEHOLDER'S RESOURCES AND QUALITIES. IN ORDER TO ACHIEVE (MULTILATERAL) PARTNERSHIPS, SEVERAL COMPONENTS ARE A PREREQUISITE, LIKE TRUST AND MUTUAL UNDERSTANDING.



▲ Figure 8: ***The partnering-flower (own illustration, derived from Nyström, 2007)***

2.1.1 THE EVOLUTION OF PARTNERING

The concept of partnering within the infrastructure industry dates back to the 1980's, since then, the scientific knowledge about this topic has kept on growing. Although the concept is known in the construction and infrastructure sector for quite some time, compared to the manufacturing industry, the concept is relatively new (Li et al., 2000). Below, the timeline of partnering is presented summarizing the course of the evolution of (multilateral) partnering. The blue line represents the pupularity of partnering in time.

1980's

In the 1980's, interest grew to collaborate closer during construction projects; partnering was seen as the way to do so (Bresnen & Marshall, 2010). It was introduced as a means to overcome the industry's problems due to adversarial relationships, which was a problem occurring frequently in the construction industry in the second half of the twentieth century (Barlow & Jashapara, 1998). Other illnesses present in the construction industry in the 1980's were low productivity, litigious environments and low speed of innovation and implementation of those innovations. Furthermore, the concept of partnering was seen as a way to better share the risks between stakeholders in a project and providing suppliers with a more steady stream of income, as well as optimizing the integration of design and realisation in a project (Barlow, Cohen, Jashapara, & Simpson, 1997). In the following decades, the concept of partnering became popular as it proved to be of positive impact on overall project performance.

+ - 1990's

From around 10 years after the introduction of the concept of partnering in the construction and infrastructure industry, governments across the world started to promote partnering in public governmental reports, since they believed it would contribute to economic growth (Nyström, 2007). The promoting of the use of partnering by governmental institutions was fed by academics researching the advantages of the implementation of partnering (Crespin-Mazet, Ingemansson, & Linné, 2014). One of the reasons governments promoted partnering was to reduce costs, as Cain (2004) estimated that supply chain integration and a focus on unnecessary costs induced by partnering could potentially save 30% of the total costs.

+ - 2000's

Also in the Dutch construction and infrastructure sector, partnering became more and more important at the beginning of the 21st century. Due to budget problems, the Dutch government introduced new contract forms, in order to share of transfer more risk to public parties. To be able to do this, close collaboration was essential, because public parties were invited to the table in an earlier phase of a project (Koops, 2017). However, this development also brought some problems to the stage. Risks were transferred to parties that were least able to refuse them, instead of handled by the party which was best able to manage them, which is a common mistake made in poorly managed public private partnerships (PPP's) (Jin & Zhang, 2011). This resulted in companies taking risks they were not able to withstand.

2003

Another problem which occurred during the beginning of the 21st century was the well-known construction fraud affair (De Bouwfraude). Numerous Dutch contractors had made illegal agreements on procurement strategies in order to make more money (Enquêtecommissie Bouwnijverheid, 2003). This national scandal was widely reported in the media and generated much negative publicity for all involved parties and the construction and infrastructure industry as a whole. This scandal affected the relationship between the Dutch government and public parties greatly, as the trust had been betrayed. In the years to follow, distrust dominated the construction and infrastructure sector, and a long time was needed to recover from this scandal.

2011

In 2011, positive steps were taken regarding partnering in the construction and infrastructure sector in the Netherlands, as around 50 practitioners from public and private parties signed an agreement to commit themselves to more and closer collaboration in projects. In this document, collaboration is seen as a necessity in order to successfully complete increasingly complex problems in the built environment (Rijkswaterstaat, 2010). The build-up toward the moment of signing this agreement was the beginning of the turnaround regarding trust in the construction and infrastructure industry.

2013

Rijkswaterstaat experimented with a new way of tendering, in a pilot project called 'Project DOEN' (Project Team NU DOEN, n.d.). This project ran simultaneously with the development of the Market Vision, which was started in 2016, and was the first example of the implementation of the Market Vision in a real-life project. Close collaboration was one of the main learning goals in the project. This project turned out to be very successful, and an example for upcoming projects of Rijkswaterstaat (Westra, 2018).

2016

In 2016, another development accelerated the use of partnering in the Netherlands as several contractors and clients took the initiative to develop a new vision on creating a vital and sustainable building sector, the so-called Market Vision (Marktvisie) (Rijkswaterstaat, n.d.-e). Jan Hendirk Dronkers, former Director General of Rijkswaterstaat called for change, and the building sector saw the need to change the vision of the sector as well. This led to a collaboration with companies like the Central Government Real Estate Agent (het Rijksvastgoedbedrijf), Prorail, Bouwend Nederland, etc. Together, they developed a vision to improve the building and construction sector in collaboration with all involved partners (Rijkswaterstaat, 2015a). To be able to achieve this vision, the Market Vision stresses the necessity to collaborate with all stakeholders in the industry, and to all feel responsible for the implementation of the market vision in the upcoming years. Since the introduction of the Market vision in 2016, more than 1500 individuals from the construction and infrastructure sector have signed the vision and have said to commit to the goals and conditions stated in the document.

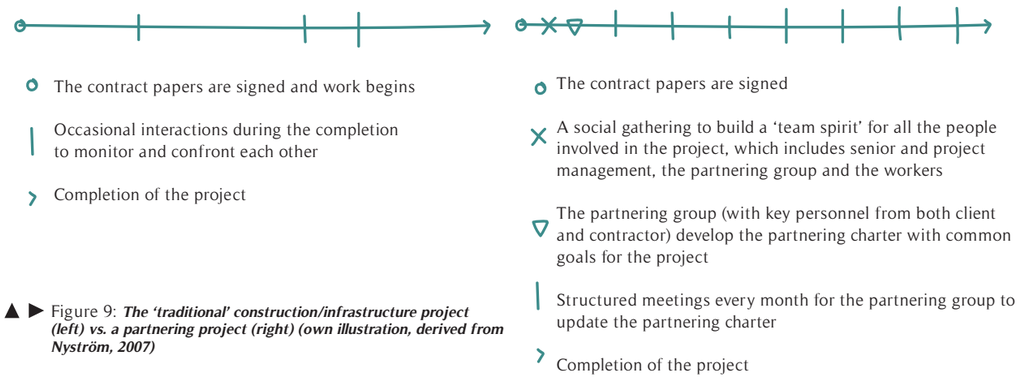
2.1.2 THE PROCESS OF PARTNERING

One of the clearest differences between a 'traditional' project and a partnering project can be visually explained by the help of Figure 9. In a 'regular' project, after the contracts of the project are signed, the only meetings organised between client, contractor and other stakeholders take place in case a conflict obstructs the regular way of working. Therefore, these meetings usually have a negative atmosphere (Nyström, 2007). In partnering projects, regular (monthly) meetings are planned, to resolve problems quickly and in a friendly setting. Due to these regular encounters between stakeholders, trust and mutual understanding are created (Bresnen & Marshall, 2010; Kaluarachchi & Jones, 2007). This helps to keep positive attitudes of all stakeholders. Next to those regular meetings, three initial meetings are held in which the contract is signed, the partnering charter is set up and a 'social gathering' for the entire team is organized. Those initial meetings all contribute to the team spirit, which benefits the outcome of the project (Markert, 2011; Nyström, 2007; Pishdad-Bozorgi & Beliveau, 2016).

2.1.3 THE IMPORTANCE OF THE CONTRACT

The process of partnering is vital to the successful execution of a partnering project, as explained in the previous paragraph. However, a contract still is one of the most important legal documents on which any infrastructure project is based. Setting up contracts for complex projects like construction or infrastructure projects costs a lot of time and transaction costs are high. Furthermore, contracts are always considered to be somewhat incomplete, as uncertainties are always present, and they cannot include all contingencies (Zheng et al., 2008). Whereas the costs of setting up a detailed contract are high, the advantage of such a contract is the low risk of opportunism. The other end of the scale of contracts is an incomplete contract. Setting up such a contract is much less costly and time consuming, however, the risk of opportunism is high. This is visualized in Figure 10.

With the help of partnering, one can enjoy the advantages of an incomplete contract, and reduce the negative aspects of such a contract, by eliminating opportunism. This reduction or even elimination of opportunism is the result of the characteristics which are at the heart of partnering; trust, mutual understanding, openness, etc.



▲ ▶ Figure 9: ***The 'traditional' construction/infrastructure project (left) vs. a partnering project (right) (own illustration, derived from Nyström, 2007)***

▲ Figure 10: ***The difference in complete and incomplete contracts (own illustration, derived from Nyström, 2007)***

2.1.4 THE BENEFITS OF PARTNERING

With the help of partnering, an incomplete contract can be set up, without the high risk of opportunism. This significantly reduces the costs of setting up the contract. However, there are many more advantages of partnering, which will be explained below.

Partnering in the construction industry has been proven to be a way to increase overall project performance in terms of costs, time, quality, buildability and fitness-for-purpose (Bresnen & Marshall, 2010). Several researchers have dived into the positive effects partnering could reflect on projects and its outcomes. For instance, already in 1995, Larson drew the conclusion from a study of 280 construction projects that partnering brings higher performance than traditional procurement methods (Larson, 1995). In the same year, Bennet and Jayes stated partnering leads to earlier completion of construction projects and a higher quality of the end product (Bennett & Jayes, 1995). A recent study gives a more elaborate overview of positive effects partnering can bring about, as this study collected the results of multiple studies executed between 1995 and 2010 (Hosseini et al., 2018). In the early years of the use of partnering in the construction industry, the benefits were mostly connected to the elements of the 'Iron Triangle' (Atkinson, 1999). For instance, partnering increases efficiency, quality and safety, but reduces litigation (Bennett & Jayes, 1995; Larson, 1995). In later years, the positive effects of partnering on project results unrelated to the Iron Triangle became apparent as well. Academics found positive effects of partnering on sustainability, communication and the better sharing of risks (Chan, Chan, & Ho, 2010; Cheung, Ng, Wong, & Suen, 2003; Eriksson, 2010; Naoum, 2003).

The complete list of perceived benefits, according to Hosseini et. al. (2018) is as follows:

- Increase Efficiency
- Increase Quality
- Innovation
- Reduce Litigation / Dispute Resolution
- Increase Customer Satisfaction
- Elimination of Adversarial Relationships
- Sustainability
- Safety Performance
- Reduce Risk / Risk Shared
- Enhance Communication
- Continuous Improvement

2.1.5 RECOGNIZING PARTNERING

A general understanding has now been created of the concept of partnering, as well as the benefits partnering can bring to an infrastructure project are. However, how does one recognize partnering in a project? As one of the main aims of this study is to gain empirical knowledge about the link between partnering and the transition to a circular economy, a clear description of the concept itself is needed to grasp partnering in the case study. A list of elements which describes partnering can be used as a 'checklist' whether the elements of partnering are present in the case study. Also, a clearly defined set of elements of partnering eases the communication during interviews performed in the case study, as the elements of partnering can be used as input for the conversation. Furthermore, a clear list of elements of partnering will also help choose a transition theory based on partnering in the upcoming chapter. This will make sure the choice of a transition theory will be well substantiated on the basis of partnering.

As mentioned, many academics have contributed to the theoretical knowledge on the concept of partnering. This not only resulted in many different definitions of the concept, many attempts are also undertaken in presenting a list of elements used to describe a 'perfect partnering project'. The partnering flower of Nyström (2007) is an example of one of these attempts. However, many more lists of elements of partnering are presented in scientific literature in recent decades. These lists all have several corresponding elements, however, none of the lists of elements exactly the same. Hosseini et. al. (2018) provides an overview of nine most frequently quoted lists of elements. The combined list of these nine articles presented by Hosseini et. al (2018) consists of fifteen elements of partnering. It can be concluded this list of elements of partnering provides a thorough understanding of the elements of partnering which together describe a 'perfect partnering project'. This list of elements will be used in the further course of this study, as this list includes the knowledge of academics of the last decades. The elements will be described one by one on the next page.

1. **Trust**
2. **Common Understanding**
3. **Collaborative Contractual Clauses**
4. **Early Involvement of Suppliers**
5. **Incentives, Pain/Gain Share**
6. **Common Goals**
7. **Team Building Activities**
8. **Structured Meetings/Workshop**
9. **Facilitator**
10. **Committed Participants**
11. **Conflict Resolution**
12. **Open and Effective Communication**
13. **Open-Book Economy**
14. **Continuous Improvement**
15. **Continuous Joint Evaluation**

1 Trust

The element of trust is mentioned in all nine scientific articles analysed by Hosseini et. al. (2018), and might thus be seen as (one of) the most important element(s) in a partnering project. Trust is explained as the belief that someone or something is reliable, good, honest and will not intentionally harm you (Collins Dictionary, n.d.). In partnering, trust is highly important as it "develops through reciprocal co-operative strategies from both parties" (Nyström, 2007, p. 476).

2 Common Understanding

To be able to work towards the best outcome of the project for all involved stakeholders, one needs understanding of each stakeholder's individual expectations and values (Bygballe et al., 2010). To work effectively and in everybody's interest, these expectations and values, or needs, will have to be known to other stakeholders, otherwise they will not be able to perform optimally (Ng et al., 2002).

3 Collaborative Contractual Clauses

In traditional construction projects, the contract is long and elaborate, but does not explain the 'rules' of collaboration before and during the project itself. Collaborative contractual clauses refer to the more common known 'Partnering Charters', a document which is set up jointly by all parties, which explains a list of common goals and objectives of the project, which may refer to safety, mutual respect, a pleasant working environment and other 'soft' elements (Hosseini et al., 2018; Markert, 2011; Nyström, 2007).

4 Early Involvement of Suppliers

The advantage of early involvement of suppliers in a project is twofold. First of all, the expertise of the supplier can contribute to the plans set up before execution. Second, if the suppliers have had a say in designing the project, they will automatically support the decisions made in line with this plan (Beach et al., 2005; Bygballe et al., 2010; Eriksson, 2010; Nyström, 2007).

5 Incentives, Pain/Gain Share

Related to common understanding, incorporating incentives in a contract is also part of the concept of partnering, as incentives support the goals of sharing (financial-) setbacks or successes. Sharing these enhance collaboration, as it endorses a win-win mentality (Eriksson, 2010). Non-financial incentives such as appreciation, personal development, influence, etc. can also improve the effort of stakeholders (Nyström, 2007).

6 Common Goals

Next to common understanding of each other's expectations and value, common goals need to be formulated as well, as a lack of common goals will make fruitful collaboration impossible (Hosseini et al., 2018). A list of common goals to which all stakeholders dedicate themselves reduces the chances of litigation (Larson, 1995).

7 Team-Building Activities

Team-building activities are, to most academics, a pre-requisite for partnering, as it is about personal relationships and positive attitudes. These team building activities are the most important during the start-up phase of the project, but must be repeated often to maintain the personal relationships (Bygballe et al., 2010; Eriksson, 2010; Kadefors, 2004)

8 Facilitator

In order to evaluate the progress and adjust the partnering charter when needed, regular and structured meetings or workshops are needed. These meetings strengthen reciprocity between stakeholders, which have a positive effect on eventual conflicts in the further course of the project (Eriksson, 2010; Nyström, 2007).

9 Structured Meetings/Workshops

During the structured meetings or the partnering workshop at the beginning of a partnering project, the presence of an external facilitator can be of help to the partnering stakeholders. A facilitator is an outsider, thus has no standpoint in the matter of the project. It will purely manage the process of partnering, and oversee if a positive atmosphere is maintained (Eriksson, 2010; Nyström, 2007).

10 Committed Participants

A positive outcome of a partnering project is easier to achieve if the participants of the project have a positive attitude towards the use of partnering (Nyström, 2007). Also, in case the participants are not willing to use partnering in the project, adversarial relationships between the stakeholders are easier formed (Cheung et al., 2003).

11 Conflict Resolution

Because the setting up of a partnering project takes up much time and effort, the 'front-end' costs of a partnering project are relatively high. This is usually compensated by the fact that conflicts arise less quickly due to the good relationships between the stakeholders. Therefore, the 'back-end' costs are reduced. By the use of conflict resolution methods, problems and conflicts can be detected early, and relations are not harmed beyond repair (Kadefors, 2004; Nyström, 2007).

12 Open and Effective Communication

In order for the participants to share their expectations and needs, open communication is essential. Furthermore, the communication between the participants will have to remain two-sided during the entire project, to maintain a balanced and healthy relationship (Cheung et al., 2003). Also, to optimize the partnering process, both personal communication as well as professional communication requires effort to maintain at a high level (Yeung et al., 2007).

13 Open-Book Economy

By being transparent about the financial status of the project and the company itself, trust and confidence are built between the collaborating parties. At the initiation phase of a partnering project, good will is shown by providing open books (Eriksson, 2010).

14 Continuous Improvement

By bringing working partners together in an environment of trust and mutual understanding, the parties can encourage one another to consider continuous improvement in all fields of the project (Naoum, 2003). However, to be able to keep improving during the process, parties should be committed to learn from experience and apply the gained knowledge (Yeung et al., 2007).

15 Continuous Joint Evaluation

To keep the level of learning at a high level, the relationships and knowledge gained and applied need to be constantly shared, by the means of regular evaluation. Also, the partnership process itself can be monitored to see that the partnership is developing according to the expectations of the participants (Beach et al., 2005; Cheung et al., 2003).

2.2 OTHER CRITERIA SPECIFIC FOR THE CASE

A clear description of partnering within a transition theory must be present, as this is the main topic of this study. The list of elements presented on the previous pages will help recognize partnering in the case, but also to decide on a transition theory which will be used for the case study. Nevertheless, due to the uniqueness of the single case which will be analysed, multilateral partnering is not the only criterion on which the decision of a transition theory can be based. Therefore, the transition theory to be used to analyse the case will also have to consider three other characteristics: project characteristics (size, complexity, time span, etc.), early phase of the project, dedication to innovation. These three additional criteria, together with partnering, provide a complete image of the case and the characteristics which make this case one of a kind.

2.2.1 PROJECT CHARACTERISTICS

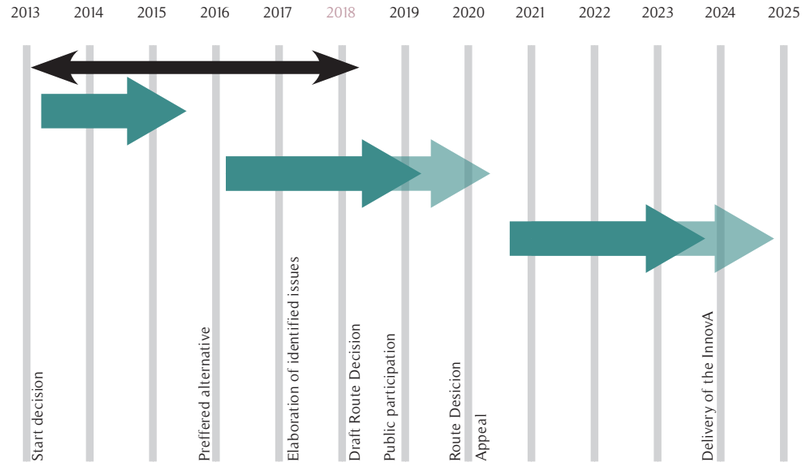
Transitions are long term processes, they usually take more than a generation to fully develop, and have an unclear starting and ending point (Rotmans, 2017). Thus, a case like the one which will be analysed in this study cannot be seen as a transition in itself. It is merely a contribution to the bigger transition to a circular economy. However, the project is still a collection of several innovations which are implemented, thus it is important the transition theory is applicable to the simultaneous implementation of several innovations.

2.2.2 EARLY PHASE OF THE PROJECT

For this study, one specific project case is analysed. As this project is an ongoing case, only the developments up until the point of this research can be analysed. This is mainly due to time constraints. It would be of great interest to analyse the entire project from initiation up until delivery and use of the asset, however, it is unfeasible to analyse the project phases of the case which are currently still in the future. Therefore, this research will focus on the early phase of the project, which can be seen in Figure 11 by the indication of the black arrow.

2.2.3 DIVERSITY OF PROJECT GOALS AND DEDICATION TO INNOVATION

The InnovA58 is a very complex project with multiple (contradictory) goals, as many interests are present. Because of the dedication the project has regarding innovation, multiple interests arise. Implementing the ideas of a circular economy is one of the innovative sides of the project, but bringing down the energy consumption during construction and during the use of the asset is also a highly valuated project goal. Therefore, the transition to a circular economy does not have the full attention of the project team. Another aspect that hampers the full attention to the transition to a circular economy are practical, economic and political factors. As can be understood, the project will have to be finished following the schedule, the safety of the road cannot be compensated for and there is a tight budget, which limits room to manoeuvre.



▲ Figure 11: ***Project planning InnovA58 (own illustration, derived from Rijkswaterstaat, n.d.-d***

2.3 TRANSITION THEORIES

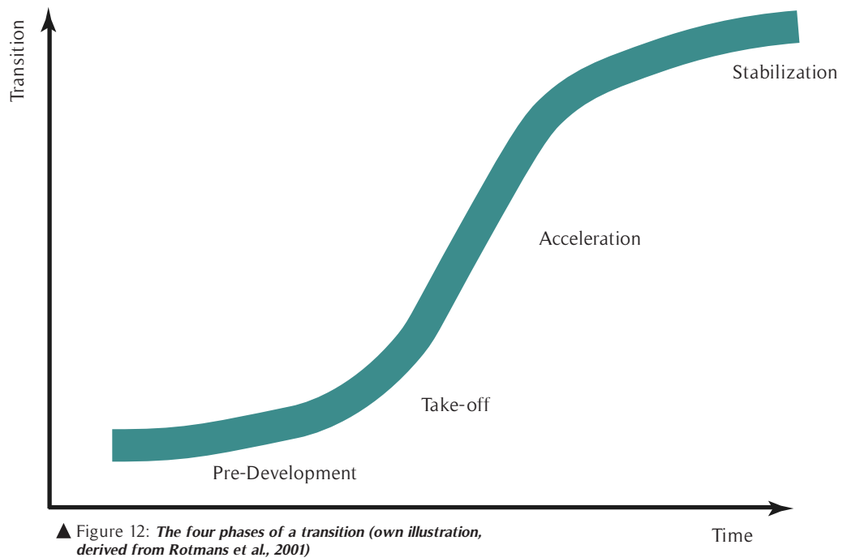
To be able to select a transition theory to analyse the case, the available transition theories must be evaluated on the basis of the criteria set up in the previous paragraph. However, first, a general image of transitions will be given. Thereafter, the four available transition theories will be discussed.

Transitions like the transition to a circular economy are not something new, as we have gone through many transitions before. A transition can be described as a "process in which society changes in a fundamental way over a generation or more" (Rotmans et al., 2001, p. 15).

A transition takes a minimum time of one generation to unfold (25 years), but can take many years longer (Rotmans et al., 2001). Every transition consists of four consecutive phases, in which the speed of the developments in a transition varies greatly. The speed of the developments and the phases can be seen in Figure 12. The four phases can be described as follows (Rotmans et al., 2001):

1. Pre-development phase: The status quo doesn't visibly change yet, however, it is known to the general public something needs to be changed.
2. Take-off phase: The state of the system slowly starts to change, and the transition is starting to take shape.
3. Acceleration phase: structural changes in socio-cultural, economic, ecological and institutional systems are apparent and the process of transition is non-reversible.
4. Stabilization phase: the transition has reached its adulthood and the speed of socio-technical changes is slowing down. Eventually, a new dynamic equilibrium is reached.

In scientific literature today, four different transition theories are described and empirically used to analyse transitions in divergent disciplines. These four theories, Transition Management (TM), Strategic Niche Management (SNM), Multi Level Perspective (MLP) and Technological Innovation System (TIS), will be shortly described and evaluated using the criteria. This results in a complete overview which presents the usability of those transition theories to analyse the role of partnering in the transition to a circular economy in an ongoing empirical case. Every transition theory will be elaborated upon first, where after a critical evaluation will take place based on the criteria. At the end of this paragraph, an overview of the scoring of the theories is presented as a summary of the following information.



▲ Figure 12: ***The four phases of a transition (own illustration, derived from Rotmans et al., 2001)***

A well-known example is the demographic transition, which describes the transition from high birth and death rates to low birth and death rates as a country develops to an economically healthy system. This transition is currently in the stabilization phase, as almost every country has successfully transitioned nowadays. However, some developing countries are still struggling. (Caldwell, Caldwell, Caldwell, McDonald, & Schindlmayr, 2006).

Another example which we are currently going through in the Netherlands is the energy transition. Today, we are still dependent on coal and natural gas to provide us with heat and electricity. However, the pressure on the government is increasing to ban out these forms of energy, both because of the harm these finite resources have on the environment as well as the effect the production of natural gas had on the province of Groningen, the province in which natural gas is extracted from the earth in the Netherlands. This transition can now be considered to be in its acceleration phase, as developments are going very fast, and the government has set itself goals to be met.

2.3.1 TRANSITION MANAGEMENT (TM)

The theory of Transition Management (TM) was introduced by Jan Rotmans, René Kemp and Marjolein van Asselt in 2001, and presented in their paper 'More evolution than revolution: transition management in public policy' (Rotmans et al., 2001). This theory is later elaborated by Prof. dr. ir. Jan Rotmans in his book 'Omwenteling', which focusses transitions from a human, organizational and institutional perspective (Rotmans, 2017).

In TM, a transition is described as the result of developments in different domains, reinforcing each other but taking place in different areas, such as current technology, the economy of a country, culture and belief systems. A transition can be compared to a self-reinforcing spiral, in which independent developments which strengthen each other and cause the system to change into a different state of being (Rotmans et al., 2001). A transition cannot occur in only one domain, as it entails a radical change for the entire community. However, it might be possible the changes in one domain might counteract the changes in another domain, but the general trend will lead to the eventual end stage (Rotmans, 2017). This can be explained by the fact that a transition is a long-term development, in which many short-term developments take place. These short-term developments can work in the opposite direction from the transition, but as long as the majority of developments steer in the direction of the transition, the counteracting development will not harm the transition. This concept is visually explained in Figure 13.

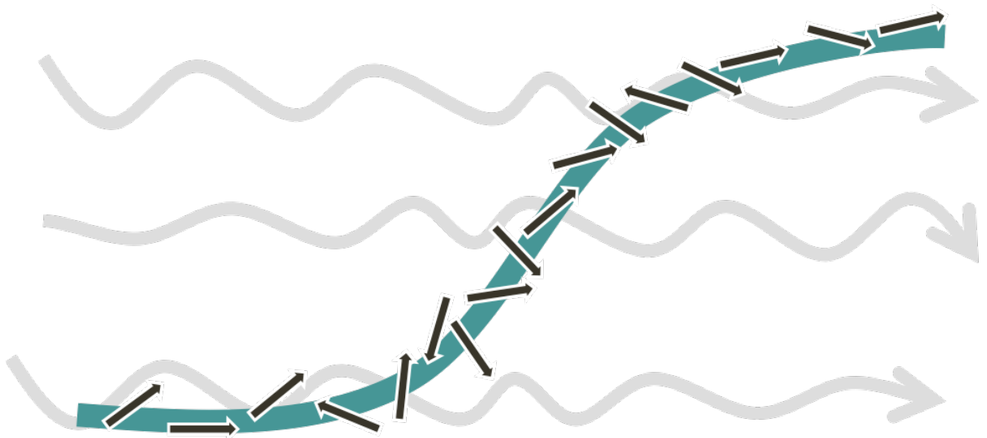


Figure 13: ***Short-term and long-term developments in a transition (own illustration, derived from Rotmans et al., 2001)***

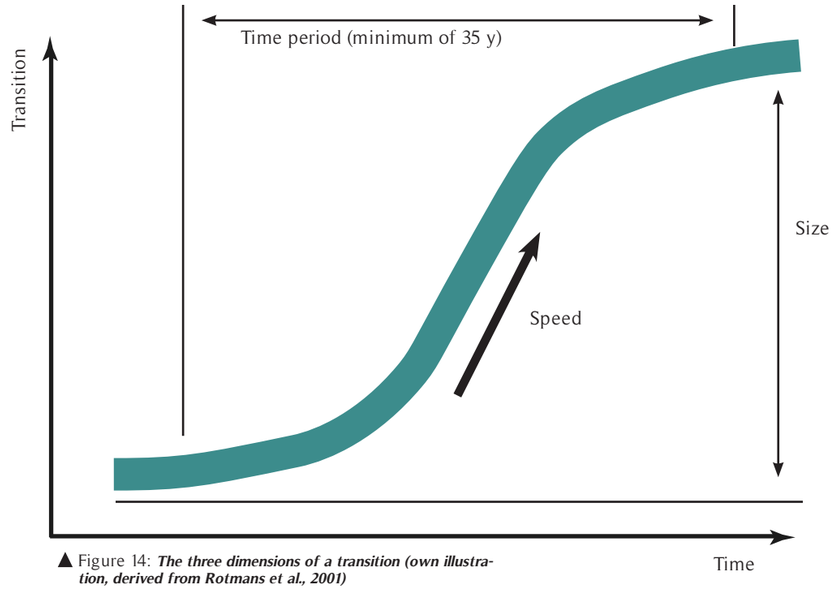
A transition is dependent on three dimensions; the speed of the transition, the magnitude of the transition, and the time period of the transition in which it takes place. The visual representation of this concept can be seen in Figure 14.

Transition Management is based on the fact one should focus on the long-term vision, in which short-term goals and objectives must be formulated. The long-term vision can be adjusted on the way of the transition; hence, flexibility is needed from the policy makers which are involved in the transition process (Rotmans et al., 2001). This differs from 'regular' policy making, since this only uses short-term visions, without ever formulating the ultimate goal society must work to. Current policy is usually aimed at a time period of five to ten years, TM focusses on at least 25 years or longer.

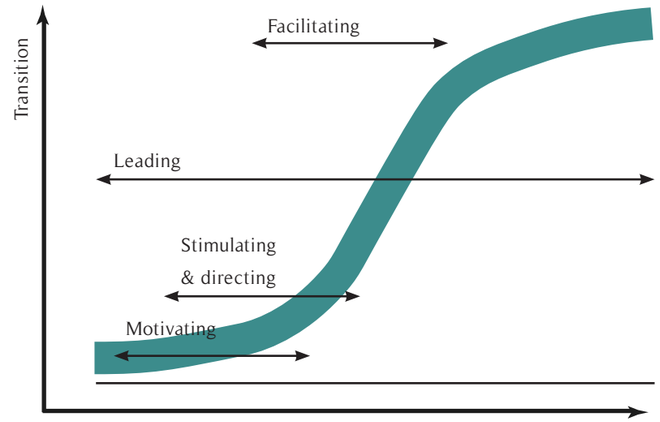
To achieve a transition, the joint effort of multiple actors is needed. However, the government has the most versatile and important role, as it has a leading role during the entire transition and must adopt a stimulating and directing role in the take-off phase to encourage progress in the right direction. In the pre-development phase, it is of high importance the government motivates actors to engage in the transition. Furthermore, during the acceleration phase, the government must adopt a facilitating role, so actors are not withheld by unnecessary regulations or bureaucratic processes. The roles of the government during a transition is visualized in Figure 15.

The most important conclusions which can be drawn from the research from Rotmans, Kemp and van Asselt (Rotmans et al., 2001) and from Rotmans (2017) can be summarized as follows:

- A transition can only occur if developments are facilitated in multiple domains and in multiple levels.
- No actor on its own can accomplish a transition. The joint effort of many stakeholders, actors, institutes and (local) authorities is needed to make a transition successful.
- Transition Management thinking builds on the idea of the development of a long-term vision, which works as a framework to formulate short-term goals and objectives.
- The government has an important role in a transition, and this role it must adapt is dependent on the phase of the process it is in.



▲ Figure 14: ***The three dimensions of a transition (own illustration, derived from Rotmans et al., 2001)***



▲ Figure 15: ***Roles of the government during a transition***

2.3.2 TRANSITION MANAGEMENT REGARDING CRITERIA

Now a theoretical foundation of the concept of partnering is created, the theory will be described in greater detail, by describing to what extent Transition Management elaborates upon the criteria.

Partnering

As the concept of partnering is quite specific, the exact term is not mentioned in Transition Management theory literature. However, Grin, Rotmans, & Schot (2010) do mention the importance of forming alliances. Following their opinion, the formation of alliances allows for building pressure on politics and the market, which is needed to safeguard the long-term vision the transition entitles. Also, Rotmans et al (2001) mention collaboration in relation to learning and evaluating during a transition, as they stress the importance of development rounds in which the learning process and its dynamics must be evaluated. This asks for discussion and collaboration to (re)formulate the goals and ambitions for the next phase of the transition, at least until the next development round takes place. In the book of Grin, Rotmans, & Schot (2010), TM was used in several cases. From these cases, it can be learnt close collaboration and regular meetings positively influenced the process as well as the outcome. Also Rotmans (2017) mentions the importance of collaboration or partnering, albeit in other words. He states organisations as well as its employees need to be flexible and transformative, in order to successfully transition. The ability to co-create is essential to being flexible and transformative.

Project characteristics

Rotmans (2017) focusses on three types of transitions; societal transitions, organisational transitions and human transitions. The second explains how a company, organisation or cooperation can handle the fast and disruptive changes the world is going through. To be able to transition a large organization, a select group of motivated employees must first make an example, before the transition can be embraced by the entire organization. Although indirect, a link can be made with the construction and infrastructure sector, in which the case acts as the example.

Early phase of the project

Transition Management is focussed on the complete transition from start until finish. As transitions take a long time to evolve, there is no specific information mentioned about the early phase of a project itself.

Diversity of project goals and dedication to innovation

In both a construction or infrastructure project as well as in the description of TM, contradictory goals are present. However, as long as they do not hamper the direction in which the transition moves or where the project wants to be, this will not be a major issue. Also, TM theory stresses the importance of experimentation. Following the same route over and over does not create room for innovation or change. Taking risks is also involved, and one must accept projects will fail while experimenting.

2.3.3 STRATEGIC NICHE MANAGEMENT (SNM)

Whereas Transition Management is a theory which describe how a transition process takes place, Strategic Niche Management (SNM) prescribes a way on how to implement new radical innovations successfully. This theory was first mentioned in 1994, where after several other academics added to the knowledge and use of this theory. According to Kemp, Schot and Hoogma, SNM is (1998, p. 168): "[…] the creation, development and controlled phase-out of protected spaces for the development and use of promising technologies by means of experimentation, with the aim of (1) learning about the desirability of the new technology and (2) enhancing the further development and the rate of application of the new technology".

Thus, SNM tries to overcome the 'valley of death'; a metaphor for the high probability of an innovation or product to die off before a steady stream of revenues is set up (Markham, Ward, Aiman-Smith, & Kingon, 2010).

The theory of SNM tries to overcome the 'valley of death' by the creation of 'safe spaces'. In these protected spaces, an innovation can develop and mature, before having to deal with the forces of the market (Schot, 1998).

The underlying reason for radical (sustainable) innovations to be unsuccessful is that these innovations must compete with well-established technologies already available. These existing technologies are embedded in socio-technical regimes, which will intuitively work against new innovations, since those innovations are a threat to the existing products or services (Mourik & Raven, 2006).

Weber, Hoogma, Lane, & Schot (1999) and Mourik & Raven (2006) provided the academic world with some tools to help innovations survive in the market and to overcome the barriers. First of all, before the introduction of an innovation, expectations need to be managed and shaped to the wish of the innovation. Positive associations towards the innovation even before the introduction, positively contributes to the acceptance of the innovation. A second tool is to create networks with different actors in the project, and to collaborate to come to a common understanding of the goal of the project; the implementation of the innovation. This will make sure all involved stakeholders will work towards a common goal, which positively influences the success of the innovation. Thirdly, learning processes during the implementation of SNM are vital to the success of the innovation. One must understand the necessary technical developments, possible infrastructural issues or design specifications, the user context, societal or environmental impact of the innovation itself and the government policy and regulatory frameworks.

When the barriers are known and the necessary learning goals are clear, the following steps, derived from Kemp et al. (1998), Weber et al. (1999) and Mourik & Raven (2006) can be followed to implement an innovation using the theory of SNM. See Figure 16.

The 'valley of death', is created by several barriers, which can be of various natures, for example technological, governmental/political or cultural/psychological (Kemp et al., 1998; Mourik & Raven, 2006). Examples of such barriers are:

- Technological barriers: the radical innovation lacks technical stability or accompanying technologies are needed in order for the innovation to work optimally, which may induce a lot of extra costs.
- Government regulations and policy barriers: current laws and regulations must first be altered before the new innovation can be introduced in the market.
- Cultural and psychological factors: the new innovation does not fit (personal) preferences and values, these need to change by familiarization of the innovation.
- Demand factors: The new innovation does not fit the demand of the users, because it is too expensive or (future) users do not yet accept the new innovation as something they would want to use.
- Production factors: Firms can be reluctant to investing in new innovative products or services if these products or services might compete with their core business. Also, high initial investments withhold firms from investing if the innovation has not yet proven itself to be profitable.
- Infrastructure and maintenance factors: Needed infrastructure and maintenance networks are not yet available.
- Undesirable societal and environmental effects: radical innovations might solve an environmental problem in one place but might cause environmental degradation somewhere else.

1. A promising technology or innovation needs to be selected to which SNM can be a contribution in implementation. The innovation must be a radical change compared to the current situation. However, the concept itself must be simple in the beginning, adding complexities to the concept must wait until implementation is successful.
2. Next, the most appropriate setting needs to be identified. In this setting, the advantages of the innovation must weigh up to the financial or other disadvantages. The setting also requires the setting up of a network, or the so called 'protected space'. These networks of actors protect the innovation and help them grow.
3. When the setting is clear, and the protected space has been designed, the goals, aims, ambitions, promises etc. can be formulated. This step also involves learning-by-doing; experimenting and evaluating what works and what did/does not.
4. In the fourth step, the innovation is ready for the scaling up of the local project. In this step, the innovation will be presented to the entire niche in which it is desired to thrive.
5. The last step encompasses the slowly but steadily breaking down of the initial protected space, as the innovation must in this stage of the project stand on its own.

The most important conclusions resulting from the analysis of relevant SNM literature can be summarized as follows:

- The theory of SNM is meant to help new innovations survive at the beginning of their implementation, when those innovations are vulnerable to the forces of the market.
- One must be knowledgeable about the barriers which can withhold an innovation from successful implementation, in order to overcome those barriers.
- Shaping the markets expectations, creating actor networks and learning-by-doing all contribute to the process of implementation.
- The SNM theory is based on five steps of implementation, from choosing the technology which is desired to be implemented until the breaking down of the actual 'protected space' in which the innovation could develop and grow.

▲ Figure 16: ***Steps to follow when using SNM***

2.3.4 STRATEGIC NICHE MANAGEMENT REGARDING CRITERIA

Again, after the introduction of the theory itself, a more detailed explanation regarding the criteria of the study and the case will be given.

Partnering

The networks which need to be set up in the second step of the SNM theory is based on the formation of close bonds or partnerships. Those partnerships protect the innovation as the partnerships try their best to promote the innovation and help it grow. As explained by Caniëls & Romijn (2008), the setting up of a co-operating actor network is one of the main characteristics of Strategic Niche Management, next to the niche formation process and experimental-based learning. According to Hoogma (2000), it will be of positive influence to the success when actors are intrinsically motivated to collaborate, and are not driven by short-term financial gains. This proves the importance of the 'human side' of collaboration, where initiators must make sure the actors in the network are willing work together, without a hidden agenda based on financial gains.

Project characteristics

The theory of SNM is fully focussed on the implementation of a product or innovation in the market. A determinant of success for such a product or innovation is that it must still be in the phase of prototyping. In this way, it does represent the idea of the product it will become when fully developed, but still caters the scope for change or extension (Caniëls & Romijn, 2008; Kemp et al., 1998). This shows the theory is only suitable for the implementation of a new technology within a product, or an entire new product. The theory therefore lacks the possibility to be directly implemented in a long-term infrastructural project in which many innovations are implemented.

Early phase of the project

As the theory of SNM is only applicable to the introduction of an innovation or technology itself, one cannot evaluate what the importance of the early phase of a project in the construction and infrastructure sector is.

Diversity of project goals and dedication to innovation

Within the development of an innovation or product, the team of developers responsible are all working towards a common goal (Caniëls & Romijn, 2008). Hoogma (2000, p. 85) explains this fact as follows: '"Actors' strategies, expectations, beliefs, practices, visions, and so on, must go in the same direction and become more specific and consistent". This also feels natural, as in the implementation or development of a product, the project team cannot have conflicting goals, as his would obstruct the process of implementation. As a project within the construction or infrastructure sector has a much bigger scope and much more stakeholders to co-operate with, conflicting goals are inevitable.

2.3.5 MULTI LEVEL PERSPECTIVE (MLP)

The third transition theory discussed is the theory of Multi Level Perspective. Kemp & Rip (1998) were the first academics to introduce this theory. It was later adapted by Geels (2002) and compared to other transition theories by Markard & Truffer (2008).

It is a means for explaining how a technological transition has taken place. The theory comprises of three levels in which society can be divided; the Socio-Technical Landscape, the Socio-Technical Regime and the Socio-Technical Niche Level. Those three levels can be seen in Figure 17 and are explained below.

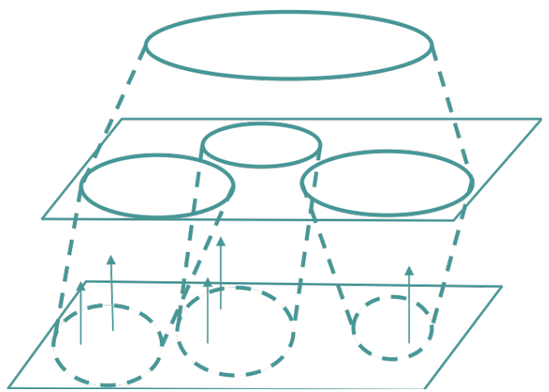
- The first most overarching level is the Socio-Technical Landscape, which operates at the macro-level. Landscapes are hard to change, as it is exogenous to the two lower levels. It is influenced by for instance the economic environment, cultural values, demographic trends and environmental circumstances.
- The second level is called the Socio-Technical Regime, operating at the meso-level. This level is characterised by a web of interlinked actors across several different social groups and communities, which establish their own set of rules and behaviours.
- The third and lowest level is the Technological Niche Level. Radical innovations are created in niches, and these niches can eventually change the regime level. At this level, safe spaces can be created using the theory of Strategic Niche Management, to make sure an innovation can develop before it is launched in Socio-Technical Regimes (Geels, 2002).

A transition takes place in all three levels. A transition can start by a radical innovation within the niche level. This can influence the regime level, and the regime level can in its turn influence the landscape level. If this happens successfully, it can be said a transition has taken place (Geels, 2010). However, a transition in the niche level cannot act and move in a direction on its own. It must be supported by the regime- and landscape level to some extent, as the alignment of developments within the three levels will determine whether the transition will take place (Kemp, Rip, & Schot, 2001).

As radical innovations are hard to implement, adding a radical innovation to an already existing product or service makes the implementation easier, as the proven and existing product or service acts as a vehicle for the radical innovation to mature and develop. An example of this is a hybrid car; the regime and landscape has long embraced the technology of cars, but the addition of a hybrid function is still a radical innovation. The radical innovation has a positive impact on the mature technology, and the mature technology helps the radical innovation grow (Pistorius & Utterback, 1995).

There is a known danger to the innovation of a new technology or product; a technology lock-in. This mechanism happens for instance in case an innovation gets 'locked-in' in an already existing solution, creating a sub-optimal solution. When the sub-optimal option has been chosen as the desired solution, it becomes very difficult to change the regime and to adopt the radical innovation, as the sub-optimal option is already integrated in the (social) environment (Kemp et al., 2007).

Another aspect of MLP is the consideration of impact that is desired. On the one hand, one can decide to implement a highly radical innovation with a high impact on the regime. However, this means the probability of failure is also high. On the other hand, one can decide to dedicate itself to a less radical innovation which will be more compatible with the regime, which will have a higher chance of success. However, the impact one will accomplish will be significantly lower (Markard & Truffer, 2008).



▲ Figure 17: ***The Multi Level Perspective (own illustration, derived from Geels, 2002)***

The most important insights of the theory of Multi Level Perspective are:

- The theory is based on the evaluation of three levels which are present in society, the socio-technical landscape, regime and niche level. The niche level is the one in which radical innovations are implemented. (Geels, 2002; Kemp & Rip, 1998; Markard & Truffer, 2008).
- The niche level can influence the regime level. The regime level can in his turn influence the landscape level. In order for a transition to take place, all three levels will have to be aligned in order to transform (Kemp et al., 2001).
- A technical lock-in is described as a radical innovation which is included in a known design, or when a sub-optimal alternative is chosen to be the preferred design. This must be avoided since this slows the speed of the wanted transition (Kemp et al., 2007).
- A trade-off needs to be made in the niche level regarding the potential success of an innovation and the degree of impact it may have on the transition (Markard & Truffer, 2008).

2.3.6 MULTI LEVEL PERSPECTIVE REGARDING CRITERIA

In this paragraph, the criteria will be described for the third transition theory explained. This will be done keeping the study and the specifications of the case in mind.

Partnering

The theory of Multi Level Perspective focusses on the three levels in society which are present and in which changes need to happen in order for a transition to occur. Theory studied regarding MLP does not specifically mention partnering. However, in the lowest level of MLP, the niche level, theory does acknowledge innovations or new products do have to be protected from 'outside powers', referring to the regime and landscape level (Markard & Truffer, 2008). This protection can only be given to innovations by collaboration within the niche level, as without the effort of the actors within that level, the innovation will face the forces of the market.

Project characteristics

As a construction or infrastructure project is of a considerable size, multiple radical innovations can be implemented simultaneously, which can be compared to several niches within the MLP framework. Those innovations together might together influence a regime. Also, a project in which many radical innovations are successfully implemented can act as an example for future projects that have the same sustainability ambitions. This is explained by Smith, Voß, & Grin (2010), as a slight change in regime creates a better environment for future radical innovations, as this is already supported by the changing regime.

Early phase of the project

As the theory of MLP tries to combine the different levels in a society which must work together in order for a transition to take place, it focusses on the entire process of change. Therefore, no specific information is shared based on the early phase of a project.

Diversity of project goals and dedication to innovation

Within the MLP framework, the niches work together in order to disrupt the current regime and eventually the socio-technical landscape. When the niches follow the same trend, they current regime will slowly follow this trend as well. In a construction or infrastructure project, conflicting goals are inevitable, however, as the overarching goal works towards the ultimate goal of the project, the conflicting goals do not withhold the regime from changing (see Figure 16) (Rotmans et al., 2001).

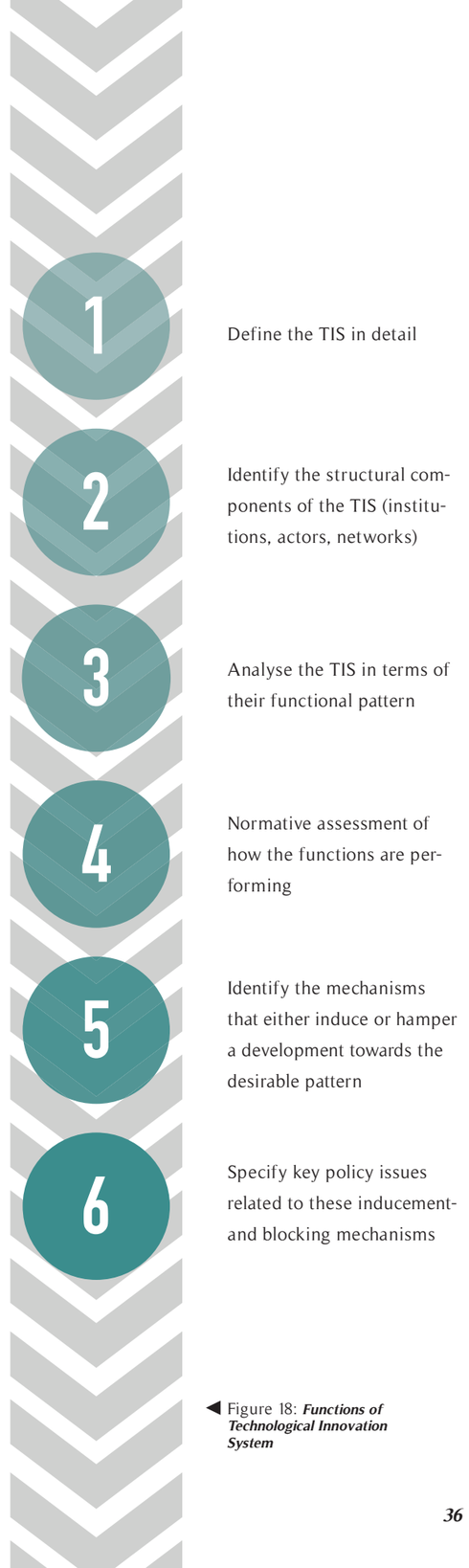
2.3.7 (FUNCTIONS OF) TECHNOLOGICAL INNOVATION SYSTEM (FTIS)

The concept of Technological Innovation System (TIS), is one of the many theories which is fitted in the wider theoretical school of Innovation Systems Approach (Smits, 2002). The Technological Innovation System was introduced in the 1980's to study technological change and to evaluate the development of a technological field in terms of the structures and processes that support/hamper it. An innovation system is composed out of actors, networks and institutions, which contribute to the development, diffusing and utilization of new products, services or processes (Carlsson & Stankiewicz, 1991). Hekkert, Suurs, Negro, Kuhlmann, & Smits (2007) further elaborated the theory by designing a framework that can be used to evaluate a technological innovation system, called 'functions of Technological Innovations Systems (fTIS). Hekkert et al. (2007, pp. 415–416) designed the framework based on the question: "what are the conditions that foster the growth of an emerging innovation system in such a way that it becomes so large and entrenched in society, that it is able to compete with and even become part of existing (innovation) systems?".

The theory of the functions of TIS can be explained by six steps, see Figure 18. The main aim of the carrying out of these steps is to identify the weaknesses in the system, which can thereafter be improved (Bergek, Jacobsson, Carlsson, Lindmark, & Rickne, 2008).

The steps to take are (Bergek et al., 2008):

1. Define the TIS in detail
2. Identify the structural components of the TIS (actors, networks, institutions)
3. Analyse the TIS in terms of their functional pattern
4. Normative assessment on how the functions are performing
5. Identify the mechanisms that either induce or hamper a development towards the desirable pattern
6. Specify key policy issues related to these inducements- and blocking mechanisms



◀ Figure 18: ***Functions of Technological Innovation System***

2.3.8 TECHNOLOGICAL INNOVATION SYSTEM REGARDING CRITERIA

Based on the criteria explained at the beginning of this chapter, the theory of functions of Technological Innovation Systems (fTIS) is explained.

Partnering

Although the term partnering is not directly mentioned in the theory of fTIS, the importance of collaboration is expressed thoroughly. First of all, in the second step of the analysis, the networks need to be described, which automatically means one needs to take a look at the collaboration between actors in those networks. Furthermore, as one describes the actual functions of the TIS, function 3, 4 and 5 directly involve the collaboration of several actors. Although not specifically described, the remaining functions do not automatically rule out collaboration, as for example function (6) Resources Mobilization, may only be successful if actors collaboratively step forward to reach that goal.

Project characteristics

The theory of fTIS focusses on the development of a new technology, however, it does not specify one technique or innovation must be the centre of attention by using this theory. Hekkert et al. (2007) bring forward the example of the introduction of biofuels in Germany, thus, a continuous change process, like the transition to a circular economy within an infrastructure project, can be analysed using fTIS.

Early phase of the project

All functions described are applicable during the entire project, thus also during the early phase of the project, the functions can be normatively described based on the performance of those functions. Also, the starting phase of a project may be considered as an entrepreneurial activity on its own, when implementing innovations is one of the key goals of a project.

Diversity of project goals and dedication to innovation

As conflicting goals in a project may hamper the actual implementation of desired innovations in a project, this fact needs to be closely managed within a project. This is described by function 7, as this function describes the need of creating legitimacy of innovations and to counteract the resistance to change. As the construction and infrastructure sector is reluctant to change, this function is highly important when a project is analysed using the theory of fTIS.

2.4 DECISION ON TRANSITION THEORY

All transition theories are explained and evaluated using the criteria set up. This leads to a choice in transition theory which will be used as a framework to analyse the case. This is done by qualitative scoring, as it is the interpretation of the researcher whether a link was found between the transition theory and the four criteria. In case a direct link could be found, or in other words, when a transition theory specifically mentioned the criterion, a plus sign is awarded to that transition theory. When no link could be found, a minus sign was assigned. Sometimes, not a direct link could be found, but the theory did mention an implication towards a criterion. In that case, a zero will indicate this, as a middle way between a checkmark and a cross.
Although for now a transition theory is chosen to analyse a case, this does not mean this transition theory is superior to the other theories. The decision is made based on the goal of the study and the characteristics of the case. In any other study, another transition theory might be the better choice.

2.4.1 SCORING OF THE TRANSITION THEORIES

As the goal of this study is to analyse the relation between (multilateral) partnering and the transition towards a circular economy, this is the most important criterion to evaluate the transition theories. TM, SNM and fTIS all three mention or describe one or more of the elements which can be used to describe partnering. In none of the theories, the use of partnering is exactly stated, however, this was expected, since the connection between the use of partnering to enhance transitions has not been made in scientific literature.
Since the case which will be analysed is highly unique, three other criteria were set up to make a sound decision on which transition theory to use. First of all, project characteristics were elaborated upon in MLP as well as in fTIS. In TM, an indirect link could be made to project characteristics. The second case specific criterion is ‘early phase of the project’ as this is part of the scope of the project. This criterion was only mentioned in fTIS, the other transition theories were not applicable to the early phase of a project. The third and thereby last criteria was ‘diversity of project goals and dedication to innovation’. This criterion could not be traced in SNM, where the other three transition theories did mention it. The qualitative scoring of the transition theories can be seen in Table 2.

Transition Theory	TM	SNM	MLP	fTIS
Criteria				
Partnering	+	+	0	+
Project characteristics	0	-	+	+
Early phase of project	-	-	-	+
Diversity of project goals and dedication to innovation	+	-	+	+
+ = criteria is mentioned in transition theory				
- = criteria is not mentioned in transition theory				
0 = criteria is not directly mentioned in criteria but link to criteria is there				

▲ Table 2: ***Qualitative scoring on the four transition theories using the set of criteria.***

2.4.2 CHOICE OF THEORY; DISCUSSION

It can be concluded that the transition theory most suitable to analyse the case is functions of Technology Innovation Systems. All criteria are met by this theory, no other transition theory scored a checkmark for all four criteria. Also, the theory of fTIS presents a framework which can thus be used to analyse the case which this study revolves around. This also provides an answer to the subquestion stated at the beginning of this chapter: "What is multilateral partnering and how can it benefit transitions?". After a thorough literature review has been conducted, a definition has been proposed to use as a guideline for the rest of this study. This definition reads: 'Multilateral partnering a long-term commitment of multiple stakeholders to closely collaborate, in order to successfully complete a project or specific business objectives, by making maximum use of the stakeholder's resources and qualities. In order to achieve (multilateral) partnerships, several components are a prerequisite, like trust and mutual understanding.'

With the help of the collection of elements which describe partnering, as explained by Hosseini et al. (2018), and several other scientific sources (Beach, Webster, & Campbell, 2005; Bygballe, Jahre, & Swärd, 2010; Cheung et al., 2003; Eriksson, 2010; Kadefors, 2004; Larson, 1995; Markert, 2011; Naoum, 2003; Ng, Rose, Mak, & Chen, 2002; Nyström, 2007; Yeung, Chan, & Chan, 2007), 15 elements of partnering are described. These elements can be used to recognise partnering in a construction or infrastructure project. With the help of transition theory literature, the second part of the subquestion can be answered. In all four transition theories, the need of partnering is made clear. For instance, Transition Management stated that close collaboration and regular meetings positively influence the process as well as the outcome of a project (Grin et al., 2010). Strategic Niche Management tells us that intrinsically motivated actors regarding collaboration, have a positive influence to the success of a project (Hoogma, 2000). The theory of Multi Level perspective is less direct, however, Markard & Truffer (2008) do state that in order to protect innovations from outside powers, protection must be given in the niche level, which can only be accomplished by collaborating. Functions of Technology Innovation Systems, as a fourth and last theory, stresses the importance of close collaboration in both the analysis steps as well as in the functions of the system. Thus, it can be concluded transition theories agree on the fact that collaboration and thus partnering is key in the process of a transition. It helps enabling -among other benefits- trust, mutual understanding and lowers the chance of disputes and difficulties. Therefore, from theory, one can conclude partnering benefits transitions by creating an environment which helps accelerate the transition to a circular economy (Grin et al., 2010).

Next, the theory of fTIS must be described in greater detail, before it can be applied to the case. Furthermore, a practical framework will have to be developed which will give direction to the methodology of analysing the case in question: the InnovA58.

CHAPTER 3

Methodology

3 | APPROACH OF THE STUDY

This chapter will focus on the methodological approach of the study. It will do so by answering the second subquestion which has been formulated. This question reads: *"How can a transition theory be used to study partnering in the early phase of a Dutch infrastructure project?"*
To be able to answer this question, first, a more elaborate explanation of the chosen transition theory must be given. Therefore, the theory of functions of Technological Innovation Systems will be dived into, to create a practical framework to collect the empirical knowledge further in this study. The second part of this chapter will provide the methodological approach. It will be explained how the framework of the fTIS theory will be used to answer the third and fourth subquestion of this research. Thereafter, the methods and techniques which are used to give answer to the research question are presented.

3.1 FUNCTIONS OF TECHNOLOGICAL INNOVATION SYSTEM; THE FRAMEWORK

The transition theory 'functions of Technological Innovation System' is chosen in chapter 2 as a guideline for the analysis of the case. This theory must now be further elaborated to create a practical framework. On the basis of scientific literature, this framework is presented as a roadmap to perform the case study in a structured way. The framework is based upon the theory of TIS and extended with the functions as described in the theory of fTIS, as these functions provide insight in the way the technological innovation system performs. (Bergek et al., 2008; Hekkert et al., 2007). Within this framework, scientific literature focussed on recognizing partnering within a construction or infrastructure project is added, to study the role of partnering. Whereas this chapter will explain the methodological framework used to analyse the case, chapters 4 and 5 will present the outcomes of the application of the framework on the case study. Due to the uniqueness of the case and the addition of the elements of partnering in this research, some of the steps of the fTIS theory are altered to the benefit of the case. In the following paragraphs, the original steps of the fTIS theory are explained, in case a step is altered, this will be elaborated upon as well.

The theory of functions of Technological Innovation Systems has been extensively used to study transitions which have taken place in (recent) history, for instance the biomass gasification TIS, the biofuels TIS and the hydrogen and fuel cell TIS (Suurs, 2009). Using the theory to analyse an on-going transition like the transition to a circular economy is however a new field of research. Therefore, the methodology of the TIS theory is not strictly followed but used as a guideline to structure the analysis of empirical data. As explained in chapter 2, the theory of Technological Innovation System consists of 6 consecutive steps, used to analyse the desired transition. See Figure 18 for the steps as explained in fTIS theory. As this study tries to capture the role of partnering in relation to the transition to a circular economy in a Dutch infrastructure project, the focus will lie on the third and fourth step of the fTIS methodology.

Although the study will focus mainly on the third and fourth step, the remainder of the steps will be executed as well, to create a cohesive storyline of the studied transition. This is visually explained in Figure 19. The column left to the numbers of steps presents the 'original' fTIS theory, the columns to the right of the numbers of steps focus on the theory altered to fit the case study. The steps are explained on the following pages.

	Original fTIS theory	fTIS theory specified for InnovA58 case	How?	Derived from?
1	Define Technology Innovation System	Define TIS - Case specific	Present a detailed description of the case study which is wished to analyse	Literature study, InnovA58 documents, Personal communication
2	Identify structural components (Institutions, Actors, Networks)	Identify structural components (Institutions, Actors, Networks) + define ecology of actors	Present a stakeholders description and their interactions (actors, networks, institutions) Define the ecology of actors	Literature study, InnovA58 documents, Personal communication, Public available documents
3	Analyse functions of TIS	Analyse elements of partnering in case InnovA58	Analyse importance and presence of the fifteen elements of partnering	Interviews, Document Analysis
4	Normative assessment of functions	Link elements of partnering to the functions of TIS	Find the role of the fifteen elements of partnering to the seven functions of the TIS theory	Interviews, Document Analysis
5	Define the present barriers and drivers	Define presence and performance of elements of partnering and functions of TIS Generalise insights to be used in future cases	Provide analysis based on InnovA58 to give insights in the case, as well as a generalization for future cases	Interpretation of interviews
6	Specify the key policy issues	Recommendations regarding partnering case specific as well as general	Interpret the data generated from interviews and document analysis to draw conclusions	Conclusions of case study

▲ Figure 19: ***The case study Framework (own illustration, derived from Bergek et al., 2008; Hekkert et al., 2007; Nyström, 2007)***

3.1.1 STEP 1: DEFINE TECHNOLOGICAL INNOVATION SYSTEM

The first step of the analysis will be to describe the actual Technological Innovation System studied. For this research, the case study will be elaborated upon; the InnovA58. To provide a complete image of the case which will be studied, the InnovA58 project will be shortly explained first, this consists of a physical project description and an elaboration on the project gaols and the project team responsible for the execution of the project.

3.1.2 STEP 2: IDENTIFY STRUCTURAL COMPONENTS

In the second step, as can be seen in Figure 19, the structural components of the case will be defined. This consists of three elements, namely (1) the institutions, (2) the actors, and (3) the networks. This provides an overview of all stakeholders involved in the process of designing the InnovA58 and how these interact with each other. These three components result in an ecology of actors. Again, as the transition is still evolving, an overview of the actors, networks and institutions can only be given known up to this point. In the (near) future, other actors or institutions might be involved in the project as well, which may also cause the emergence of new networks and a change in the ecology of actors. As the process of the InnovA58 is somewhat vague and diffuse, it can be considered to be a 'black box', from which insights are generated. To create an overview of this 'process as a black box', a process view is visualized as a result of the analysis to the structural components. Step 1 and 2 combined give a general overview and demarcations of the Technological Innovation system which will be analysed in depth in the following steps of the analysis. Following these two steps, the actual data gathering and analysis will take place.

3.1.3 STEP 3: ANALYSE FUNCTIONS OF TIS

Where the first two steps describe the Technological Innovation System to analyse, the third and fourth step are meant to analyse the empirical knowledge about the functions of the TIS. To be able to study the link between the functions of the TIS theory and partnering, first of all, the elements of partnering are analysed within the case. After the elements of partnering have been studied, the role of these elements can be evaluated within the functions of the TIS theory.

Several academics have put effort in providing a complete list of functions which can be used to analyse a TIS. In this study, the list composed at the University of Utrecht will be used, see Hekkert & Negro (2009), Hekkert (2007) and Suurs & Hekkert (2009). These functions of the TIS theory are: (1) Entrepreneurial Activities, (2) Knowledge Development, (3) Knowledge Diffusion through Networks, (4) Guidance of the Search, (5) Market Formation, (6) Resources Mobilization, and (7) Creation of Legitimacy/ Counteract Resistance to Change. To the right, in Table 3, all seven elements are explained. To operationalize this knowledge to into practical application in the case study, examples on how to recognize these functions within the case study are presented in the right column of the table. These indicators are used to spot the functions in the case study.

▼ Table 3: ***Functions of TIS and their indicators***

	Function and explanation	Indicators
1	**Entrepreneurial Activities** Without entrepreneurial activities, new innovations would not be presented to the market, therefore, a transition will not take place without the presence of entrepreneurs. The entrepreneur must take concrete action to turn potential ideas into business opportunities by the means of knowledge development and the use of networks and markets.	New techniques are used in design Material use is limited Materials are sought in the close perimeter of the project area. Openness towards a new way of thinking Promote creativity Involving start-ups Considering different contract types
2	**Knowledge Development** In any innovation process, creating new knowledge is at the heart. Research and Development (R&D) will need to be invested in to come to the new knowledge needed to implement business ideas by entrepreneurs. This involved both 'learning by searching' and 'learning by doing'.	Creating an environment in which new knowledge can be acquired Open mind towards new ideas Facilitate Triple Helix collaboration
3	**Knowledge Diffusion through Networks** The networks in a TIS need to share attained knowledge, as this is their primary function within the market. This is especially important in the heterogenous context of R&D, the government, competitors and the market. This is because the government influences R&D by making policy decisions and vice versa by R&D by shifting focus to a new business opportunity. These activities are regarded 'learning by interacting' and 'learning by using'.	Bringing actors and institutions together to share knowledge Involving the right people Creating the right environment so actors are willing to share knowledge
4	**Guidance of the Search** Setting a goal of where society must aim for helps guiding the TIS in the right direction. Visible and explicit wants and needs of the market, society and the government thus enable innovation. An example of this function is a policy aim of the government to become 'fully circular' in 2050 (Dutch Ministry of Infrastructure and the Environment & Ministry of Economic Affairs, 2016).	Support from higher management Clear description of higher goals InnovA58 must comply to Setting a clear future path in which small steps lead towards a fully circular economy Transparent leading organization (Rijkswaterstaat) Create expectations the project can live up to. Create and propagate sense of urgency
5	**Market Formation** Sustainable innovations often have a difficult time competing with current technologies as for example, technological lock-ins might occur. Protected spaces, which might be generated by the use of SNM, are a way to help mature new, radical innovations without the negative forces of the market. Favourable tax regimes or consumption quotas are examples which enhance market formation.	Support innovations by relaxing current regulations Create room for experimentation within project scope

6	**Resource Mobilisation** The mobilisation of resources is related to both financial capital as well as human capital. These are needed as input for the innovation system to grow and flourish.	Enlarge budget to boost innovations Appoint more employees to dedicate themselves to the project
7	**Creation of Legitimacy/Counteract Resistance to Change** For an innovation to become the new standard, the technology either needs to become part of an existing regime, or has to overthrow it. Parties involved in the business of the existing regimes will oppose to the innovation. This opposition will have to be overcome, which can for instance be done by the help of advocacy coalitions.	Create public sense of urgency Advocate for innovation to increase sustainability Press goal of 'fully circular' in 2030

Use of functions in case study

For each TIS, the above-mentioned functions can be described and analysed. The analysis of the functions describes the performance of the System and with that, the performance of the transition it focusses on. However, as is clear from the explanations, not all functions will perform positively from the beginning of the transition. For instance, usually, the resistance of change will not be present at the very early stages of a transition, as the threat of the new innovation is not yet experienced. This is expected to be true for the Circular Economy transition in the infrastructure sector as well, as it is still in its infancy. As explained by Rotmans et al. (2001), there are four stages a transition can be divided into, and the transition to a circular economy is still in one of the early phases (Netherlands Environmental Assessment Agency, 2018). As Luo et al. (2012) describes, it is customary the first functions are most critical in the early stages of a transition, whereas the later functions need to be fulfilled in the later stages of a transition. As we know the Circular Economy transition is still in the early phases of a transition; it is expected the first four functions are represented in the case study, whereas the last functions will not (yet) be fulfilled. The question rises whether this is the case, thus whether the transition to a Circular Economy in the Dutch infrastructure sector follows the ideal path as set out in scientific literature.

Therefore, all seven functions of the TIS theory will be analysed, to be able to confirm or reject this hypothesis. As the link between partnering and the transition to a circular economy is the main interest of this study, the elements of partnering, as earlier described in chapter 2, will be linked to the functions of the TIS. With this link, the role of partnering can be evaluated in the early stage of a transition.

3.1.4 STEP 4: NORMATIVE ASSESSMENT OF FUNCTIONS

Following earlier case studies which make use of the fTIS framework, the fourth step consists of the normative assessment of the functions of the system, based on a scale from zero to five. As this study is qualitative of nature and a first attempt to capture the role of partnering in the early stage of a transition considering an infrastructure project, no normative assessment of the functions will be carried out. However, the role of an element of partnering can be found to have a positive or negative effect on the specific function, from which conclusions can be drawn regarding the transition to a circular economy. Therefore, this step will, together with step 3, focus on the evaluation of the role of partnering on the functions of the transition theory. The evaluation of the role of partnering will be done on the basis of the 15 elements of partnering as described in chapter 2.

3.1.5 STEP 5: DEFINE THE PRESENT BARRIERS AND DRIVERS

The fifth step of the fTIS theory focusses on the barriers and drivers currently present in the Technological Innovation System. In this study, focus lies on the debate which elements of partnering are not (yet) fulfilled, and why. This analysis is also performed for the functions of the system. The presence and performance of the elements of partnering and the functions of the system gives insights into where the project can improve regarding the elements of partnering, and which effect the elements have on the functions of the system. Also, based on the insights from the case study, outcomes can be generalised to other cases. This results in other cases to be able to learn from the specific case of the InnovA58.

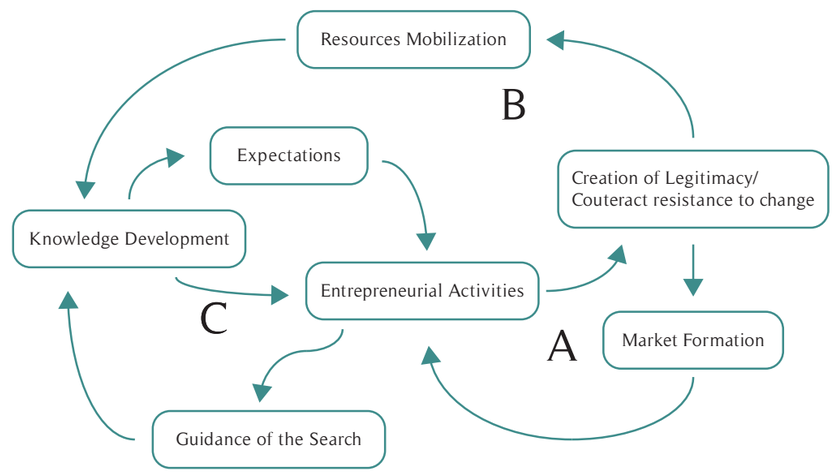
3.1.6 STEP 6: SPECIFY THE KEY POLICY ISSUES

The last step of the Technological Innovation System framework is the concluding step, which provides policy issues to improve the system. This can be done by looking back on the barriers and drivers which influence the transition, as is for instance done by Suurs & Hekkert (2009). Another option is to use the systems functions in foresight studies, in which the functional analysis can help identify weaknesses in the system and propose policy issues as a roadmap for the described transition in the future (Andersen & Andersen, 2014; Haddad & Uriona Maldonado, 2017). In this study, this step will present recommendations regarding partnering, which can be improved to accelerate the transition to a circular economy, as this is the main focus of this study. These recommendations will be twofold. First of all, recommendations will be made which will be of help for the project of InnovA58. This will result in an advice on how to use partnering for the benefit of implementing circular economy in the further course of the project. Secondly, an advice can be given to future projects which will be in the exploratory phase, as is the InnovA58 right now. This step will give an answer to the fourth subquestion of this study.

3.1.7 CUMULATIVE CAUSATION; MOTORS OF CHANGE

Functions of a TIS can interact with each other and reinforce each other, both as a negative and as a positive spiral. This is known as cumulative causation. This may cause the TIS to accelerate or decelerate, according to the positive or negative effect the functions have on each other.

Cumulative causation might be very helpful during a transition, as it can accelerate the process of implementation of new innovations, ideas and products. Usually, cumulative causation is triggered by one or more functions, which form the starting point of this acceleration of the process. This starting point is referred to as a 'motor of change'. Figure 20 depicts three typical motors of change (the example in the grey box on the next page corresponds with motor C).



▲ Figure 20: ***Typical motors of change (own illustration, derived from Hekkert et al., 2007)***

Researchers perform a study to a new way of recycling concrete. The outcomes of this study are promising and receives a lot of attention from the public. This attention was way more than expected, and the research group tries their hardest to share the conclusions they drew. This research project therefore contributes to knowledge development (F2 & F3). Because of the new knowledge which is attained during the study and the public attention it received, the expectations of the public are high considering the new way of recycling concrete. The high expectations of the technology feed the direction of the search (F4). The attention, together with the high expectations set by the outcomes of the study might cause policy makes to decide to set up a subsidy program. This subsidy program makes sure resources are mobilized (F6) in forms of money and or human capital, which opens up doors for researchers to conduct further research in the topic of recycling concrete (F2). This virtuous circle may be repeated infinitely, accelerating the transition to a circular economy (Hekkert et al., 2007).

3.2 METHODOLOGY

This part of the report is focussed on the methodology of how to analyse the case which will provide the empirical data needed to be able to answer the research question. The explained framework of the fTIS framework will be translated into a methodology which will be guideline to conduct the case study.

First of all, the research strategy will be discussed, in which also the reasoning and the scope will be elaborated upon. Secondly, the research design is presented, in which the type of case study is chosen and substantiated. Thirdly, the way in which data will be gathered is discussed, which will include the actual case study and the corresponding interviews. In this part, the interview protocol is also presented. Thereafter, the way of data analysis is described, together with the quality assessment of the gathered data. The last part of this paragraph will deal with the validation of the gathered data from the case study.

3.2.1 STRATEGY OF THE RESEARCH

To formulate an answer to the research question and the accompanying subquestions, an adequate research strategy must be set up. Because of the lack of empirical knowledge available on the relation between partnering and transition theories, this study would like to contribute to the field of knowledge. This will be done by performing a single case study. Because of the limited available knowledge, this study will be explorative of nature. The goal of this study is not to test existing ideas or theories, but would like to generate hypotheses and ideas (Baarda, Goede, & Teunissen, 2009). For this reason, this study will be a qualitative study. This is also described by Field and Morse as follows: “It is not the purpose of qualitative research to determine objectively what actually happened, but, rather, to objectively report the perceptions of each of the participants in the setting” (1996, p. 49). To be able to report the perceptions of the participants in the case study, a complex, detailed understanding of the issue is needed. This can only be established by having direct contact with the stakeholders involved in the case study, thus by performing in-depth, face-to-face interviews. These interviews will in their turn provide the data which is needed as input to generate the hypotheses and ideas. This study will therefore focus consecutively on the collection of this data, where after this data will be analysed to create insights in the topic and provide the answers to the research questions.

Scope

Because the case which will provide the empirical data is an on-going case study, this results in a scope limitation. Data cannot be collected and analysed about events which are still in the future. Therefore, the study can only focus on the early phase of the project, as the project is currently at the end of the early phase.

Triangulation

This study will gather its data from one single case study, therefore, triangulation is of high importance to eliminate chance as much as possible. Triangulation entails the use of more than one method or data source; this creates an opportunity to cross-check findings or obtain different perspectives on the same phenomena (Van de Ven, 2007). In this research, two ways of triangulation will be used; data triangulation and theory triangulation. Data triangulation entails the use of multiple data sources. In this study, semi structured interviews and a document analysis will provide the needed data. The interviews held were the primary source of data, the document analysis was used as a validation of the found insights. Theory triangulation involves the use of multiple perspectives to interpret the data. These perspectives will be heard from the client, the engineering company (Witteveen+Bos) and external parties involved in the project case.

3.2.2 DATA COLLECTION

The strategy of the case study is now clear. The following step is to present the way in which the empirical data will be collected. The data will be collected by the means of interviews and a document analysis. These methods will be explained below. In addition to this, the interview protocol and the role of the researcher will be explained.

Interviews

A qualitative study of explorative nature asks for in-depth face-to-face interviews, as this is the most common way of collecting empirical data (Verschuren & Doorewaard, 2013). This data will be attained by performing semi structured interviews with multiple stakeholders of the project, project team members, (senior) advisors of the project and external parties such as the municipalities located in the region that the highway system connects. By interviewing stakeholders of different organizations and companies which are all involved in the project, empirical data can be selected from a broad spectrum of knowledge. As partnering between actors is described as the interaction between stakeholders, the process of partnering can best be analysed by performing interviews (Gadde & Dubois, 2010). Therefore, the primary source of data was collected by semi-structured interviews with actors participating in the project.

The respondents of the interviews were selected by discussing the list of potential respondents with two project team members of the case, one of which is employed at the company where this study is performed, one is employed by Rijkswaterstaat and is responsible for implementing circular economy in the case project. This is called purposeful or strategic sampling, and is done to avoid atypical sampling, which will have serious consequences for the validity of the research. By strategically deciding on which respondents to approach for an interview, the researcher is guided by the information that is desired to extract from those interviews. Furthermore, during the interviews, the researcher asked whether he/she had recommendations on which actor could provide useful information as well (Verschuren & Doorewaard, 2013). This is called snowball sampling, as one respondent refers to another (Biernacki & Waldorf, 1960). This method can be useful as respondents might be added to the list which would otherwise not have been spoken to. A list of respondents which were interviewed for this study can be found in Appendix A.

Interview protocol

Although the interviews which will be performed will be in the direction of open interviews, some guidance is still needed to make sure the relevant data is extracted from the respondents. This is done by setting up an interview protocol, in which the topics on which data is desired to collect are presented. This interview protocol will be helpful for the researcher, as some structure can be built into the interview. However, by just formulating topics with relevant example questions, the interview will still feel like a natural conversation, which is helpful with creating depth in the collected case study data (Verschuren & Doorewaard, 2013). During the interview, the researcher will make use of probing questions to try and find the underlying reasons for the answers respondents give during the interview. In this way, more in-depth knowledge is obtained. The interview protocol, together with the interview agenda and the partnering table used for this case study can be found in Appendix B.

Document analysis

During two phases of this research, a document analysis provided the needed information. First of all, in the first and second step of the functions of Technological Innovation System analysis, a thorough description of the system and its accompanying actors, networks and institutions will be given. This is needed to be able to perform the next steps of the analysis, as a clear understanding of the system itself is needed to analyse it in further detail. To be able to present the needed information in the first two steps of the analysis, written documents presented by Rijkswaterstaat are of high value, since Rijkswaterstaat publishes much information about the project case. This information can be found on the website dedicated to the project (innova58.nl), on which a library presents al publicly available data. Secondly, in the third and fourth step of the analysis, the document analysis was used as a validation of the role of partnering in the functions of the TIS theory. Interviews were the primary source of data, however, some of the elements of partnering could be substantiated with documents.

Role of the researcher

The researcher always has an influence on the outcomes of a qualitative study, since the data needs to be interpreted by the researcher itself. When no measures are taken in order to reduce the impact of the researcher on the study, the validity of the study itself becomes jeopardized. Therefore, the researcher must be aware of its role within the study, try to be as transparent as possible, and act accordingly. In this study, this is attempted by reducing the contact between researcher and respondent. Project team members which are spoken to on a daily basis are not included in the empirical study, as the prior contact between the researcher and the respondent would influence the interview in a later stage. This is related to the 'going native effect', which can occur when a researcher is too closely involved in the group of respondents. The result of the 'going native effect' is a biased view of the researcher, which again negatively influences the validity of the collected data (Louwe, 2017).

Furthermore, the role of the researcher during the interviews is important as well. Especially at the beginning of the interview, as the setting is created. The setting of the interview is important, as an open and pleasant environment will contribute to the willingness of the respondent to share information and knowledge. A way to create a pleasant setting, is by creating a good rapport. This is for instance done by starting the interview with some small-talk. The respondent is put at ease and is not directly confronted with questions which might be hard to answer. Trust is created between researcher and respondent, which results in a more open environment during the interview (Research Methods and Statistics, 2016).

3.2.3 DATA ANALYSIS

The data obtained in this case study will be analysed before the data can be used to formulate conclusions for this study. Both the methods for analysing the data sources of interviews and document analysis will be explained.

Interviews

All interviews are held in person, as critical information such as expression or body language cannot be observed when performing an interview over the phone. During the interviews, which all took around 45-60 minutes, full attention was given to the respondent by preparing the questions well and by not making notes during the interview itself. The interviews were, with the approval of the respondent, recorded and later transcribed into a literal transcription of the interview.

After the process of transcription, two rounds of coding took place, open coding and selective coding, as described by Verschuren & Doorewaard (2013). This process is explained in the paragraph 'data analysis sequence' at the bottom of this page.

Document analysis

Data was not only attained by performing interviews with relevant stakeholders, some information was gathered by performing a document analysis. All publicly available documents presented on the website of the InnovA58 (innova58.nl) were scanned and analysed. In case a document presented relevant data, the file was saved for later use. Documents which were discussed during the interviews were also collected, to make sure all relevant written data would be included in the research. Furthermore, documents available to Witteveen+Bos were analysed using the same method as for publicly available sources. Due to confidentially, documents only available to employees of Rijkswaterstaat were not included in this research. A list of documents analysed can be found in Appendix G.

After the process of gathering all relevant douments, the data was analysed using the same method as for the interviews. First of all, a round of open coding was performed by hand. Thereafter, using ATLAS.ti, a second round of selective coding was conducted.

Data analysis sequence

After all data was collected, several consecutive steps were undertaken to analyse and interpret the data. First of all, open coding gave a first impression of the important and relevant text fragments by highlighting those fragments on paper. The second round of coding was performed by the use of the software program ATLAS.ti, a qualitative data analysis tool (ATLAS.ti Scientific Software Development GmbH, 2018). A coding plan was set up and the relevant quotes were assigned with codes. This was an iterative process, as all transcripts were coded multiple times to assure all relevant data was extracted. The third step was to connect the elements of partnering to the functions of the Technology Innovation System theory. With the help

of Atlas.ti, quotation reports were produced for all combinations of functions and elements. This resulted in 105 individual quotation reports (seven functions and fifteen elements). An example of a quotation report can be seen in Appendix C. The fourth step consisted of collecting all quotations per function in Excel, to create an overview of all quotations. Every function was separated in a sheet, every element of partnering was separated in a separate row of a sheet. Table 4 shows an example of how the quotes were sorted and organised per function. Seven of these tables were created. Every quotation per element was summarized and comments were added where background information was needed. The last step was conducted to collect all summaries, written in several Excel sheets. This resulted in an overview of all seven functions of TIS, together with all fifteen elements of partnering. This table consisted of 105 cells, every cell representing the role of a specific element on a specific function.

Validation

Qualitative research is always, to some extent, subjected to the personal bias of the researcher. To decrease the amount of bias, and thus to increase the validity and trustworthiness of the conclusions of this study, the document analysis provided a validation for the outcomes, as the presence, or lack of some of the elements of partnering could also be found in the documents analysed.

▼ Table 4: ***Excel sheet format***

Function 1: Entrepreneurial Activities			
	Quotes	**Comments**	**Summary**
Trust	Quote #1	Comment #1	Summary of the role of the element of trust on the first function; Entrepreneurial Activities
	Quote #2		
Common Understanding	Quote #3		Summary of the role of the element of common understanding on the first function; Entrepreneurial Activities
	Quote #4	Comment #2	
	Quote #5	Comment #3	
	Quote #6		
	Quote #7	Comment #4	
Collaborative Contractual Clauses	Quote #8		
Etc...	Etc…	Etc…	Etc…

CHAPTER 4

Case Study

4 CASE STUDY INNOVA58

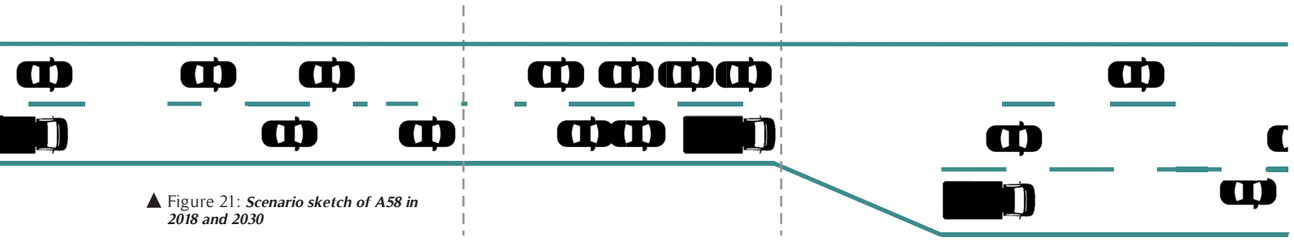
As the methodology has been clearly defined in chapter 3, this chapter will present the findings of the case study. The results were found in both interviews and by the means of a document analysis. These findings contribute to answering the main research question by focussing on the third subquestion, which stated: *"How does partnering, in the early phase of an empirical on-going case, relate to the chosen transition theory?"*
This chapter will follow the structure of the fTIS theory. First of all, the Technological Innovation System will be defined, as explained in step one of the theory. This will create an overview of the project case studied. Thereafter, the structural components of the system will be defined (step 2). These two steps create an understanding of the case and its characteristics. The subsequent paragraph will focus on the data gathered from the case study, and will present the findings regarding the elements of partnering, following by the findings of the role of partnering on the transition to a circular economy. These findings correspond to the third and fourth step of the TIS theory.

4.1 CASE DESCRIPTION

General knowledge on the case, the InnovA58, is needed to better understand the findings of the case study itself. Therefore, an elaborate explanation of the case is presented below, which consists of the first and second step of the fTIS theory.

4.1.1 DEFINITION OF TECHNOLOGICAL INNOVATION SYSTEM

The A58 is a Dutch highway, running in the south of the Netherlands, in the province of Brabant. It connects most of the bigger cities in the province with each other and with the province of Zeeland. It does not only connect the Dutch territory, but it is also an important route to and from Belgium and Germany, as the A58 is part of the connections of Rotterdam-Antwerp and Rotterdam-South East Netherlands-Ruhr area (Germany) (Rijksoverheid, n.d.). A study performed by the National Government in May 2011 has however shown that the A58 will become a serious bottleneck in 2030, when looking at the high economic growth scenario. This means that due to economic growth and growing prosperity, traffic on the A58 will drastically increase, and is prospected to keep increasing after 2030. This will result in more frequently occurring traffic jams and serious congestion. Also, because of column formation by freight traffic, the safety on this stretch of highway in the near future cannot be guaranteed anymore (Ministerie van Infrastructuur en Milieu, 2017). This increase in traffic jams are a hindrance to commuters, plus results in economic damage. This economic damage slows the economic growth in the Netherlands, as well as in our neighbouring countries. To add to that, the higher risk of collisions is unacceptable. A visualization of the problem can be seen below in Figure 21, where the scenario of broadening the highway versus leaving the situation as it is, is shown.



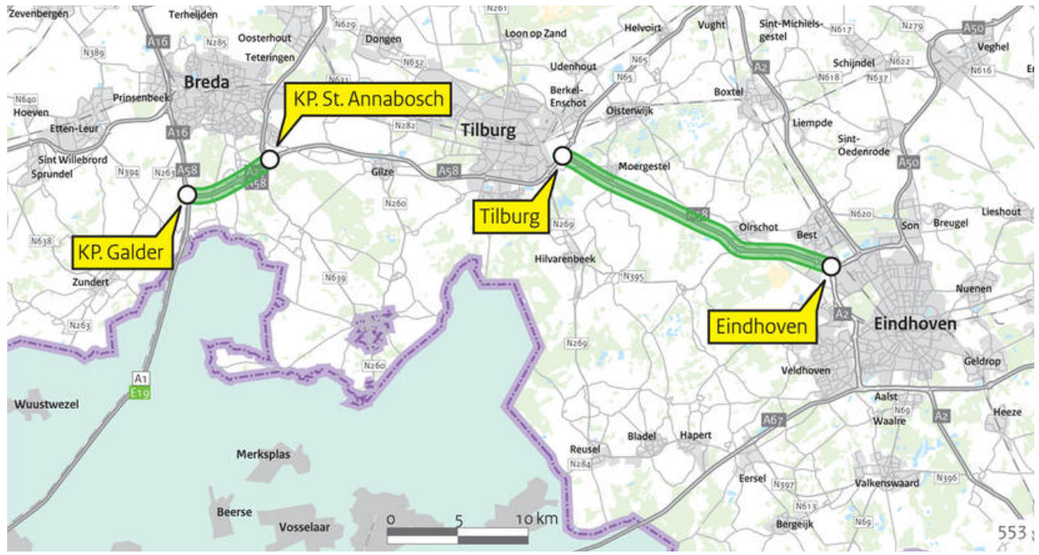
▲ Figure 21: ***Scenario sketch of A58 in 2018 and 2030***

Physical project description; size, costs, scope

Although the A58 runs from the harbour area south of Middelburg in the province of Zeeland to the city of Eindhoven in Brabant and has a total length of 150 kilometres, the project of InnovA58 only focusses on two smaller stretches, see Figure 22. These stretches are situated between the junctions of Galder and St. Annabosch, which runs over a length of 7 km, and between Tilburg and Eindhoven, which runs over a length of 28 km. To solve congestion problems in the present and even bigger problems in the future, these stretches will be broadened from two to three lanes. The budget appointed by the minister of Infrastructure and Environment is 405 million euros, of which 10 million euros are dedicated to the development of a Living Lab, a research concept to enhance innovation Rijkswaterstaat wishes to implement in the InnovA58 (Ministerie van Infrastructuur en Waterstaat et al., 2018).

Additional goals and facts of the InnovA58

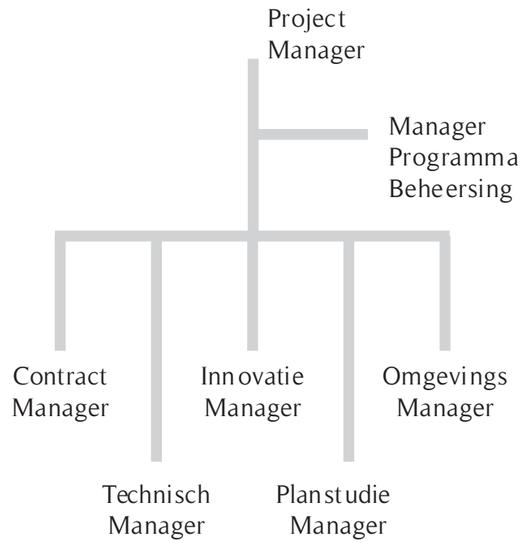
Improving the traffic flow on the A58 and thereby reducing the traffic flow on the A58 is the main goal of the project, however Rijkswaterstaat has set up a list of complementary goals which are desired to be fulfilled, most of them focussing on the implementation of innovations.
The project is planned to be delivered in 2023. In 2013, it became clear the A58 needed alterations, and in 2015, the exploratory phase begun. Currently, the project team is working on the draft route decision (OTB: Ontwerp Tracé Besluit). This means the project is still in the precontractual or exploratory phase. Next to the project planning, an innovation process is running parallel, with the intention to provide input regarding innovations to the project. This will be more elaborately explained in paragraph 4.14. For the actual project planning, see Figure 23.
Participation with the public and local residents is important to Rijkswaterstaat, as they feel participation will increase the support of the public. Therefore, many participation meetings are planned after every deadline of the project, to keep the residents up to date with information about the execution of the InnovA58.
Rijkswaterstaat wants to make use of a Living Lab, which focusses on four innovation themes: (1) optimal life cycle costs, (2) energy-neutrality and less environmental damage, (3) new services at the side of the road, and (4) smart mobility and C-ITS. This Living Lab is situated at a resting area next to the highway. In this physical space, innovations can be tested in real life, to optimize them for eventual use at other locations. A more elaborate project explanation regarding the additional goals and facts can be found in Appendix D.



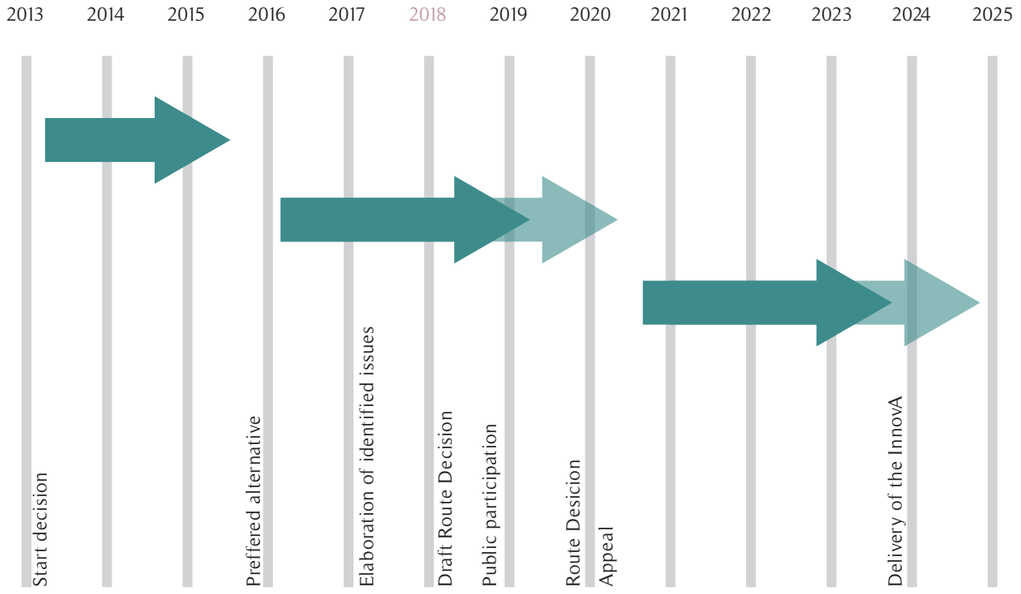
▲ Figure 22: ***InnovA58 project location (Rijkswaterstaat, n.d.-d)***

Project Team

Next to the technical description of the project, the human capital involved in the project of the InnovA58 is highly important as well. The InnovA58 project team consists of seven team members, all working for Rijkswaterstaat (Figure 24). The project team members are assisted by technical engineers from several engineering companies, among others, Witteveen+Bos. The project team works day to day for the InnovA58 and keep in touch with all main stakeholders involved in the project. In the case of InnovA58, these current main stakeholders in the project are the Ministry of Infrastructure and Water Management, Metropool Regio Eindhoven, Hart van Brabant, Gemeente Breda, Enexis, Tennet and Stichting MOED (Midden-Brabantse Ontwikkelingsmaatschappij voor Energie en Duuzaamheid). Witteveen+Bos was assigned in 2017 by Rijkswaterstaat to design the draft route decision and to write the Environmental Impact Assessment report.



▲ Figure 24: ***Project Team InnovA58***



▲ Figure 23: ***Project planning InnovA58 (own illustration, derived from Rijkswaterstaat, n.d.-d)***

4.1.2 IDENTIFICATION OF STRUCTURAL COMPONENTS

The second step of the TIS theory describes the identification of the structural components of the System. This delineation needs to be formulated individually for every case, since every study is unique. Therefore, this must be done for this particular study as well. These structural components can be defined as (1) the institutions, (2) the actors, and (3) the networks. With the help of the identification of these components, the ecology of actors can be described.

Institutions

Even though the InnovA58 is still in its early phase of the project, the exploratory phase, many actors are already involved. The actors and their associated roles will be explained one by one.

The government of the Netherlands: The government of the Netherlands is responsible for the overall wellbeing of our country. It assigns the Ministry of Infrastructure and Water Management with the task to "improve quality of life and provide access and mobility in a clean, safe and sustainable environment" (Government of the Netherlands, n.d.). It does this by creating an efficient network of roads, rail- air- and waterways, as well as by protecting the Netherlands against flooding. The ministry gave Rijkswaterstaat the task to alter the A58, as the ministry saw the congestion rates would become alarming in the near future.

Rijkswaterstaat (RWS): As said, Rijkswaterstaat was given the challenge of widening the A58 to lower the congestion rates on the highway, as Rijkswaterstaat is responsible for the practical execution of the responsibilities of the Ministry of Infrastructure and Water Management. Rijkswaterstaat is responsible for the exploratory phase of the project, as well as for the execution of the project. It is seen as the client of the project and provides the project team of its members, as well as has the responsibility to manage time as well as costs, together with the accompanying project goals, such as innovation and circular economy

Province of Noord-Brabant: As the entire InnovA58 is situated in the province of Noord-Brabant, the province has an interest in the project. As the province sees a challenge in providing the province with renewable energy, it wishes to be involved in the project of the InnovA58, as it provides great opportunities to cope with the rising demand of renewable energy in the province.

Municipalities: As the InnovA58 is a corridor running from west to east in the province of Noord-Brabant, many municipalities are run through by the highway. Because the highway is part of their spatial domain, they have an interest in the project. At the same time, the municipalities acknowledge the renewable energy challenge that lies in front of them, and thus would like to link their energy grid to the A58, as the highway alteration project is an opportunity to generate energy by the means of solar energy or wind energy.

Witteveen+Bos: The engineering company Witteveen+Bos was assigned by Rijkswaterstaat to design the draft route decision of the InnovA58. It brings much knowledge in the project as this engineering company has a lot of experience with projects like the InnovA58. Also, Witteveen+Bos was assigned to perform an Environmental Impact Assessment (EIA). Rijkswaterstaat is the client for this job, but also relies on the expertise of the engineers and consultants at Witteveen+Bos, as they deliver advisors to the project team of Rijkswaterstaat.

Other engineering companies: A consortium of (engineering) companies has been assigned the task to perform a research to the future wants and needs regarding products and services at resting areas, as well as to propose two separate modern resting area, one in each direction of the highway, making use of digital systems and smart mobility (Vosters, van Amelrooij, de Vries, & van der Mierden, 2017).

Bouw Circulair: The platform Bouw Circulair is a platform that has as main goal to accelerate the transition to a circular economy in the infrastructure sector. It tries to accelerate the transition by organizing network-events to facilitate knowledge sharing in so called 'betonketens'. These 'betonketens' are groups of companies working in the construction and infrastructure sector in and around a specific city or municipality. As three of Bouw Circulair its betonketens directly border the InnovA58, knowledge sharing between the betonketens and the project team of the InnovA58 brings great opportunities.

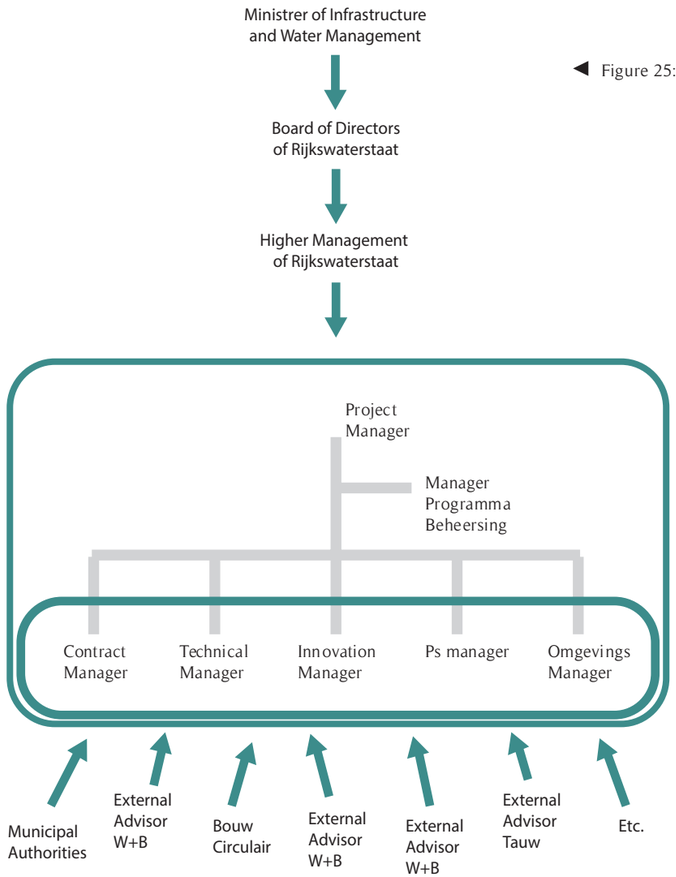
Actors

From the aforementioned institutions one or more actors are directly involved in the InnovA58 project. First of all, Rijkswaterstaat assigned seven employees to take part in the actual project team. This project team consists of a Project Manager which is the head of the project. He is responsible for the six other project team members which all have a specific task such as the contract manager or the innovation manager.

Close collaboration is present between the project team members and the governmental organizations like the province of Noord-Brabant and the municipalities surrounding the InnovA58. It also tries to keep in contact with local residents in the area, by the help of public participation, this in order to gain local support for the project. The governmental organizations are usually represented by a sustainability manager, who keeps in touch with the stakeholder manager of the project team.

The project team is backed by several external advisors, which are employees of Witteveen+Bos, the engineering company also responsible for designing the draft route decision. Experts of Witteveen+Bos are not part of the project team of the InnovA58, but work closely together with the project team members, as most of them have one or more advisors to help them in decision-making.

The platform of Bouw Circulair is led by two actors, responsible for organising the network- and knowledge-sharing events. Two project team members and an external advisor from Witteveen+Bos have given a presentation about the initial plans of the InnovA58 at three separate betonketen meetings. This was to inform the local authorities and contractors the project is on the horizon, and value innovative ideas regarding sustainability and circular economy.



◀ Figure 25: ***Organigram of InnovA58***

Networks

The networks of actors and institutions responsible for the InnovA58 can be defined as formal or informal networks (Bergek et al., 2008). The network established between Rijkswaterstaat and Witteveen+Bos was initiated by Rijkswaterstaat as it presented the task of performing the EIA and the design of the draft route decision to Witteveen+Bos. The relation is based on a level of hierarchy, as Rijkswaterstaat is the client of Witteveen+Bos. As the collaboration between those two institutions is based on an assignment given by one company to another, the network can be defined as a formal relationship.

Besides the institutional network relation between Rijkswaterstaat and Witteveen+Bos, the individual actors also have a network relation with one another. The advisors of Witteveen+Bos all have their individual professional expertise, and work for the employee of Rijkswaterstaat responsible for the topic of expertise of the Witteveen+-Bos advisor. This network relation can be described by both a formal and an informal relation. Formal in working relation as the external advisors are hired by Rijkswaterstaat, but informal -to some extent- in personal contact.

Furthermore, as Rijkswaterstaat is part of the Ministry of Infrastructure and Water Management, naturally, there is a close relation between the two of them. However, as the entire project of the InnovA58 is the responsibility of Rijkswaterstaat, the relation between these two institutions is based on formal arrangements.

As the collaboration between Bouw Circulair and the project team of the InnovA58 has not (yet) been well defined, this network relationship is still limited. However, the contact between the two institutions can be called formal. See Figure 25 for the organigram of the InnovA58.

4.1.3 THE PROCESS AS A 'BLACK BOX'

The main empirical findings were gathered by conducting semi-structures interviews with project team members of the InnovA58 and other actors involved in the project. As the InnovA58 project is very diffuse with many processes running parallel, the findings of the research were all characteristic elements from these parallel processes. To give an insight in the entire process of the InnovA58 project, the on-going process of the study on which this study focusses, is visualised in Figure 26.

Roughly, there are three parallel but distinctive processes with accompanying goals in which the respondents of this case study are currently participating in:

1. Betonketen

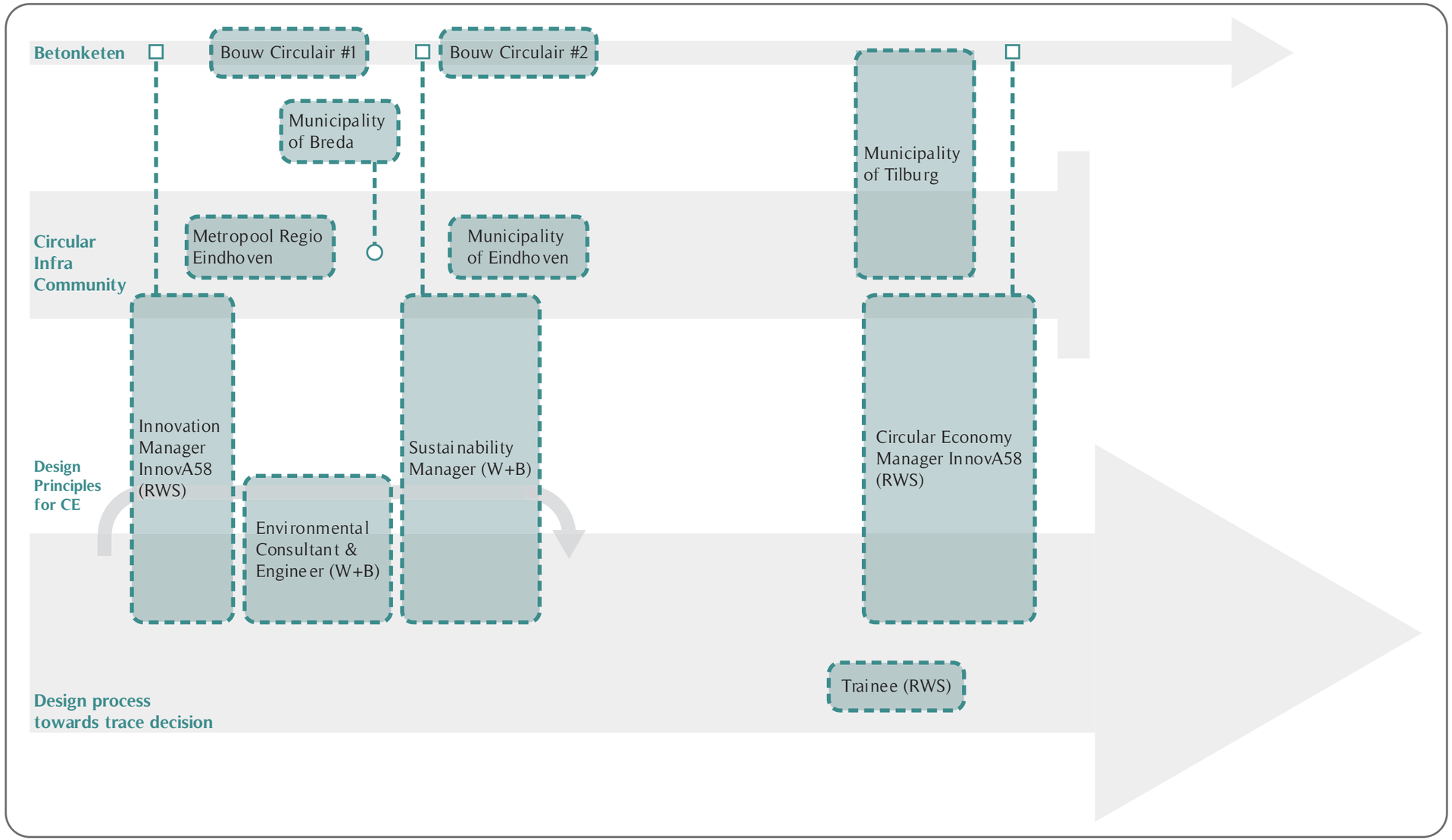
Bouw Circulair organises 'Betonketens'; regular getto-gethers with relevant players in small geographical areas with the goal to enhance and accelerate the transition to a circular economy in the infrastructure sector. Three so called 'Betonketens' are situated around the InnovA58; namely Betonketen Tilburg, Betonketen Breda and Betonketen Eindhoven. As locally produced materials and goods are considered to be more circular, the InnovA58 presented its project and goals in all three Betonketens. The goal of these presentations held by project team members was twofold; to inform the local producers and contractors about the project, and to collect new knowledge or information about (production) techniques unknown to the project team. In the future, the project team likes to explore the options to collaborate with the players of the different Betonketens.

2. Circular Infra Community

The Circular Infra Community was a community set up to be able to think outside of the box, and to deliver input to the integral design process of the InnovA58. Three meetings were organised, in which three sub groups brainstormed on different aspects of the project. These meetings were hosted by the Bouwcampus in Delft, an organization that has as goal to bring together companies and organisations to innovate in the building and infrastructure sector (Bouwcampus, 2018). Because of the difference in values and goals, the Bouwcampus has stopped facilitating the Circular Infra Community, and thus the community has quit.

3. Integral Design Process

The actual design process of the alteration of the A58 is the main process around which the InnovA58 revolves, this process needs to adhere to strict deadlines and rules. As can be seen in Figure 23, currently the draft route decision is worked on.



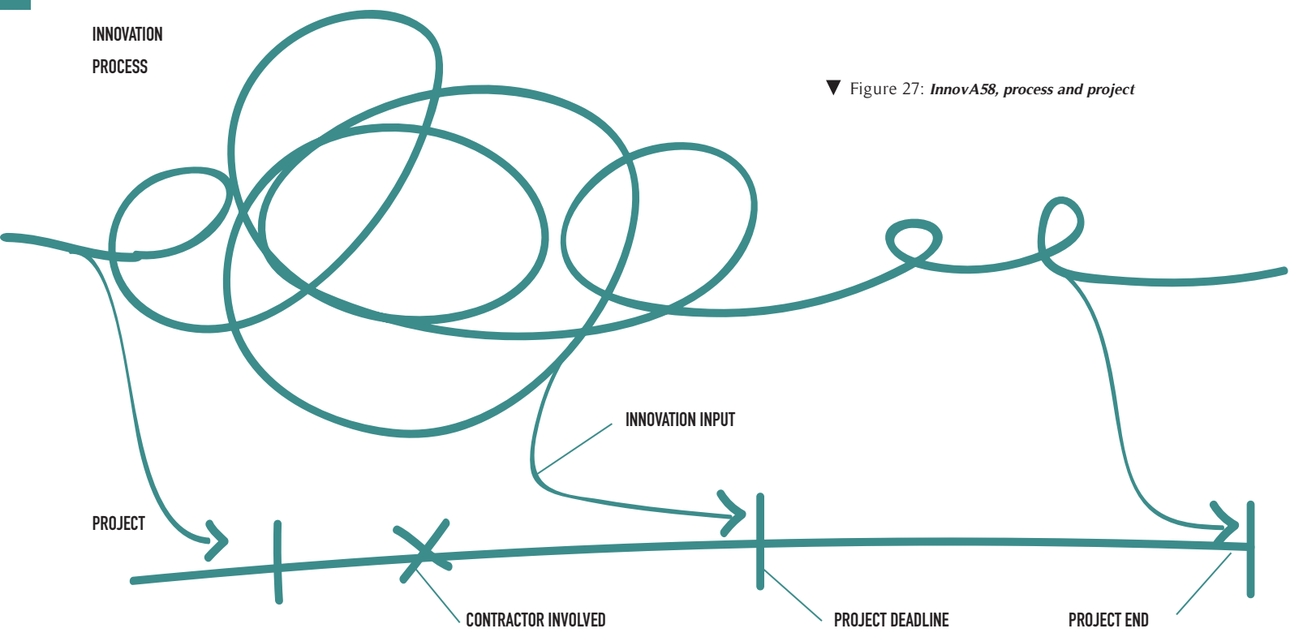
▲ Figure 26: ***The studied process of InnovA58***

(The process in which the respondents of the interviews are represented does not, in any way, show the order in which the respondents were spoken to.)

4.1.4 THE PROJECT AS A PROCESS VS. THE PROCESS AS A PROJECT

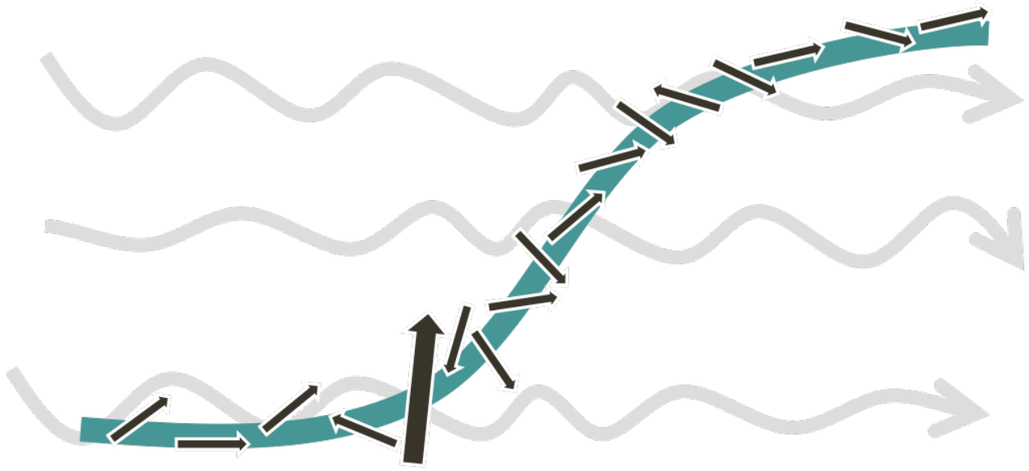
The InnovA58 can be described as a project, as the development of the InnovA58 has many project characteristics, such as deadlines, a definite start and end and the outcome of the development is known beforehand. However, describing the InnovA58 purely from the perspective of a project has some shortcomings. Next to the project's timeline, an innovation process takes place, which is meant to provide input for the project (preferably before each deadline of the project), but without the boundaries which are present in a 'project environment'. The innovation process running parallel to the InnovA58 project is designed in such a way the participants can innovate freely, with less restrictive (unwritten) rules and regulations, as are present in a project.

Also, there will be a point in time where a contractor will be involved in the project. This is at the end of the tender phase, somewhere in the upcoming 2 years. This is also an important moment in time due to the contract which will be signed once a contractor is involved. In this contract, some of the elements of partnering will clearly express, for instance (3) Collaborative Contractual Clauses. This creates a division in the project between the pre-contractual phase, before a contractor is involved, and the execution phase, after the contractor has been involved. Therefore, identifying the InnovA58 purely as a 'project' does not create a complete image. Figure 27 is a schematic representation of the InnovA58, above the diffuse innovation project, trying to generate input for the strict project planning with its deadlines, below a schematic representation of the actual project timeline.



▼ Figure 27: ***InnovA58, process and project***

Another important insight is that the project of the InnovA58 is, when looking at the time frame, very small in comparison to the entire transition to a circular economy. The project of the InnovA58 cannot by itself cause the transition to be completed successfully. However, it is a contribution to the transition; the more successful the InnovA58 in terms of the implementation of the ideas of a circular economy will be, the bigger the impact of the InnovA58 on the transition to a circular economy. This is also explained by Rotmans et al. (2001), as a transition is a long term development, however is created by multiple short term developments. The InnovA58 is an example of a short-term development which influences the long-term development; the transition to a circular economy. It is wished the InnovA58 contributes maximally to the transition to a circular economy, as can be seen in Figure 28, where the desired contribution of the InnovA58 is represented by the larger arrow.



▲ Figure 28: ***InnovA58 as a contribution to the transition***

4.2 FINDINGS: ELEMENTS OF PARTNERING

In this section, the empirical findings of the case study will be presented regarding the elements of partnering. The findings and interpretations of these findings will eventually lead to the answer on the third subquestion. The findings of the case study were the result of interviews conducted, together with a document analysis of the InnovA58. Interviews were held with project team members of the InnovA58, as well as employees of several other companies and (governmental) organizations, which are all involved in the project of the InnovA58, see Figure 26. The respondents have different perspectives on the matter, which ensures triangulation of the data. The document analysis was conducted to support the data retrieved from the interviews.

4.2.1 THE IMPORTANCE AND PRESENCE OF THE ELEMENTS

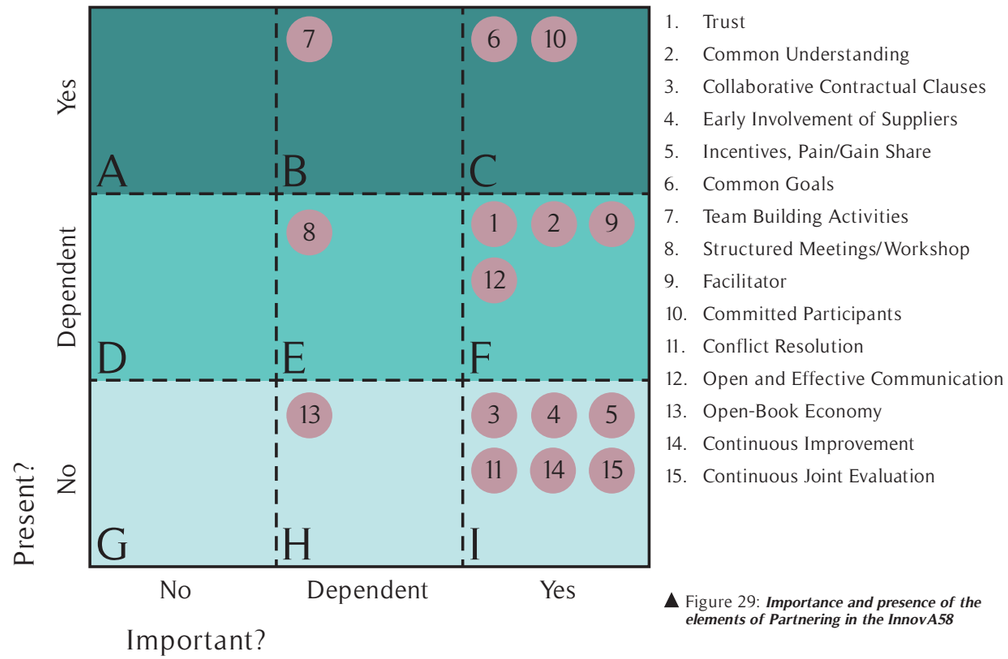
As this study is explorative and qualitative of nature, the data gathered from the case study must be correctly interpreted. Therefore, first of all, the respondents were asked which elements, as described by Hosseini et. al. (2018), they believed are important in an infrastructure project in which circular economy ambitions are high. Second of all, the respondents were asked whether the elements of partnering were present in the project of the InnovA58. As the respondents could freely express their vision on the matter, some of their answers were no definite yes or no, this was indicated by 'dependent', as the respondents stated the importance and/or presence of some of the elements were dependent on the situation. The answers of the respondents were collected, and the mode of the answers was taken. This results in a matrix with nine planes of interfaces, as can be seen in Figure 29. The full analysis based on all interviews can be found in Appendix E. The nine interfaces in Figure 29 do not only show whether the respondents believed the element of partnering is important and present in the InnovA58, it also provided a second layer of information; the attitude of the respondents towards the different elements. This attitude influences the information shared by the respondent and must thus be kept in mind while analysing the qualitative data.

In case all elements would have been at the top row of the matrix, this would describe a perfect partnering project, as all element would be present in the project. In case all elements would be in the third and last column of the matrix, this would tell all respondents would believe the elements depicted as important in an infrastructure project, would also be of importance in a project specifically focussing on circular economy.

The biggest spread in elements can be observed in the rows of the matrix, thus whether an element is present in the InnovA58. Therefore, these rows are coloured dark blue (present), blue (dependent), and light blue (not present). This colour coding will be helpful in the further analysis of the data, as will be shown in paragraph 4.3.

The spread in the importance of the elements is less, therefore, no additional colour coding was added to increase readability in the figure. However, as the difference between the elements perceived to be of high importance to a project in which circular ambitions are high and the elements that are perceived to be of importance only under certain circumstances, is significant in the further analysis of the data, this difference will be visualized and elaborated upon in paragraph 4.3 as well.

> For instance, when an element of partnering is seen as not important, the respondent will have a somewhat negative attitude towards this element. Therefore, the added value of the element can be visible in the case, but will not be noticed by the respondent. Another example is a case in which an element is neither seen as important nor is present. In this case, the respondent will find it satisfactory, however, he/she doesn't know how the project would perform in case the element would have been present. It thus is considered to be an 'unknown unknown', and no conclusion on this outcome can be drawn (Kim, 2012).



▲ Figure 29: ***Importance and presence of the elements of Partnering in the InnovA58***

4.2.2 ELEMENTS IN THE CORNERS OF THE MATRIX – THE EXTREMES

As can be seen in Figure 29, the respondents were most outspoken in their opinion about the elements present in one of the four corners of the matrix (interface A, C, G, I). The attitude of the respondents towards those elements thus are more opinionated than towards the elements present in the middle area of the matrix (interface B, D, E, F, H). Therefore, the elements of partnering present in the extremes of the matrix, thus interface A, C, G and I, will be elaborated upon first.

The elements of partnering placed in the top right corner of Figure 29 were both found to be of importance and present in the InnovA58. From the interviews, it followed two elements of partnering could be placed in this interface. When an element is seen as important and is also present in the InnovA58, respondents feel the need of the element being present and act accordingly. As the outcomes of this research step are no definite yes or no, there could still room for improvement regarding the specific element.

6 Common goals: Respondents were of the opinion common goals were highly important to successfully deliver a project in which circular economy goals are at the heart of the project. As stated by the respondents, without common goals, there is no common support for the aim which you will work towards. In the case of the InnovA58, common goals were formulated before the start of the project. However, as a critical note, respondents did press the common goals were outdated as they were formulated quite some time ago, therefore, a suggestion was to update the goals to the present standards (personal communication, September 19, 2018).

10 Committed Participants: Respondents stated personal drive to work towards the best outcome of the project is very helpful, therefore, it is seen as an important element of partnering. Overall, the respondents were convinced the project had many committed participants willing to give a little extra effort for the outcome of the project. However, respondents felt that although the project team members were committed, a broader commitment towards the transition to a circular economy is needed, and is currently not present.

No elements are assigned to the interfaces A and G, which can be explained by the fact that every element is regarded important, to some extent. The elements found in interface I are believed to be important in a project like the InnovA58, however, are not currently present. Thus, much room for improvement on is there, this is also recognized by the respondents. Thus, there must be indications as to why those elements are not present in the project.

3 Collaborative Contractual Clauses: Making arrangements concerning how to collaborate, as is summarized as collaborative contractual clauses, is found to be important. "Yes, this is very important, as when conflicts rise, you can fall back on the 'rules of the game' set up beforehand" (personal communication, September 12, 2018). Despite the fact this element was found to be of importance, it is not currently present in the InnovA58. One respondent mentioned the fact that such clauses are not present since employees of Rijkswaterstaat have a 'RWS-way-of-working' (Personal communication, September 19, 2018). He underpinned this by stating most project team members have already worked for Rijkswaterstaat for such a long period the way of working feels automatic for them.

4 Early involvement of Suppliers: The early involvement of suppliers is believed to be of importance to a project like the InnovA58, and this can be explained in two ways. First of all, the suppliers can be involved early in the process to make sure they are informed about which innovations and techniques will be applied in the project, therefore, they can prepare themselves in advance of the tender becoming public. Secondly, the suppliers can be involved in the design process, in which the way of thinking can be completely changed: "You can look at a guardrail from many different approaches. The design of a guardrail can be completely different if you look at it from the perspective of an ecologist, but may function just as good" (Personal communication, September 11, 2018). However, suppliers are not yet involved in the InnovA58, although the project team has made some tries, for instance within the Circular Infra Community.

5 Incentives, Pain/Gain share: The advantages of incentives, pain/gain share is seen by most of the respondents, however, some external actors are not convinced it will contribute to the course of a project like the InnovA58. Nevertheless, no incentives or pain/gain share is implemented during the early phase of this project.

11 Conflict Resolution: The general opinion of the respondents is that conflict resolution is definitely highly important in any project, as disputes may occur and the way to deal with this is to make clear agreements. Some respondents did mention the fact that this element of partnering is to importance to any project, they didn't feel is was specifically more important to a project in which circular ambitions are high. Currently, there are no agreements made regarding conflict situations in the project.

15 Continuous Joint Evaluation: Respondents agree on the importance of continuous joint evaluation, they also refer to the Deming Circle as a helpful tool to evaluate the projects course (Rouse, 2015). However, up until now, no evaluation moment has taken place in the InnovA58.

Abovementioned elements are the 'outliers' in the matrix, and thus tell the most remarkable outcomes. The elements in the top right corner of the matrix are satisfactory fulfilled, the elements in the lower right corner are not. Therefore, the elements in the lower right corner can be improved upon a lot. As these elements are all considered to be of high importance, according to the respondents, they have a positive attitude towards those elements.

4.2.3 ELEMENTS IN THE MIDDLE AREA OF THE MATRIX

To structure the outcomes presented in this paragraph, the matrix will be explained one interface at a time, from top right (important; yes, present; yes: interface C) to bottom left (important; no, present; no: interface G). Therefore, the order of analysis of the interfaces will be B, F, E, H.

Elements in the interface of B are found to be present, but not especially important. This might mean the element is easy to fulfil and is thus present although the importance is unclear or invisible to the respondents. Within interface B, only one element is present.

7 Team Building activities: Team building activities is, in the eyes of the respondents, seen as time that could have been spent more efficiently and costs money that isn't available. A respondent mentioned it is better to form a team out of employees who are intrinsically motivated to work towards the common goal of the project, thus making team building activities unnecessary (Personal communication, September 11, 2018). At the start of the InnovA58 project however, a so called 'Heisessie' was organized, for every actor involved in the project, in which team building was the main goal of that session.

Within interface F, the elements are believed to be of importance, and are -to some extent- present in the InnovA58 project. However, there is still much room for improvement.

1 Trust: Trust is seen as one of the most important elements, "without trust, you can pack your bags and leave, since a project will never become successful" (Personal communication, October 29, 2018). Observed fact is that there is a clear difference in the level of trust internally and externally. Mutual trust between Rijkswaterstaat and external actors is not felt as unconditional in the InnovA58, as external stakeholders are hesitant to provide Rijkswaterstaat with knowledge without some sort of contractual commitment, as they fear they won't be given credit for their knowledge and or experience shared (Personal communication, September 18, 2018). Within the project team on the other hand, the level of trust between members of the project team is satisfactory. The project team has a hard time building up the trust between them and external parties, also due to the fact the expectations are high for this project, and the external parties do not feel the Ministry of Infrastructure and Environment will live up to these expectations. Therefore, external parties are somewhat reluctant.

2 Common Understanding: The second element, common understanding, is the second most important element, next to trust. "Common understanding is a prerequisite, if you do not understand each other and have different explanations for certain concepts, the project will fail" (Personal communication, September 12, 2018). However, respondents still observe actors have different understandings of the goals and wishes of the project. It also plays a role that respondents feel Rijkswaterstaat is not a transparent organization, in which the business processes are hard to fathom (Personal communication, September 11; 2018, September 12, 2018).

9 Facilitator: "A facilitator can help smooth the process of collaboration, and it is wise to appoint someone for this role" (Personal communication, September 11, 2018; September 12, 2018). Theory states an external facilitator must guide the process, however, not all respondents are not convinced an external party is needed, an internal actor who takes the role of a facilitator will be just as beneficial (Personal communication, September 19, 2018; October 29, 2018). An external facilitator was only present during the four Circular Construction Community meetings, but as this community has come to an end, no external facilitator is currently involved in the project.

12 Open and Effective Communication: When collaborating, open and effective communication is key. It is often mentioned together with trust and common understanding (Personal communication, September 11, 2018; September 12, 2018; September 20, 2018; October 23, 2018). Within the InnovA58, the need for improvement in this element is felt, as the extent to which communication is open and effective, depends on the situation and the involved actors. For instance, within Rijkswaterstaat, some departments were unaware the InnovA58 was even taking place, since the project team member responsible for communication with those departments didn't feel it was necessary to involve them, as their input was not yet needed in this stage of the process (Personal communication, September 19, 2018).

14 Continuous Improvement: Continuous improvement of the project, sometimes referred to adaptive management, is seen as a way to improve the success of a project, and thus is important to a project. However, respondents felt this element is important in any infrastructure project, not just for projects focussing on circular economy. However, this element is absent in the InnovA58, as the time pressure hinders this (Personal communication, September 11, 2018). Furthermore, continuous improvement was not implemented, as employees from Rijkswaterstaat tend to fall back on old habits in case there

is any friction occurring during the course of the project (Personal communication, October 23, 2018).

Within interface E, the importance and presence of the element is dependent on many variables, it is thus clear room for improvement regarding those elements is there, however, the respondents do not feel the urge to improve this a lot, since the necessity is not felt.

8 Structured Meetings/Workshops: The only element in the middle of the matrix, thus being both important and visible to a limited extent, is structured meetings/workshops. Respondents do see the importance of defining a goal to a meeting, otherwise the topic of the meeting can go either way, and this hampers the continuation of the process (Personal communication, October 23, 2018). However, "compared to other elements on this list, this element is less important" (Personal communication, September 11, 2018). Currently, the meetings are found to be structured, however, there is much room for improvement. An agenda was always strictly followed; however, time was always limited, and important topics were not always treated with the enough attention, in case the meeting came to an end.

Interface H depicts the elements of partnering that are seen as important, but only under certain circumstances, but are not currently present in the InnovA58 case. The respondents thus feel the presence of these elements can be of added value to a project, but do not see it as essential for a project to perform well.

13 Open-book economy: Respondents are uncertain whether having an open-book economy is beneficial to a project like the InnovA58 (Personal communication, September 11, 2018). Besides this, respondents state that a complete open-book economy is currently not possible under Dutch regulations (Personal communication, September 19, 2018; September 20, 2018; October 23, 2018). Respondents do however feel that an open-book economy can improve trust between actors or institutions, which thus has an indirect positive effect on the project (Personal communication, October 23, 2018). In the project case of the InnovA58, open-book economy is not one of the elements currently present.

4.2.4 KEY TAKE-AWAYS

As can be concluded from the matrix which can be seen in Figure 29, no element of partnering is seen as unimportant, according to the respondents. So, all elements contribute, either directly or indirectly, to a positive outcome regarding circular economy in an infrastructure project in the opinion of the respondents. However, the presence in the InnovA58 sketches a different picture, as most of the elements are only present to some extent, or even not at all. This indicates the InnovA58 is currently far from a perfect example of a partnering project, and much room for improvement is there. Another remarkable finding was the fact that for several elements, there was a difference which could be noted between actors or institutions. For instance, trust was present within the project team, however, they could not convey this trust to external actors. This also applied to open and effective communication.

4.3 FINDINGS: FUNCTIONS OF TECHNOLOGICAL INNOVATION SYSTEM

As the findings regarding the elements of partnering are now presented, the link between the elements of partnering and the theory of Technological Innovation System can be made, as the following step in the analysis. To do this in a structured way, the functions of Technological Innovation System will be described in numerical order. Within the description of the functions, the role of partnering will be evaluated for every function. In Table 5, the complete overview of the relations found between the elements of partnering and the functions of TIS can be seen.
As Table 5 presents a lot of information, the following information is important when reading the data from the table:

- The explanation of the elements of partnering and the functions of TIS can be found in chapters 2 and 3, respectively.
- All combinations between the seven functions of TIS (columns) and the fifteen elements of partnering (rows), are indicated with a cell of the table. This results in a total of 105 cells, thus 105 possibilities of the role of partnering on the functions of TIS.
- The cells which are indicated with an X, present a found role of the element of partnering on the corresponding function of TIS. As can be seen, in 34 combinations of elements and functions, a role was found in the case study of the InnovA58.
- The cells which are empty represent the combinations of elements of partnering and functions of TIS, in which no definite relation could be found in the case study of the InnovA58.
- The colours of the rows (dark blue, blue and light blue) correspond with the presence of the elements within the InnovA58, as can be seen in Figure 29.
- These colour will also be used in the following paragraph, in the elaboration of the role of the elements of partnering in the functions of TIS, see paragraph 4.3.1 to 4.37.
- As explained in paragraph 4.2.1, the perceived importance of the elements of partnering are not colour coded, for the sake or readability. In Table 5, the elements which are, according to the respondents, only important under certain circumstances, can be identified by the names of the elements being ***italic (elements (7), (8) and (13)).***
- The table only represents in which of the functions of TIS a role of a specific element of partnering could be found. The complete overview of the role and substantiation thereof regarding the separate elements of partnering on the functions of the Technological Innovation System, can be found in Appendix F.

▼ Table 5: ***Overview of Functions and Elements relationships***

Functions of Technological Innovation System

Elements of Partnering	1. Entrepreneurial Activities	2. Knowledge Development	3. Knowledge Diffusion Through Networks	4. Guidance of the Search	5. Market Formation	6. Resources Mobilization	7. Creation of Legitimacy	Present in InnovA58?
1. Trust	X	X	X	X				Dependent
2. Common Understanding	X	X	X	X				Dependent
3. Collaborative Contractual Clauses								No
4. Early Involvement of Suppliers	X	X	X	X				No
5. Incentives, Pain/Gain Share								No
6. Common Goals	X	X		X				Yes
7. Team Building Activities			X					Yes
8. Structured Meetings/ Workshop				X				Dependent
9. Facilitator		X	X	X				Dependent
10. Committed participants	X	X	X				X	Yes
11. Conflict Resolution								No
12. Open and Effective Communication		X	X	X		X	X	Dependent
13. Open-Book Economy								No
14. Continuous Improvement	X	X	X					No
15. Continuous Joint Evaluation			X	X				No

On the following pags, the functions of TIS will be elaborated uon one by one. Within this elaboration, the role of the elements of partnering is explained for every element which is found to have an influence on the functions of TIS. The colours in Table 5 will also be assigned to the role of the elements in the upcoming paragraphs. Thus while reading, the presence of the elements (thus referring to dark blue (present), blue (dependent) and light blue (not present) can be seen at an instance.

Where the element is perceived to be of importance only under certain circumstances *(thus in italic in Table 5)*, this is explained in the text, as this is not colour-coded in the table.

4.3.1 FUNCTION 1: ENTREPRENEURIAL ACTIVITIES

As explained in chapter 3, entrepreneurial activities are of importance to a transition, as without entrepreneurial activities, new innovations would not be presented to the market, therefore, a transition will not take place. To bring potential ideas to the market, the entrepreneur must need to take concrete action, in order to accelerate the transition to a circular economy. The first function of the theory of TIS, Entrepreneurial Activities, is found to be influenced by six elements of partnering.

The absence of trust in the InnovA58 hampers entrepreneurial activities in two ways: (1) external parties need contractual commitment before they are willing to share their innovations. Due to the high speed in which innovations develop in the field of CE, this has a large negative influence, and (2) the Ministry of Infrastructure and Water Management does not trust start-ups willing to innovate in the InnovA58, due to size of the tender and the accompanying risks.

Common understanding has a negative role in entrepreneurial activities, as practical results are hard to obtain when common understanding is still searched for. The discrepancy between the stakeholders who 'think outside of the box' and the ones with a 'traditional' way of thinking causes tension in collaboration.

Many innovations come from the hand of suppliers, as they try to beat their competition by constantly innovating. When these suppliers are involved early in a project, this knowledge can be beneficial to implement these innovations in an infrastructure project. Currently, this element is not visible in the InnovA58, however, the actors do see the opportunities the early involvement of suppliers can bring.

Common goals influence entrepreneurial activities in the InnovA58 as the interpretation of what circular economy means in the specific project must be established before innovative ideas can be thought of and shared. Also, the strict formulation of common goals helps making decisions in the process, as delaying decisions hamper entrepreneurial activities.

The commitment of participants towards the project plays a clear role in entrepreneurial activities. The circular economy manager of the InnovA58 project team described it as: "If you do what you always did, you will get what you always got". (personal communication, October 23, 2018). Hence, referring to committing yourself to an innovative project in which much has to be changed in comparison to 'traditional' project management. However, it is also mentioned that the commitment higher up in the hierarchy of Rijkswaterstaat still needs to improve, to give support to project teams to invest in entrepreneurial activities.

The role of continuous improvement is only found to be there in the (near) future, as new projects can learn from the InnovA58. As a transition is a long continuous process, small steps need to lead to the wanted end result. Continuous improvement can contribute to that by leaning by doing, trying new ideas and therefore engage in entrepreneurial activities.

4.3.2 FUNCTION 2: KNOWLEDGE DEVELOPMENT

Within a transition process, the creation of new knowledge is at the heart as this knowledge is a prerequisite to radically change the environment in which the innovations are implemented. Research and Development (R&D) will need to be invested in to come to the new knowledge needed to implement business ideas by entrepreneurs.

Within the second function of the TIS theory, knowledge development, the role of eight elements was clearly defined within the scope of the case study.

The role of trust within the InnovA58 is minimal. Due to the lack of trust, players in the field of the InnovA58 tend to only develop knowledge within their own company or institution, instead of together. This is different however for the Circular Infra Community, as the creation of knowledge was the main focus of these meetings (Verweij, van den Burg, & Gugerell, 2018).

The formulation of the circular economy principles for designing an infrastructure project contributes to the common understanding within the project, hence, within the InnovA58, common understanding contributes to knowledge development.

As suppliers have the most knowledge on the materials used in a project, their knowledge is highly valuable to the InnovA58 project team, as this can lead to solutions and knowledge regarding design challenges faced on the way, thus contributing to knowledge development.

Well defined common goals play a role in the creation of new knowledge, as with the help of common goals, more specific and precise questions may be asked to the market, which may be answered by the creation of new knowledge. The presence of and understanding of the importance of common goals set by the project team also facilitated the 'Circular Economy Design Principles for Infrastructure' (Circulair Ontwerpen in het MIRT proces) (Dijcker, Crielaard, & Schepers, 2018).

The role of a facilitator is not very clear, as in the integral design process, no external facilitator was appointed. However, respondents did see the role of a facilitator in 'knowledge development', as the positive effect of the presence of an external facilitator was already experienced in the Circular Infra Community.

The commitment of participants has the same role in knowledge development as it has with entrepreneurial activities. Committing to innovations like the circular economy automatically means one has to commit to finding the knowledge needed, as it is a new field of expertise not much is known about yet.

Within the Betonketen, open and effective communication stimulates the development of new knowledge, as actors can easier collaborate when communication is clear, and stakeholders meet each other on a regular basis. However, within the design process, the communication between the actors could still be improved.

Continuous improvement contributes to the learning experience, both for the project itself as for new upcoming projects. Within the InnovA58, this role is prominently visible, since this is a one of a kind, first attempt project. Therefore, many experiences are new to the majority of the stakeholders, which makes it a project from which many lessons may be learnt. There is also a downside to continuous improvement, as incorporating adaptive management within you process might slow the process down, because of the increase in complexity.

4.3.3 FUNCTION 3: KNOWLEDGE DIFFUSION THROUGH NETWORKS

Knowledge acquired needs to be shared within the networks engaged in the transition, as sharing this knowledge benefits all stakeholders in the transition, thus contributing to it. Interaction between the government and R&D is also needed to make policy decisions related to the transition. This third function of Technological Innovation System is influenced by the most elements, nine in total.

The role of trust in the third function is acknowledged within the case. Players are reluctant to share their knowledge without a (contractual) commitment from the potential client, however, respondents believe knowledge diffusion is easier in the province of Noord-Brabant, due to the culture of the province.

The role of common understanding on knowledge sharing is clear in the case of the InnovA58, as having the same ideas on topics is a prerequisite for transferring knowledge successfully. As Rijkswaterstaat is not seen as a transparent organisation, sharing knowledge is seen to be a challenge.

As suppliers are found to be most knowledgeable, the early involvement of suppliers is of great influence on knowledge diffusion through networks. The challenge for the project team is to create such an environment that the suppliers are willing to share their knowledge, without a hidden agenda.

Team Building Activities only have a role in the third function, as an open and friendly environment between the project team enhances the sharing of knowledge. The respondents did not see the added value of Team Building Activities, as most project team members knew each other. Therefore, the somewhat negative attitude of the respondents towards this element might have an influence on the role of the element of the function of knowledge diffusion through networks, as due to the negative attitude, the respondents might not put their effort in building the relationships in the project team, which hampers the function of the TIS.

As in the function 'knowledge development', the respondents did see the role of a facilitator in 'knowledge diffusion through networks', as the facilitator could guide the process of a meeting in the direction which could positively influence these functions.

When actors are committed to the best outcome of the project, this positively influences their willingness to share information. Therefore, the commitment of the participants in the process plays a role in the function of knowledge diffusion through networks.

The commitment within the project team is acknowledged, however, the commitment of external actors within the Circular Infra Community degraded over time as the actors felt they got nothing in return.

Open and Effective Communication can be clearly assigned to the function 'knowledge diffusion through networks' as it rests on communication. Communication in the InnovA58 was present at three different levels; public participation with inhabitants living around the project area, external communication with potential working partners, and internal communication within the project team. Only public participation and internal communication were found to have a positive impact on knowledge sharing,

Continuous improvement plays a role in knowledge diffusion, as the intention to improve makes communication and chain collaboration mandatory. Also outside of the boundaries of the scope of the InnovA58, continuous improvement influences knowledge diffusion as the lessons learned can be implemented in future projects.

Continuous Joint Evaluation facilitates moments of reflection, in which project team members can reflect on the collaboration thus far, as well as on the outcomes of the project and its progress. These moments of reflection are thus moments of knowledge sharing, as actors can learn from the process and directly apply these lessons learnt in practise.

4.3.4 FUNCTION 4: GUIDANCE OF THE SEARCH

Guiding the search in the right direction for the transition is helpful to all involved actors and institutions. Thus, visible and explicit wants and needs of the market, the society and the government enable innovation. The government propagating goals supports this.

The fourth function of the TIS theory is, like presented in Table 5, influenced by eight elements of partnering.

Within the InnovA58, the role of trust is evident. Without trust, partners relying on each other's services or information are uninformed in which direction developments and innovations will unfold, which hampers the transition to a circular economy.

The lack of common understanding is a threat to 'guidance of the search', as when management's focus lies with the Iron Triangle, other topics such as the implementation of circular economy ideas are not stimulated. Also, a pubic sense of urgency of the problems and challenges we face today is needed to create support for the investments in both time and money needed to solve the current issues.

Involving suppliers early in the process contributes to guidance of the search, as suppliers are confronted with the upcoming challenges earlier in the process. This is currently not the case in the InnovA58. Also, the suppliers in the field of the InnovA58 have low expectations of Rijkswaterstaat due to bad experiences in the recent history, therefore, they are not eager to be involved early in the process.

The definition of common goals leads to a better defined 'guidance of the search', as common goals make sure the image shared about the project shared with external organizations is constant, thus limiting the chance of misunderstandings. Although considering all perspectives from actors involved in the project increase the support for the project, it also increases complexity. This must be taken into consideration, however can contribute to guidance of the search as all actors support the chosen path of development.

'Structured meetings/workshop' were only found to be of influence on 'guidance of the search', as it can help align the direction of the search between project team members. Without clear structure in meetings and or workshops, discussed topics will not contribute to the greater goal. Within the InnovA58, no definite positive or negative influence has been found. This is related to the fact the respondents are not convinced structured meetings or workshops contribute to the implementation of circular economy. This might negatively influence the transition to a circular economy, due to the negative attitude towards the element.

As a facilitator was not present in the design process, no definite conclusion can be drawn regarding the role of a facilitator on 'guidance of the search'. However, respondents did see a facilitator can help concentrate on the bigger goal by facilitating meetings and keeping the actors focused.

Open and Effective Communication can be clearly assigned to the function 'guidance of the search', as it is the way to bring about the ideas and wishes of the Ministry of Infrastructure and Water Management to the public, external parties and institutions.

By this, stakeholders are steered in the right direction and thus follow the path towards a circular economy. As the transition to a circular economy is a long and continuous process which will face many difficulties, it is important to realize small steps towards the right direction are needed. In this process, Continuous Joint Evaluation can help by fuelling the guidance of the search.

4.3.5 FUNCTION 5: MARKET FORMATION

Radical innovations are in treat of ending up in the 'Valley of Death', therefore, protected spaces in which innovations can grow are helpful to the transition. Encouragements from the government in financial aids can be helpful too.
Within the InnovA58, a Living Lab is created. A Living Lab is physical space in the project area which is seen as a 'playground' to try out new innovations and ideas, to experience how these innovations will perform outside test lab settings. It is seen by respondents that physical space and human capital is needed to test out innovations in real life situations. In the project of the InnovA58, a physical Living Lab is created at a resting area next to the A58. This physical space is used to test out innovations and new technologies in the form of smart mobility. Although the Living Lab only stretches over a small surface area, it does create a so-called playground for the project team. Currently, the plan of approach is drafted on how to approach this Living Lab (personal communication, October 23, 2018). As the plan is still in the pipeline, the function of market formation is not (yet) fulfilled by any of the elements of partnering. No clear role of any of the elements could be found. However, the respondents did see the importance of the function 'market formation', as the Living Lab as the InnovA58 is seen as the space where they can implement creative ideas and innovations, which would not have been possible to incorporate in the actual broadening of the highway.

4.3.6 FUNCTION 6: RESOURCES MOBILIZATION

Within the InnovA58, only 10 million euros (the total budget for the InnovA58 is 405 million euros), which is under 2,5% of the budget, is dedicated to the Living Lab, in which innovations will be tested in real life situations. Respondents mention this budget will have to be stretched in order for the Living Lab to have a considerable impact. When the budget is under pressure, respondents see that budget cuts are always at the cost of innovations, which hampers the transition to a circular economy. They are of the opinion the mobilization of financial resources is highly needed to make the InnovA58 a successful and innovative project, instead of just an alteration to the existing highway, as they are afraid this is what the InnovA58 will become. At this stage of the project, resources, both in financial resources as in human capital are on a tight budget, as the higher management of Rijkswaterstaat is focused on the Iron Triangle, of which the goal is to keep the project within tight budget and time planning. This contradicts the innovative goals of the InnovA58, as it is believed higher investments upfront are needed to deliver an innovative project which contributes to the transition to a circular economy, especially in this stage of the circular economy transition (personal communication, November 5, 2018). This interaction between traditional management focussing on the Iron Triangle and the attempt to embed innovative solutions in the InnovA58 causes great friction in the project.

Currently, as resources mobilization is not the main point of attention from higher management in the InnovA58, it isn't clearly reflected in the role of partnering. As there is always a fight about the budget and the planning, open and effective communication does play a role in this function. Respondents feel this is inherent to a project of this size, however they did expect more effort of higher management as the project is 'advertised' as an innovative project. Thus, the negatively experienced communication about (financial) resources hampers the transition to a circular economy.

4.3.7 FUNCTION 7: CREATION OF LEGITIMACY/COUNTERACT RESISTANCE TO CHANGE

For an innovation to become the new standard, the technology either needs to become part of an existing regime, or has to overthrow it. Parties involved in the business of the existing regimes will oppose to the innovation. This opposition will have to be overcome, which can for instance be done by the help of advocacy coalitions. In case of the transition to a circular economy, the current regime needs to be overthrown in order for the circular economy to become the new standard. Some players in the market currently are resistant to this change, as they have a benefit in continuing the way of working as they are used to. This can for instance be illustrated by the fact that contractors have no incentive to use recycled concrete, as they have their own quarries, thus willing to use the raw materials they can generate themselves (personal communication, September 18, 2018). Therefore, this resistance to change needs to be counteracted in order for the transition to become successful. However, within the InnovA58, no explicit action is currently undertaken.
Part of counteracting the resistance to change can be achieved by creating a public sense of urgency. This is needed in order for the public to accept the changes in the infrastructure sector which are needed to accelerate the transition to a circular economy. Currently, the government tries to create this sense of urgency by promoting the benefits of circular economy, although this does not yet translate itself in the project of the InnovA58.

From the case study, it followed two elements of partnering have a role in the creation of legitimacy. First of all, the commitment of participants in the project is very important to overcome the setbacks in the process and keep the eyes on the higher goal, as transitions are considered to be long and tough processes. For this, support from higher management is of great value, as they can act as an ambassador of the higher goal. However, in the InnovA58, the role of committed participants is of negative influence, as Rijkswaterstaat is seen as a conservative organization, which is resistant to change.
Secondly, the element 'open and effective communication' negatively influences the creation of legitimacy. This is due to the fact that Rijkswaterstaat is an organisation in which hierarchy plays a distinctive role. Also, the conservative nature of the organisation hampers the open mind which is needed to accept innovative ideas. Because decisions need to work through many layers of the organisation before an agreement is made, this communication has a negative role in the creation of legitimacy.

4.3.8 KEY TAKE-AWAYS

There is a clear division between the first four functions and the last three, as can also be clearly seen in Table 5. Whereas the first four functions are all influenced by six or more elements of partnering, the last three functions are by one or two, or none at all. Market formation is currently not influenced by any of the elements of partnering. Within function six, recourses mobilization, a minor role of open and effective communication is visible, where in function seven, a role of committed participants as well as open and effective communication is found. Furthermore, it can be noticed several elements of partnering have no role in the transition to a circular economy, considering the case study of the InnovA58. These elements are: (3) Collaborative Contractual Clauses, (5) Incentives, Pain/Gain Share, (11) Conflict Resolution, and (13) Open-book Economy.

4.4 EVIDENCE ANALYSIS – CASE DOCUMENT RESEARCH

Primary data collection was acquired by the means of interviews, as partnering is described by the interaction between those stakeholders, thus, primary evidence can be found best by conducting interviews (Gadde & Dubois, 2010). This can also be explained by the fact some of the elements of partnering can merely be found by conducting interviews, as for instance the level of trust between stakeholders cannot be found any other way. Multiple publicly available documents were scanned and evaluated for this document research. An overview of all documents analysed for this document research can be found in Appendix G. Although the interviews were the primary source of information in this case study, findings can be substantiated by document research. Below, the elements of partnering and their role of influence on the functions of TIS, which can be corroborated with document evidence, is elaborated upon below.

4.4.1 COMMON UNDERSTANDING/COMMON GOALS

Common understanding, as well as common goals within the InnovA58 is created by, among other things, a document set up by Witteveen+Bos in collaboration with Rijkswaterstaat. This document is called 'Circulair ontwerpen in het MIRT proces' (Dijcker, Crielaard, & Schepers, 2018). The goal of this document is to present circular design principles for an infrastructure project like the InnovA58. Although this document was created during the initiation phase of the InnovA58, this document is not merely useful to this project, but can be used in future development or alteration projects as well. A general document in which the guidelines are presented on how to approach an infrastructure project from the perspective of circular economy helps the common understanding on the definition of a circular economy as well as on the application thereof. This creation of common understanding and the setting up of common goals by means of the circular design principles plays a role in the function of 'knowledge development'.

Within the Circular Infra Community, Common Goals was an issue which caused some tension between the actors, as the goals of the facilitating institution (de Bouwcampus) conflicted with the project assignment. The Bouwcampus values co-creation as the basis of all meetings facilitated by the institution, where the mindset of the participants is open; endless creative and innovative ideas can be thought of and the process is not limited by time. For the project's design process, this is quite different. Although it wishes to collect as many ideas as possible, time pressure is relevant, as the project deadlines are strict. This difference in goals can be summarized as the tension between concrete ideas, as is desired by the project's design process (the design of a circular design for the InnovA58) and abstract goals, which are desired by the Bouwcampus (the transition to a circular economy). This tension has a negative influence on the guidance of the search, as the tensions cause ambiguity in the upcoming process, as for the participants, it remains unclear concrete or abstract goals are strived for (Verweij, van den Burg, & Gugerell, 2018).

4.4.2 EARLY INVOLVEMENT OF SUPPLIERS

The early involvement of suppliers is seen as one of the ways to attain knowledge about innovations from the market. Within the InnovA58, the early involvement of suppliers plays a role in the first four functions of the TIS theory. This is also visible within the Circular Infra Community, as the participation of market parties was seen as a valuable contribution to the course of the Circular Infra Community. From the document analysis it can be concluded the early involvement of suppliers had a role in knowledge development and knowledge diffusion, as the main outcome of the Circular Infra Community was knowledge created and shared with all actors participating in this community (Bouwcampus, 2018). The role of the early involvement of suppliers on entrepreneurial activities and guidance of the search could not be confirmed by the document analysis.

4.4.3 COMMITTED PARTICIPANTS

The commitment of the participants is not only felt by the project team members, but also substantiated by participants of the Circular Infra Community. "What was striking to see was that the participants were all highly motivated and committed to get the best outcome out of these meetings. There is a lot of energy and willpower in the Circular Infra Community to do things considerably different. We want to transition to a circular economy, this is a huge challenge and will not take care of itself. Therefore you really need this enthusiasm and dedication" (Bouwcampus, 2018). This supports the insights attained from the interviews, as participants were found to be committed to the project and the circular ambitions of the project.

Within the Circular Infra Community, this commitment and enthusiasm greatly contributed to the willingness to create new, and diffuse the acquired knowledge, thus playing a role in the first two functions of the TIS theory. Also, the commitment of the participants could contribute to the creation of legitimacy, as enthusiasm and commitment can help in overcoming the difficulties faced in a transition hat are bound to occur. However, as the Circular Infra Community has stopped, this does not contribute anymore to the creation of legitimacy.

4.4.4 OPEN AND EFFECTIVE COMMUNICATION

The communication within the InnovA58 works on three different levels, of which the public participation was perceived to be very positive. Many public participation events were organized, as well as an online participation platform, to collect the wants and needs of the local residents about diverse ideas and concepts (Rijkswaterstaat, n.d.-c). The input local residents could give to the project team in the early phase of the project contributed to knowledge diffusion through networks and entrepreneurial activities, as the ideas generated by local residents could contribute to thinking outside of the box.

CHAPTER 5

Discussion

5 DISCUSSION

In the previous chapter, the findings were presented. This was done in a structured way, in which the findings regarding the elements of partnering were first discussed, where after the link between the elements of partnering and the functions of Technological Innovation System theory was made. This chapter, dedicated to the interpretations of the results presented in chapter 4, will follow the same structure. First of all, the analysis of the elements of partnering will lead to an interpretation of the presented results. Thereafter, again, the role of the elements regarding the functions of the fTIS theory is explained. At the end of this chapter, further insights and findings regarding the case study are presented. Together with chapter 4, this chapter fulfils the third and fourth step of the TIS theory, as both chapters focus on the link between the elements of partnering and the functions of the TIS theory. The insights attained from the case study correspond to the fifth step of the TIS theory. The analysis of the findings, together with the insights from the data, give an answer to the fourth and final subquestion of this research, namely: *"How can partnering enhance the transition to a circular economy in a Dutch infrastructure project?"*

5.1 INTERPRETATIONS: ELEMENTS OF PARTNERING

The question rises why some of the elements of partnering are perceived to be of importance to a project like the InnovA58, yet, are not fulfilled. This relates to the matrix as can be seen in Figure 29 in the previous chapter.

5.1.1 THE IMPORTANCE OF THE ELEMENTS OF PARTNERING

As can be seen in Figure 29, most elements of partnering can be found on the right side of the matrix, with slightly more elements presented in the lower part of the matrix. This indicates that the respondents of the case do generally see the benefit of the elements towards the circular economy ambitions of the project. However, a considerable number of elements are not, or only partly, visible within the case of the InnovA58. The fact that most of the elements are found to be important, can be easily explained. Literature describes all elements are of importance to a partnering project (Hosseini et al., 2018). Also, as most elements are describing positive relationship elements, it is unnatural for respondents not to agree. For instance, who would agree to the fact trust is not an important factor in collaboration towards any project goal? The elements of (7) Team Building Activities, (8) Structured Meetings/Workshop and (13) Open-Book Economy, are, within the InnovA58, not seen as highly important. In case of team building activities, this can partly be explained by the fact that several project team members already knew each other due to previous collaborations (personal communication, October 18, 2018). Therefore, the need to get to know each other was not seen by project team members. Due to the fact the respondents do not feel the element to be important, the added value of the element on the outcome of the project might be underestimated, as the respondents will only realise the positive outcomes it brought when it is not present anymore. In case the element wouldn't be present, the opinion of the respondents might change.

Another explanation is the fact that, due to the time pressure within the project, respondents felt the time dedicated to team building activities could have better been spent on dedication to the project goals (personal communication, September 11, 2018). This opinion was mostly shared with respondents only spending a few hours a week on the InnovA58, thus feeling time is very limited.

The importance of structured meetings/workshop wasn't seen this way by respondents as well. As the InnovA58 is currently in the explorative phase, the importance of the element might not yet be seen, as this only comes into play in the phase in which a contractor is involved. From that point on, the contract plays a bigger role in the relation between the stakeholders, and when the contract length will be limited to enhance partnering, structured meetings are more relevant to avoid opportunism. Literature underpins this, as Nyström (2007) mentions these meetings and/or meetings are mostly for the reason of creating trust and facilitating a time and place in which client and contractor can work together.

Respondents did not quite see the importance of an Open-Book Economy, as it is said it could be helpful to generate trust, but is nearly not as important as other elements (personal communication, October 23, 2018). As an open-book economy in the early phase of a project is not a given fact, it might be the case respondents do not see the actual benefit is can bring towards partnering.

5.1.2 THE PRESENCE OF THE ELEMENTS

Contradictory to the importance of the elements, only a few of the elements are clearly present in the InnovA58. The respondents agree actors in the project have defined (6) common goals, have engaged in (7) team building activities, and are dedicated to the project, thus having (10) committed participants.

6 Common goals were defined before commencement of the project. Although they are perceived to be outdated, they are clearly present in the InnovA58.

7 As mentioned in chapter 4, team building activities was the only element found to be less important in comparison to the presence of the element. The reason why actors have still engaged in team building activities regardless of them seeing the added value of it remains unknown, although a plausible explanation could be the actors feel socially responsible when another actor initiates team building activities.

10 The commitment of the participants in the project is high, as all actors are willing to take an extra step to make this project a success. This commitment could be explained by the fact that the InnovA58 is the first project in which circular economy ambitions are high. Therefore, this attracts actors within the collaborating institutions who are motivated to contribute to the CE transition.

Besides aforementioned elements, no other element of partnering were clearly found present in the InnovA58.

As the project is currently still in its early, pre-contractual phase, it can partly explain the fact why a considerable number of elements is not, or only partly visible in the project. Since no contractor has been awarded the project, no contractual agreements about the execution of the InnovA58 have yet been signed. The rules of collaboration in this stage of the proejct aren't as clear as at the stage the contracts have been signed. Furthermore, the innovation process which runs parallel to the project's timeline is not guided by project procedures and regulations. This is also explained in paragraph 4.14 and visually represented in Figure 27. The elements of Incentives, Pain/Gain share, Collaborative Contractual Clauses and Conflict Resolution are not yet defined, but, chances are these will be present in the InnovA58 once a contractor is involved in the project and the contract specifies these elements. Respondents were willing to set up conflict resolution clauses, as they mentioned they never thought of setting up these kinds of resolutions, however, this was considered to be stupid, as the benefits of it are clear.

Not all elements which aren't present in the InnovA58 can be attributed to the phase in which the project is currently in.

1 For instance, trust is an element independent of time, thus the reason why trust isn't an element of which the respondents are convinced present in the InnovA58 must be found somewhere else. Trust is a complex issue in which many factors play a role. In comparison to the other elements of partnering, trust is the least tangible element. Trust is not an element which can emerge in a moment, it needs to be built over time, and is not easily restored when damaged. Furthermore, trust between actors is also influenced by the reputation of the company of which the actors are working for. The organization's reputation clouds the decision of an actor who to trust (McDermott, Khalfan, & Swan, 2005). Both of the explanations come into play when analysing the level of trust within the InnovA58. Since the Bouwfraude in 2003, the level of trust in the entire construction and infrastructure industry hit a low. Although this is already a long time ago, trust is still developing today. This may also cause the level of trust to be not exceptionally high in the InnovA58. Furthermore, the reputation of Rijkswa-

terstaat plays a distinctive role as well. This factor can explain the observed difference between the internal level of trust and the external level of trust. The reputation of Rijkswaterstaat isn't perceived to be too good, for several reasons. For instance, respondents mentioned the organisation of Rijkswaterstaat is not transparent, making it hard to fully trust the organisation (personal communication, September 18, 2018). This is also found by a measurement study performed by the market research company of Ipsos into the reputation of Rijkswaterstaat, where only 37% of 272 market parties collaborating with Rijkswaterstaat felt the organisation is transparent. Another result of the measurement study was that only 57% of the respondents felt Rijkswaterstaat is targeting collaboration (Rijkswaterstaat, 2015b). These results partly explain the level of trust currently visible in the InnovA58, so room for improvement is there. However, as trust is such a complex issue, the level of trust is not easily increased. Time and dedication are needed, as well as effort to improve the reputation of Rijkswaterstaat, which will contribute to the level of trust between Rijkswaterstaat and external institutions and actors.

2 Among respondents, tension is felt regarding the common understanding in the project, especially between the innovation team and the rest of the project team, as the difference in way of thinking about the implementation of innovations in the InnovA58 hampers the transition to a circular economy. This is regarded as one of the main barriers to the contribution of the InnovA58 to the transition to a circular economy, as the focus of the higher management within Rijkswaterstaat on the Iron Triangle greatly hampers the innovations implemented in the InnovA58. This also has a negative influence on the commitment of the participants in the project team, as they feel let down by the higher management, and believe the focus on the Iron Triangle is in opposition to the goal set by Rijkswaterstaat to become fully circular in 2030. Full dedication to and common understanding of this goal must be prioritized over the foundations of the Iron Triangle, in order to make the InnovA58 a success (personal communication, November 5, 2018).

4 The fact that suppliers are not yet actively involved in the InnovA58, although this would contribute to the transition to a circular economy can be explained by multiple reasons. First of all, the most innovative ideas are usually generated by start-ups. Due to the size of the InnovA58, start-ups cannot be involved due to the risk it brings with it (personal communication, September 19, 2018). Secondly, due to the law in the Netherlands, chances are a supplier cannot join the tender phase anymore if they are involved in an earlier stage, due to non-competition clauses (Ministerie van Economische Zaken & Ministerie van Veiligheid en Justitie, 2012). Thirdly, suppliers are reluctant to share information in an early stage when no guarantee is given they will get something in return (personal communication, September 11, 2018, September 12, 2018, September 18, 2018).

9 Currently, no facilitator is involved in the design process of the InnovA58. As this is matter of choice by the project manager and its team, the absence of such a facilitator cannot be elaborated upon further. Respondents did favour the presence of a facilitator in the Living Lab, of which the plan of approach is currently written (personal communication October 23, 2018).

12 Open and Effective Communication is present in the InnovA58 to some extent. This element is closely linked to trust, as for the building of trust, honest communication is one of the main factors (McDermott et al., 2005). It was noticed the communication between the project team members was, in regular circumstances open and effective, and thus contributes to partnering. However, when setbacks occurred, stakeholders seemed to withdraw themselves from the frontline, as things suddenly were more challenging. This was found to be a remarkable observation, as participants did see the need for clear and often communication. The decrease in clear communication are believed to be caused by the size of the organisation and the high interests involved in the project (personal communication, October 23, 2018). Besides, in the communication between the project team of the InnovA58 and external stakeholders, there is believed to be room for improvement as well. As there is an infinite number of actors and institutions which could theoretically be involved in the InnovA58 project, a communication strategy would be beneficial to create and maintain the communication with external stakeholders. The lack of communication can also be attributed to personal misfunctioning of the project team members, though not intentionally. As the knowledge in the field of sustainability and circular economy is expanding so fast, the project team is contacted by many organisations or actors willing to be involved. Therefore, overview in the main actors in this process is lost, and communication suffers from that.

13 The lack of an Open-Book Economy, and the discrepancy between theory and practice in the early phase of the InnovA58 can be explained in two ways. First of all, again, the phase of the project plays an important role. With the lack of a contractor involved in the project, an open-book economy between client and contractor cannot yet be established. Furthermore, Witteveen+Bos has received a lump-sum payment for its services, thus ruling out the importance of an open-book economy as well. Second of all, the Dutch law prohibits the players in a project to share their books with the other stakeholders, as explained by several respondents (personal communication September 11, 2018; September 20, 2018).

14 Continuous Improvement has not been applied in the early phase of the process of the InnovA58, although respondents agree it can be highly beneficial to apply learnt lessons in the course of the process. One of the reasons why this hasn't been done is due to the fact that continuous improvement, or adaptive management, can change the scope of the project, as improvements are made. This alteration of the projects scope costs time, and it is believed this time isn't available. Also, the culture of Rijkswaterstaat makes continuous improvement difficult, as respondents say employees of Rijkswaterstaat usually fall back on old habits in case a difficulty arises, which is believed to bring the opposite of continuous improvement (personal communication, October 23, 2018).

15 Regular evaluation moments increase the sharing of knowledge, for instance about how to continuously improve. Also, the partnering process itself might be evaluated. However, in the InnovA58, no evaluation is currently undertaken. Again, experienced time pressure might cause the respondents to feel they have 'better things to focus on', however, the exact reason the team does not undertake evaluation is unclear (personal communication, October 23, 2018). The Deming Circle, or the Plan Do Act Check Cycle, is mentioned by external actors as a means to structurally carry out evaluation (personal communication, September 11, 2018; September 20, 2018).

5.2 INTERPRETATIONS: FUNCTIONS OF TECHNOLOGICAL INNOVATION SYSTEM

Following the interpretations of the elements of partnering, the functions of the TIS theory will now be elaborated upon. The interpretations are based on Table 5. Two striking observations can be done on the basis of this table. First of all, one can see the elements of partnering play a clear role in the first four functions of the TIS theory. No role of any of the elements was found in the fifth function, and the sixth and seventh function are only influenced by one and two elements of partnering, respectively. Second of all, one can see four elements of partnering were not linked to any of the functions of the transition theory, thus stating that in the scope of the case study performed, the elements of partnering had no role in the transition to a circular economy. In the following paragraphs, a deeper understanding of those two observations is created, to be able to explain why these observations are made and what this means in the broader sense of the research.

5.2.1 DISCREPANCY BETWEEN FUNCTIONS

The first four functions of the TIS theory are influenced by a considerable portion of the elements of partnering. This shows that partnering plays a role in the transition to a circular economy. Therefore, it can be concluded the elements of partnering cannot be explicitly divided between the functions of the Technological Innovation System, the functions of TIS and the elements of partnering are fluently interlinked within the first four functions of the theory. This means the elements of partnering cannot be seen independently from each other, as multiple elements play a role in more than one function. This is also true the other way around, the functions of TIS cannot be separated from each other, as functions are influenced by multiple overlapping elements of partnering.

Also, a clear division between the first four functions and the last three can be observed.

Function 1-4 and 5-7 – A clear division

A clear division can be seen in between the functions of one to four and the functions five to seven. Whereas the first functions are influenced by some to many of the elements of partnering, the latter functions are barely influenced, if at all. This difference in the extent to which the functions are exposed in the case study of the InnovA58 was already predicted in chapter 3. Luo et al., (2012) links the functions of Technological Innovation System to the stages of a transition. He explains that for the pre-development phase, knowledge development is the most critical system function. In the development phase, entrepreneurial activities is the most important system function. Those functions can be influenced by others, mostly by knowledge diffusion and guidance of the search. Therefore, in the early stage of a transition, these four functions deserve the most attention in a system analysis of a transition.

The Netherlands Environmental Assessment Agency stated in a report published in March 2018 that the transition to a circular economy in the Netherlands is currently in the start-up phase (Netherlands Environmental Assessment Agency, 2018). In the same report, the Netherlands Environmental Assessment Agency presented that the construction sector in the Netherlands, in comparison to other product categories like consumer goods of plastics, scored below average on the 10R ladder. Therefore, it can be concluded that the transition to a circular economy in the construction and infrastructure sector does, in any case, not score above average, and will thus not find itself in a later development stage of a transition than the average of all product or market categories. Therefore, the construction and infrastructure sector in the Netherlands is currently also in the (pre)development stage of the transition.

Thus, the fact that the first four functions are clearly present in the analysis of the case study, where the last three functions are barely represented, can be explained by the stage the transition is currently in. In the continuation of the circular economic transition, the functions (5) 'Market Formation', (6) Resources Mobilization, and (7) Creation of Legitimacy, are expected to come more into focus. Then, in later stages of the transition, the elements of partnering can have an influence on these functions, where it is not yet observed at this time.

Although the last three functions are currently not fulfilled in the InnovA58, the need for those functions is acknowledged by the respondents. For instance, regarding the function of market formation, the success of the Living Lab within the InnovA58 is seen as crucial for implementing innovations that contribute to the transition to a circular economy. Next to investments in human capital which are believed to be of importance to the Living Lab, the mobilization of financial resources is needed as well. The innovations related to the circular economy need an upfront investment, which will only be repaid later or in a different form. This upfront investment is currently not accounted for in the budget of the InnovA58. The last function, creation of legitimacy, is desirable since the public needs to accept the changes in the infrastructure sector, order for these changes to overtake the current regime in the market.

While the last three functions are not yet fulfilled in the InnovA58, the desire expressed by the respondents does show willingness to invest in the last three functions, however, this is not successful yet, due to the stage the transition is currently in. What this says about the role of partnering on the last three functions of the TIS is the following: when a function -in the case of the InnovA58 the last three functions- does not perform up to a certain level, so no distinctive role of partnering can be found, partnering cannot contribute to this function, thus is not able to create an impact on the transition to a circular economy. Within the case of the InnovA58, the only links that could be found, considering the last three functions, where negative of nature, and thus hampers the transition to a circular economy. This negative influence of the elements of partnering on those functions need to change, in order for partnering to contribute to the transition to a circular economy. However, it is highly probable this will only happen in a further stage of the transition.

5.2.2 DISCREPANCY BETWEEN ELEMENTS

As in the previous paragraph the difference in presence of the functions (columns of Table 5) have been elaborated upon, a remarkable observation can also be made in the presence of the elements of partnering in the functions (rows in Table 5). As can be seen, four elements of partnering are not found to be of influence on any of the functions of Technological Innovation System. This absence of these elements can be explained by several reasons. The most important reason is the current phase of the project. At time of writing, a contractor is not yet involved in the InnovA58. Therefore, some of the elements of partnering do not yet naturally occur in the collaboration between the stakeholders of the InnovA58, as these agreements simply have not been spoken about. As respondents mention, they assumed the 'Rijkswaterstaat way-of-working' was sufficiently helpful to support a positive working environment (personal communication, September 19, 2018). Literature supports this observation, as for instance Eriksson (2010) explains collaborative contractual clauses come into play in the contract formalization phase of a project when client and contractor write the appendices of a contract, in which the collaborative clauses are usually supplemented. The same is found for conflict resolution. Currently, the institutions working together, as described in the ecology of actors, work towards the common goal of writing the contract which will eventually lead to a collaboration between client and contractor. Therefore, as is usual, the conflict resolution clauses will only be relevant when the contract is signed (Colledge, 1992). Respondents did however see conflict resolution methods might be valuable in the pre-contractual phase, however, they have simply not thought about the option of setting up this resolution regulations (personal communication, September 12, 2018; October, 23, 2018). For incentives, pain/gain share, the explanation is somewhat different, as in financial terms, no pain or gain can yet be shared in the project. As Witteveen+Bos is involved in the project on the basis of a lump-sum payment, additional costs or financial benefits are not shared between the stakeholders (personal communication, September 20, 2018). Also, as the project is currently in the exploratory phase, no expenses are yet made regarding materials or human capital for the actual construction of the project. These expenses are considered to be the cost items in which the most uncertainty in terms of money is, therefore incentives or pain/gain share can improve collaboration between client and contractor when these expenses become the most important financial transactions. The last element which was not found to have an influence on any of the functions of TIS is open-book economy. Although this element is stated as one of the fifteen elements of partnering by Hosseini et al. (2018), this element is not applicable in projects in the Netherlands, as full openness in financial agreements is prohibited by Dutch law. Thus, no relation of this element could be traced back in the InnovA58.

The four elements which were found not to have an influence on the fTIS were unrelated to the functions due to several reasons. Next to the aforementioned reasons, a shared reason between the four of them is also due to the elements not (yet) present in the project of the InnovA58. When an element is not yet to be found, respondents could not provide much information about the element, and therefore, determining a relation between an element and one of the functions was not straightforward.

5.2.3 THE INFLUENCE OF THE ELEMENTS

The role of the individual elements on the functions of TIS are presented in Appendix F. To gain a deeper understanding of the role of partnering in the transition to a circular economy, per function, it will be evaluated whether the found elements of partnering influencing the function contributes to or suppresses the function evaluated. Of course, this can only be done for the 34 elements which were found to have a role in the transition to a circular economy. The roles will be evaluated as either positive (+), negative (-) or neutral (0), in which neutral represents the cases in which the elements do play a role, however, it does not directly affect the function of TIS.

Table 6 combines the results of the case study as represented in Table 5 and the perceived (positive, negative or neutral) influence on the functions according to the respondents.

A correlation can be seen between the presence of the elements (the colours of the rows in the table) and the influence of the elements of partnering on the functions of TIS. All elements which are positively fulfilled in the InnovA58 (represented by dark blue), which are (6) Common Goals, (7) Team Building Activities and (10) Committed Participants, also positively influence the functions of TIS in which they display a role. Therefore, these elements enhance the transition to a circular economy in the InnovA58. The elements of partnering which are only present dependent on the situation, (represented by blue), which are (1) Trust, (2) Common Understanding, (8) Structured Meetings, (9) Facilitator and (12) Open and Effective Communication, sometimes influence the functions of TIS positively, sometimes negatively and sometimes they are neutral. For instance, in the case of (9) Facilitator, respondents mentioned they did realize a facilitator would be beneficial for the InnovA58, however, a facilitator was not involved in the project, thus the current role of a facilitator could not be evaluated as positive or negative. Therefore, it can be concluded that putting extra effort in the elements of partnering currently not yet fulfilled in the InnovA58 can contribute to the transition to a circular economy, as the added benefits of those elements are recognized by the project team members, but not (yet) executed.

This interpretation is also supported by the negative to neutral influence of (4) Early Involvement of Suppliers on the functions of TIS, as respondents mentioned currently suppliers are not yet involved in the InnovA58, however, this would greatly contribute to all four of the functions the early involvement of suppliers currently has a role in.

The evidence is less convincing in the last two elements of partnering, namely (14) Continuous Improvement and (15) Continuous Joint Evaluation. Although the elements are, according to the respondents, not clearly visible in the InnovA58, they do positively influence the functions of TIS. This can be explained by the fact these elements are not fulfilled in the InnovA58, however, as this is the first project in its kind, future projects can benefit from the lessons learnt of the InnovA58, thus also positively influencing the functions of TIS.

Thus, generally speaking for the InnovA58, the elements of partnering which were found present in the case contributed to TIS, whereas the elements which were not present in the case negatively influenced the functions of TIS. Extra effort in realising the elements of partnering which are not yet present in the case will therefore enhance the transition to a circular economy.

▼ Table 6: ***The influence of partnering on the functions of TIS***

Elements of Partnering	1. Entrepreneurial Activities	2. Knowledge Development	3. Knowledge Diffusion Through Networks	4. Guidance of the Search	5. Market Formation	6. Resources Mobilization	7. Creation of Legitimacy	Present in InnovA58?
1. Trust	-	0	0	-				Dependent
2. Common Understanding	-	+	-	-				Dependent
3. Collaborative Contractual Clauses								No
4. Early Involvement of Suppliers	-	0	0	-				No
5. Incentives, Pain/Gain Share								No
6. Common Goals	+	+		+				Yes
7. Team Building Activities			+					Yes
8. Structured Meetings/ Workshop				0				Dependent
9. Facilitator		0	0	0				Dependent
10. Committed participants	+	+	+				-	Yes
11. Conflict Resolution								No
12. Open and Effective Communication		+	0	+		-	-	Dependent
13. Open-Book Economy								No
14. Continuous Improvement	0	+	0					No
15. Continuous Joint Evaluation			+	+				No

Functions of Technological Innovation System

5.2.4 THE QUICK WINS – HOW TO INFLUENCE THE INFLUENCE

In an ideal project in an ideal environment, Table 6 would be only present dark blue cells, as all elements of partnering would be present. Also, the influence of partnering on the functions would all be positive. Of course, this situation is not realistic, however, the comparison of Table 6 with the most ideal condition provides information on how the current situation can be improved to result in the highest possible impact.

A first observation that can be made is the fact that the element with the most negative influence on the functions of TIS should be focussed on at first. This would mean the project team should focus on the creation of (2) common understanding, the building of (1) trust and the (4) early involvement of suppliers in the project. However, the effort put into these elements might not generate the maximum impact, as the highest possible positive impact of each of the elements is unknown as well as is unique for every project. Therefore, a focus on the elements which currently negatively influence the function of TIS might not have the highest ratio impact/effort.

Literature present information which contributes to this discussion which elements should be focussed on. Although no specified general consensus can be found, the majority of scientific literature state the elements of trust, common understanding, open and effective communication and committed participants are the most important elements of partnering regarding the successful outcome of a project. These elements are found to be the most influential on project success (Chan et al., 2010; Gadde & Dubois, 2010; Hosseini et al., 2018; Nyström, 2007; Yeung et al., 2007). This also reflects within the InnovA58, as these elements are all significantly represented in the functions of Technological Innovation System, see Table 6. Therefore, the importance of these elements also applies to the transition to a circular economy. Paying attention to the most important partnering elements is not only beneficial to the project's success, but also in the contribution of the project to the transition to a circular economy. Therefore, these elements should be given priority in projects like the InnovA58, in order to generate the largest impact on the transition to a circular economy. How this can be done will be discussed below:

- Trust does not just occur, it must develop over time. Therefore, this element is next to being one of the most important to invest time in, also the most difficult to influence. By showing progress in the implementation of circular economic principles in the design process and involving external parties in the design process, the building of trust might be accelerated, as Rijkswaterstaat then shows its best intentions to external stakeholders. Also, trust is induced by other elements of partnering, such as open and effective communication, as this is one of the basic principles of building trust.
- The creation of common understanding is specifically important for the transition to a circular economy, as the definition of a circular economy is still debated upon, and many different definitions exist. This makes the discussion about the implementation of the circular economy challenging, as the lack of common understanding hampers the transition to a circular economy. It would be beneficial to the transition to a circular economy in the infrastructure sector if the common understanding of the concept of circular economy in this sector would be clear to all participants and stakeholders.
- Open and effective communication can bring a lot of impact on the transition to a circular economy, both directly and indirectly. As already discussed, open and effective communication contributes to the building of trust, which will positively influence the transition to a circular economy. Directly, there is still room for improvement in open and effective communication, especially in the communication with external parties. Therefore, improving the communication will positively influence the effect of communication on the functions of TIS, and thereby enhancing the transition to a circular economy directly.
- Committed participants is one of the elements of partnering which already have a clear positive effect on the functions of TIS, and thus on the transition to a circular economy. This applies to the project team members of the InnovA58, as they are willing to step up and put some extra effort into the project. However, the commitment of the higher management can still be improved, as currently this hampers the transition to a circular economy. Rijkswaterstaat can greatly improve this by fully dedicate to the transition to a circular economy and the goals Rijkswaterstaat has set itself, and propagate this within the entire organization.

5.2.5 THE THREAT OF THE IRON TRIANGLE

The Iron Triangle, consisting of schedule, budget and scope is the most widely used measure of project performance (El-Maaty, Akal, & El-Hamrawy, 2018). The higher management of Rijkswaterstaat also uses this tool to measure the success of their projects (personal communication, November 5, 2018). In the functions of TIS, the focus of the higher management on the Iron Triangle is perceived to be of negative influence, which reflects in multiple functions. For instance, the focus on the Iron Triangle negatively influences the guidance of the search, as the Iron Triangle shifts the focus from the implementation of a circular economy to the schedule, budget and scope. This also causes a negative effect on entrepreneurial activities, as usually they are costly, which a focus on the Iron Triangle withholds. Within the InnovA58, a negative influence of the Iron Triangle can also be evaluated in the functions of resources mobilization and the creation of legitimacy.
From this, it can be concluded the focus on the Iron Triangle is a threat to the transition to a circular economy. This is also explained by the respondents, as they feel their dedication to the innovation goals of the InnovA58 is not supported by the higher management. They are let down by the higher management as they feel they are running against a wall every time an innovative idea or plan is suggested by the project team (personal communication, October 23, 2018, November 5, 2018). This puts a strain on the course of the project, as project team members are willing to implement innovative ideas and put effort in this, however, they are constantly held back by the higher management due to the focus on the Iron Triangle. To Rijkswaterstaat, especially the schedule and budget of the project are important, as the budget is tight and higher management keeps a close eye on the planning of the project. This can be partly attributed to the risk-aversiveness of the infrastructure sector and the conservative nature of the organization of Rijkswaterstaat. The project team members of the InnovA58 try to change this nature of the organization as they do feel innovative projects implementing a circular economy can contribute to the task the government has given to Rijkswaterstaat. Respondents feel the conservative nature of Rijkswaterstaat causes the InnovA58 not to live up to the expectations the name provokes. This way, the InnovA58 might turn out to be a disappointment to the public, as well as to the project team members eager to make the InnovA58 live up to its name.

The threat of the Iron Triangle can only be averted by a change of mindset of the higher management of Rijkswaterstaat. Focusing on common welfare, social and environmental aspects might positively influence the success of the project, however, they are not reflected upon in the Iron Triangle. The concept of the Iron Triangle has already been in use since at least the 1950's, during those times, the influence of the linear economy on our planet was not yet widely acknowledged (Atkinson, 1999). Now times have changed, and the positive effects and the need of the implementation of a circular economy is clear, time has come traditional project managers, such as the higher management of Rijkswaterstaat, need to change their mentality towards a more environmental and innovation-oriented mindset.

5.2.6 THE VISIBLE EFFECT OF THE IRON TRIANGLE – LIVING LAB

The focus on the Iron Triangle reflects clearly in the InnovA58, practically speaking. Due to the tight budget and planning of the project, higher management feels innovations and investments in the implementation of circular economy are the first topics to shift to the bottom of the priority list. Naturally, this hampers the transition to a circular economy. This can be clearly seen in the development of the InnovA58 as well.
At first, the project team members believed the implementation of the circular economy would become visible in the entire InnovA58, hence, the Living Lab would stretch over the entire broadening of the highway. However, due to time and budget constraints, plans are slowly but steadily degraded to a clear division between the broadening of the highway and the Living Lab. Higher management now states only a resting area will become part of the physical area of the Living Lab, in which the project team can experiment with mew materials and other innovation beneficial to the circular economy (personal communication, November 5, 2018). The resting area is only a marginal surface area of the InnovA58, so project team members

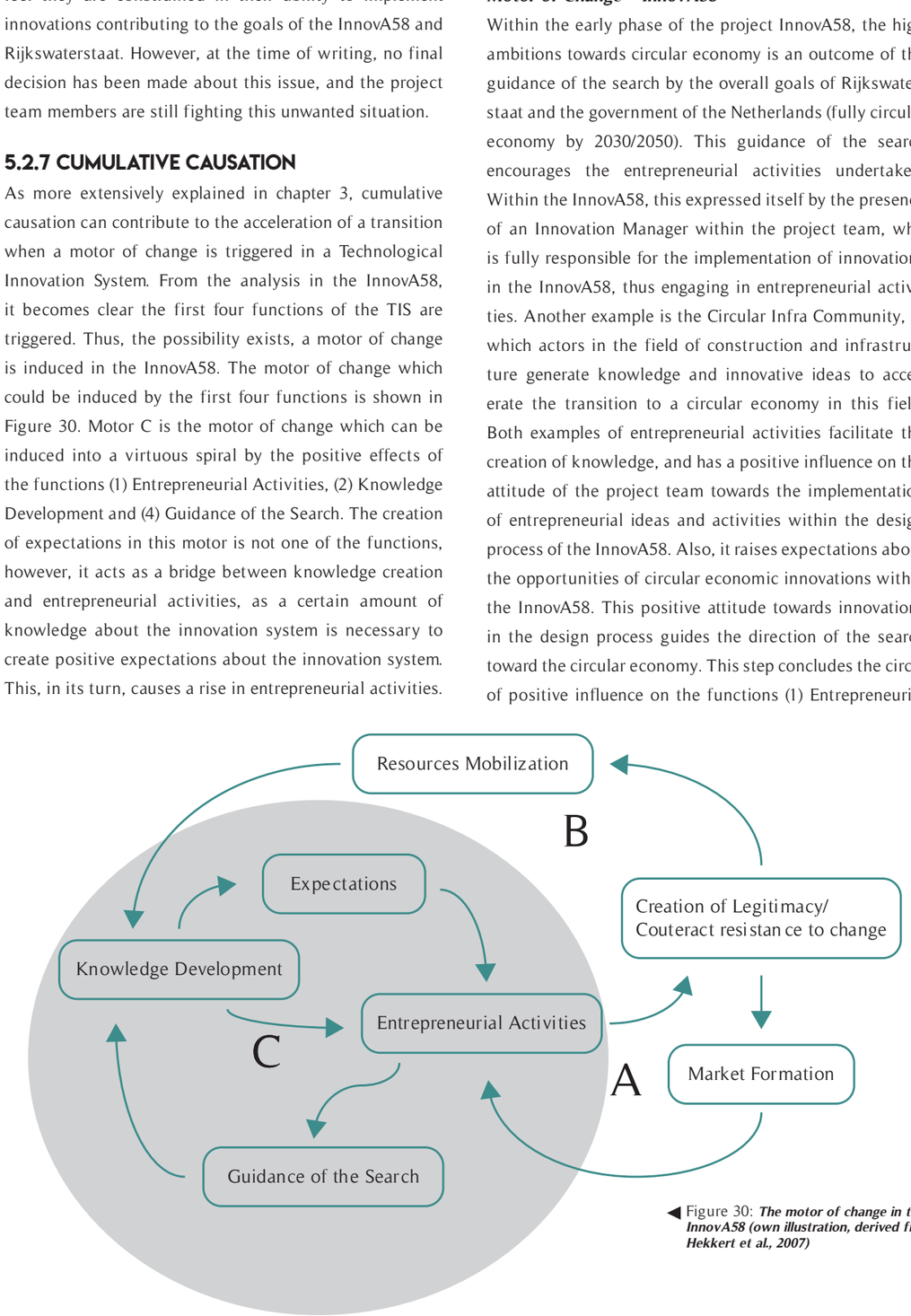
feel they are constrained in their ability to implement innovations contributing to the goals of the InnovA58 and Rijkswaterstaat. However, at the time of writing, no final decision has been made about this issue, and the project team members are still fighting this unwanted situation.

5.2.7 CUMULATIVE CAUSATION

As more extensively explained in chapter 3, cumulative causation can contribute to the acceleration of a transition when a motor of change is triggered in a Technological Innovation System. From the analysis in the InnovA58, it becomes clear the first four functions of the TIS are triggered. Thus, the possibility exists, a motor of change is induced in the InnovA58. The motor of change which could be induced by the first four functions is shown in Figure 30. Motor C is the motor of change which can be induced into a virtuous spiral by the positive effects of the functions (1) Entrepreneurial Activities, (2) Knowledge Development and (4) Guidance of the Search. The creation of expectations in this motor is not one of the functions, however, it acts as a bridge between knowledge creation and entrepreneurial activities, as a certain amount of knowledge about the innovation system is necessary to create positive expectations about the innovation system. This, in its turn, causes a rise in entrepreneurial activities.

Motor of Change – InnovA58

Within the early phase of the project InnovA58, the high ambitions towards circular economy is an outcome of the guidance of the search by the overall goals of Rijkswaterstaat and the government of the Netherlands (fully circular economy by 2030/2050). This guidance of the search encourages the entrepreneurial activities undertaken. Within the InnovA58, this expressed itself by the presence of an Innovation Manager within the project team, who is fully responsible for the implementation of innovations in the InnovA58, thus engaging in entrepreneurial activities. Another example is the Circular Infra Community, in which actors in the field of construction and infrastructure generate knowledge and innovative ideas to accelerate the transition to a circular economy in this field. Both examples of entrepreneurial activities facilitate the creation of knowledge, and has a positive influence on the attitude of the project team towards the implementation of entrepreneurial ideas and activities within the design process of the InnovA58. Also, it raises expectations about the opportunities of circular economic innovations within the InnovA58. This positive attitude towards innovations in the design process guides the direction of the search toward the circular economy. This step concludes the circle of positive influence on the functions (1) Entrepreneurial



◀ Figure 30: ***The motor of change in the InnovA58 (own illustration, derived from Hekkert et al., 2007)***

Activities, (2) Knowledge Development and (4) Guidance of the Search, with the help of creating expectations. Therefore, it can be concluded that within the InnovA58, cumulative causation takes place in the motor of innovation regarding aforementioned functions, therefore accelerating the transition to a circular economy. This motor of change is visualised in Figure 30 by the grey area, motor C. As the project is still in an early phase, the other functions of the TIS are not yet currently clearly expressed in the InnovA58. Therefore, no other motor of change is triggered at the time of writing. However, in further stages of the project, it might be possible motor A or B, as depicted in Figure 30, or even another motor of change which is not illustrated in the figure, might be induced, which may also contribute to the acceleration of the transition to a circular economy.

The elements of partnering also play a role in the cumulative causation within the InnovA58. Within entrepreneurial activities, six elements play a role in this function. The elements which contribute to the function of entrepreneurial activities thus also influence, although indirectly, to the other functions in the motor of change. This is also true for the other functions in which the elements of partnering play a role. Within the InnovA58, much room for improvement can be made regarding the elements of partnering, since a number of elements of partnering have a negative impact on the functions involved in the motor of change. Because of the virtuous cycle, improvements in the elements of partnering which hamper the transition to a circular economy represented in one of the three functions within the motor of change, can have a reinforcing effect on the transition to a circular economy.

A Future Motor of Change – Entire Transition Path

Focusing on the entire transition to a circular economy, not just within the scope of the InnovA58, the motor of change induced can also have a positive influence on the overall transition path of the circular economy. The entrepreneurial activities undertaken in the InnovA58 can guide the direction of the search in the infrastructure sector towards sustainable or circular innovations, as other projects see the InnovA58 as an example. This can, in its turn, increase public awareness, which causes players in the infrastructure market to explore the options regarding the circular economy, thus generating new knowledge on the matter. This raises the expectations of the possibilities and advantages of implementing innovations regarding circular economy in the infrastructure sector. With this, the cycle of the motor of change is complete again, thus accelerating the transition to a circular economy in the entire infrastructure sector.

This virtuous cycle which can be triggered in the entire infrastructure sector has not yet been empirically proved. However, it is expected the InnovA58 will positively contribute to this overall transition path, as Rijkswaterstaat intends the InnovA58 to be an example case for future projects to be undertaken. Setting an example for other projects triggers guidance of the search, and the cycle continues from this point of departure in the motor of change. From this prediction, it can be concluded the InnovA58 will positively contribute to the transition to a circular economy in the entire infrastructure industry. However, the extent to which the InnovA58 will accelerate the transition cannot be evaluated at this point in time.

5.3 FURTHER INSIGHTS

Besides the insights and conclusions relating to the fTIS theory as presented in the preious paragraphs, some other insights can be formulated as well. These insights can result in recommendations, both practically and scientifically, and therefore will be shard in the following paragraph.

5.3.1 AN ADDITION TO PARTNERING

The case study presented the list of elements of partnering used for this case study might not be exhaustive. The data gathered gave the insight some elements, other than the fifteen as presented by Hosseini et al. (2018), can also influence the transition to a circular economy.

The first of these newly found elements is culture. Several respondents mentioned the culture of the organizations, and especially the culture of Rijkswaterstaat, influence the partnering process and the transition to a circular economy. Rijkswaterstaat is seen as a very conservative organization, not very open for a change in way of working or collaboration. The 'Rijkswaterstaat way-of-working' ethos is deeply embedded in the organizations structure and its employees. This is partly because the culture of Rijkswaterstaat is, compared to other stakeholders in the case study such as Witteveen+Bos, very hierarchical (personal communication Novermber 5, 2018). Another factor that comes in play is that the higher management employees of Rijkswaterstaat are employed at the organization for a very long time, thus completely self-assured with the way of working and therefore not open to changes in management style. A last explanation is the fact that the organization of Rijkswaterstaat already exists for over 200 years, thus, the organizational culture is not easy to change (personal communication, October 23, 2018). The culture of Rijkswaterstaat is perceived to have a negative influence on the transition to a circular economy, as especially the higher management making the final decisions about the InnovA58 are reluctant to change and are risk aversive (personal communication, October 23, 2018). Although also employees of Rijkswaterstaat, the two project team members mostly responsible for the circular economy goals in the project see this, and try to fight this resistance to change by higher management. However, as the higher management has the final say, this is very difficult (personal communication, November 5, 2018).

The influence of culture on partnering is also acknowledged by literature. Similarities between partnering companies may contribute to success, and leader actions in support of partnering contribute to project success as well (Vidotto, Herzog, Leatherwood, & Sherlock, 2014). Jackson (2008) states that the organizational culture sets the stage for the relationship that is to develop. Therefore, a similar culture of the institutions working together have a better chance of fruitful collaboration. Within the InnovA58, there is room for improvement as the conservative and risk-aversive culture of Rijkswaterstaat hampers the transition to a circular economy.

It is realised the culture of an organization is very difficult to change, however, a start can be made by dedicated project managers, which might be able to change the culture within a project, bottom-up. These small changes in separate projects might together start the change in the entire culture of Rijkswaterstaat, although this change will take a long time.

A second elements which was found to be of influence within the InnovA58, but is not mentioned in partnering literature is the 'scope of collaboration'. Within a regular design process, the design starts by making the least detailed design decisions, such as the actual location of the broadening of the road, whereas in a circular design process, the details, such as the materials used, are of high importance from the beginning of the design process. This difference in approach to the same design challenge brings some friction, which the project team must pay attention to in collaboration, which might thus be described by the 'scope of collaboration'. At the beginning of a project, consensus needs to be reached on to which physical level of the project the actors and their institutions are collaborating.

5.3.2 IT'S ALL ABOUT HUMANS

Partnering is a theory which can contribute to the success of a project and the transition to a circular economy, which has been proven in previous paragraphs. However, it must not be seen as a panacea. The human factor in partnering must not been underestimated. For instance, the conflict resolution plan may be sound, a great facilitator may guide the partnering process and many team building activities are planned; however, when the actors working on the project are not intrinsically motivated to participate in the project, the project is destined to fail. This is -to some extent- captured in the element of committed participants, however, one can be completely committed to a project, but still lack enthusiasm to find the solution of the problem. This enthusiasm is needed for team members to work in an agile, adaptable and responsive way (Walker, 2002). This is especially true for the InnovA58, as an innovative project has many uncertainties which need to be dealt with by the team members. Therefore, project team members for a case like the InnovA58 need to be chosen by personal enthusiasm about the project, as this will greatly contribute to the project's success.

Also, the greater surroundings of the project have a great impact on the likeliness of success. To innovate in a project always brings risks with it, as well as unknown costs. These initial investments might be paid back, either in money or in benefits for the environment, however, there is always a chance an innovation will fail. Therefore, courage is needed not to choose for the easy way, and to fully dedicate to new and radical innovations. The support from higher management is required, as they must provide the necessary resources and authority for the innovations within the project to be implemented. This can be partly attributed to the elements of committed participants and the newly found element of culture, as the higher management must open up towards engaging in the unknown, as is needed for implementing innovations.

On an even larger scale, the surroundings in which the project finds itself also partly determines the project's probable success. Support from the government to innovate in a project like the InnovA58 does not only mean the government would be receptive to providing a larger budget to be used for (sustainable) innovations, but also gives the project team members recognition for the importance of there work, which will again positively influence their effort put in the project (Eisenberger, Fasolo, & Davis-LaMastro, 1990). Also public awareness regarding the sustainable challenges we face may influence project success, as they will be more likely to support the InnovA58, therefore less likely to object to the presented plans.

5.3.3 SIZE DOES MATTER

The InnovA58 is one of the largest highway alteration projects in the last decades of the Netherlands (Ministerie van Infrastructuur en Waterstaat et al., 2018). Not only in project scope, but also in financial terms. With size, complexity of the project rises as well, and thereby, the risks of the project. Taking your chances thus means a great amount of money is involved in such decisions. The focus on the Iron Triangle of the higher management plays a role here as well, as this focus also means being reluctant to uncertainties which can have great consequences. Respondents mentioned this as well, as they feel the size of the project negatively influences the probability of the implementation of innovations in the project (personal communication, September 18, 2018; September 20, 2018). A second effect of size on the transition to a circular economy is the size of the organization that is innovating. (Hueske & Guenther, 2015, p. 16) explain that "the older, larger, and more successful organizations become, the more likely they are to have a large repertoire of structures and systems which discourage innovation". As Rijkswaterstaat is seen as an organization which is old, large and successful, the structures embedded in the organizational structure discourage innovation in the projects. This is also backed by respondents, as they see the most innovative ideas are usually though of by start-ups, as their core business is to innovate and bring their products to the market, something Rijkswaterstaat is not used to (personal communication, September 19, 2018).

Furthermore, the use of process management might be beneficial in a project like the InnovA58. By the coupling of issues in the project, mutual ground can be found between stakeholders, thus committing to the issue willing to find the best solution (de Bruijn, ten Heuvelhof, & in 't Veld, 2014). This may also work in the InnovA58, as the sustainable challenges faced in this project might be coupled

with other project goals, creating common ground to which more actors would want to dedicate themselves to. However, process management might also cause a threat to the InnovA58, as it is based on the fact that when a project is approached from a process management point of view, the project is made bigger in order to find broader support for the project. However, the project of the InnovA58 is already perceived to be very large. One must be careful with applying a process management approach, as this might enlarge the project and increase complexity. Increasing complexity of the project also brings higher risks, which can eventually cause the project management to become even more risk-aversive, which will do no good to the innovativeness of the InnovA58.

5.3.4 LEVEL OF INFLUENCE

Above mentioned insights in the partnering process towards the transition to a circular economy are influenced on different levels. Some insight shared are influenced by the government, such as the creation of public awareness. Some insights are purely individual, such as the intrinsic motivation of the participants in the project. In the end, the success of the InnovA58 is dependent on three conditions; the project itself must be able, allowed and wanted. Without these three conditions, no project will have a chance of becoming successful.

Regarding the InnovA58, these three conditions can be infleunced by four layers, namely the government, Rijkswaterstaat, the project team and individual actors. This influence is explained below and presented in Table 7.

Able

The project team members must be able to perform their tasks which contribute to the project. For instance, human capital and financial resources are needed, as well as managerial support for the project. Without these elements, a project will never come about

Allowed

Some projects need alterations of laws and regulations in order for the project to succeed. Laws and regulations may be written in such a way, new radical innovations are not able to be put into use, due to, for instance, safety regulations. This hampers the implementation of innovations in a project like the InnovA58.

Wanted

The desire to innovate works in twofold. First of all, the project team members need to want to work towards the goals of the project, relating to commitment and intrinsic motivation. Second of all, the public must stand positively towards the project, as they can hamper the project by objecting to it. This has a negative influence on the course of the project and the innovations wanted to be implemented.

Whether the innovations implemented are able, allowed and wanted is influenced by different levels. The success of the project is influenced by the levels of (1) The government, (2) Rijkswaterstaat, (3) the Project Team, and by the (4) Individual Actors in the project team. An overview of the different levels whether the innovations implemented are able, allowed and wanted is presented in Table 7.

▼ Table 7: ***Able Allowed and Wanted***

	Able	**Allowed**	**Wanted**
Government		Laws and regulation must make it possible for the project team to carry out the project	Public awareness needs to be created in order for the public to want the project to be executed
Rijkswater staat	Higher management of Rijkswaterstaat needs to support the project by providing the resources needed		
Project Team	The project team needs to realise the InnovA58 is a unique case carried out for the first time, flexibility is needed to handle the project. External knowledge is needed, since this is not (yet) available within Rijkswaterstaat. The project team must acquire this knowledge.		Process management can help create (public) support for the project, however, the project team needs to take in mind process management can increase project complexity.
Individual Actors			Intrinsic motivation of the project team members is extremely important. The human factor comes into play in innovative projects. Without enthusiasm, commitment and intrinsic motivation, the setbacks that will come across will not be overcome. The courage to innovate is needed, this might be induced by other project team members or Rijkswaterstaat

CHAPTER 6

Conclusion

6 CONCLUSION

This study addresses the problem of the slow implementation of the ideas of the circular economy in the Dutch infrastructure industry. It focussed on the role of partnering in the transition to that circular economy in the Dutch infrastructure sector, which will contribute to the greater transition. To study this, a single case study was carried out, which is the first case in its kind trying to embrace the circular economy ambitions. This case is the InnovA58, a highway alteration project in Noord-Brabant, in the south of the Netherlands.
To focus on this problem, the following research question was formulated: *"What is the role of partnering in the transition to a circular economy in a Dutch infrastructure project with multiple stakeholders which has a circular economic ambition?"*

By means of a literature study and a case study, an answer was found to the defined research question. The case study consisted of 10 in-depth face-to-face interviews with 11 respondents, together with a document analysis of relevant documents regarding the InnovA58 and its design process. To be able to answer the research question, four subquestions were formulated and answered first. This report is built up in the structure of the subquestions. The subquestions were stated in the first chapter, where after four chapters were dedicated to answering those questions. This final chapter summarizes the answers of those subquestions, together with the answer to the formulated research question.
In the following paragraph, the subquestions are answered, where after the limitations of this study are presented. In the third and last paragraph, recommendations are formulated for further scientific research, for the project of the InnovA58 and for future projects. The recommendations contribute to the last step in the TIS theory, namely the sixth step. These recommendations, both practical and scientific, concludes this report and the research performed to the role of partnering in the transition to a circular economy in the Dutch infrastructure sector.

6.1 ANSWERS TO THE RESEARCH QUESTIONS

To break down the study into manageable pieces, four subquestions were formulated. In this paragraph, all four subquestions will be answered one by one, where after the research question will be answered.

6.1.1 SUBQUESTION 1: "WHAT IS MULTILATERAL PARTNERING AND HOW DOES IT BENEFIT TRANSITIONS?"

The first subquestion was formulated to gain background information on the subject focussed on in this study, namely, partnering.
A thorough literature study showed multilateral partnering can be explained by the following definition: 'Multilateral partnering is a long-term commitment of multiple stakeholders to closely collaborate, in order to successfully complete a project or specific business objectives, by making maximum use of the stakeholder's resources and qualities. In order to achieve (multilateral) partnerships, several components are a prerequisite, like trust and mutual understanding.'

The concept of partnering became used in the construction and infrastructure industry since the 1980's. Since then, popularity of partnering grew exponentially, until the Bouwfraude in 2003 negatively affected the relationship between the government and public parties. In the following years, distrust dominated the construction and infrastructure industry. In the decade thereafter, slowly but steadily, trust was restored and partnering became more popular than ever.

Furthermore, it was found partnering can be recognized in projects by the use of the following elements of partnering:

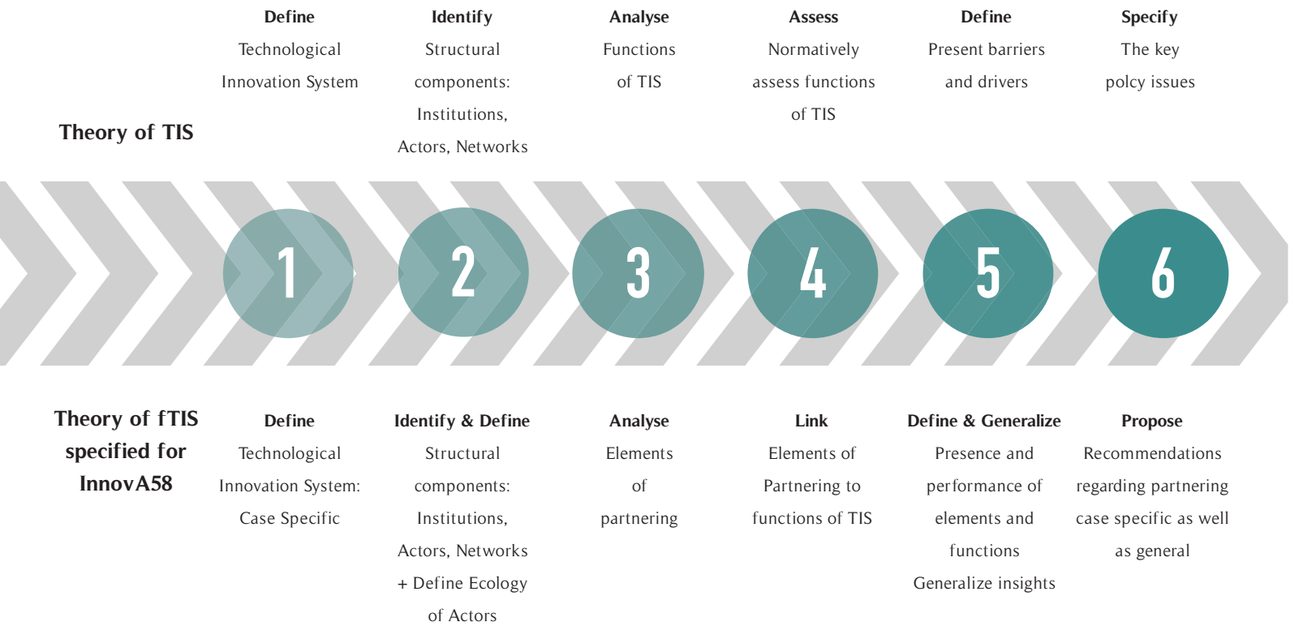
1. Trust
2. Common Understanding
3. Collaborative Contractual Clauses
4. Early Involvement of Suppliers
5. Incentives, Pain/Gain Share
6. Common Goals
7. Team Building Activities
8. Structured Meetings/Workshop
9. Facilitator
10. Committed Participants
11. Conflict Resolution
12. Open and Effective Communication
13. Open-Book Economy
14. Continuous Improvement
15. Continuous Joint Evaluation

A transition is a long and continuous process, which is disruptive in nature. Implementing radical changes in businesses and industries is a challenging task due to the uncertainties the actors have to deal with, as well as due to the unknown duration of the transition process.
Scientific literature presents four different transition theories used to describe and analyse transitions: Transition Management (TM), Strategic Niche Management (SNM), Multi Level Perspective (MLP), and Technological Innovation System (TIS). Following these transition theories, collaboration between stakeholders involved in a transition is of high importance. It is seen as the most important factor to transition successfully. Within the construction and infrastructure sector, partnering is seen as the ultimate form of collaboration. It is also known that effective cooperative relationships are a prerequisite for successful innovation within projects.
Therefore, forming (multilateral) partnerships in the infrastructure sector can benefit the implementation of radical changes in the sector, thus contributing to the transition to a circular economy.
Net to providing an answer to the first subquestion, the second chapter of this report also analysed all four transition theories, of which fTIS was found most applicable to create a practical framework to analyse the case study of the InnovA58.

6.1.2 SUBQUESTION 2: "HOW CAN A TRANSITION THEORY BE USED TO STUDY PARTNERING IN THE EARLY PHASE OF A DUTCH INFRASTRUCTURE PROJECT?"

The second subquestion was formulated to describe the methodology of the case study. Due to the uniqueness of the case, a specific methodology needed to be formulated on the basis of the transition theory chosen in chapter 2.
The theory of fTIS was used as a guideline to analyse the case study. A practical framework was created to perform the case study in a structured way. This framework used the theory of fTIS, together with the elements of partnering, as presented in chapter 2. The addition of partnering literature to the fTIS theory made it possible to study the role of partnering in the specific case study. The framework consists of six consecutive steps, as can be seen below in Figure 31. The upper row represents the original fTIS theory, the lower row presents the steps executed for this study. Several steps have been altered to fit the specific case study.

▼ Figure 31: ***Process flow framework of the case study methodology***



As this study tries to analyse the role of partnering within the functions of the TIS theory, the study focusses on steps 3 and 4 of the process framework as illustrated in Figure 31. Within those steps, the seven functions of the TIS theory will be assessed, and the role of the elements of partnering on those functions will be evaluated. These seven functions are: (1) Entrepreneurial Activities, (2) Knowledge Development, (3) Knowledge Diffusion Through Networks, (4) Guidance of the Search, (5) Market Formation, (6) Resources Mobilization, and (7) Creation of Legitimacy/Counteract Resistance to Change. Thus, the theory of functions of Technological Innovation System can be used to study the role of partnering in the early phase of the InnovA58, by following the consecutive steps of Figure 31, concentrating on the role of partnering on the functions of the TIS theory as described in step 3 and 4.

The information needed to assess the functions of the TIS theory will be collected by performing a case study. This will be a qualitative case study consisting of in-depth face-to-face interviews and a document analysis.

6.1.3 SUBQUESTION 3: "WITHIN THE EARLY PHASE OF AN INFRASTRUCTURE PROJECT, HOW DOES PARTNERING RELATE TO THE CHOSEN TRANSITION THEORY?"

Now the methodology has been described, the actual data gathering can take place. The data gathered provided the answer to the third subquestion.

Before the relation between the elements of partnering and the functions of the TIS theory could be found, the perceived importance and actual presence of the elements of partnering were evaluated within the InnovA58, as the attitude towards those elements was derived from this knowledge. In the further course of the study, this gave a deeper understanding of the insights gained from the case study. Twelve out of the fifteen elements of partnering were perceived to be highly important to a project like the InnovA58. The elements of (7) Team Building Activities, (8) Structures Meetings/Workshop, and (13) Open-Book economy were found to be important as well, however, only under certain circumstances. So, all elements contribute, either directly or indirectly, to a positive outcome regarding circular economy in an infrastructure project, in the opinion of the respondents. A notable observation was made however when these opinions were compared to the actual presence of the elements of partnering in the InnovA58. In this case, only three out of the fifteen elements of partnering were actually satisfactory fulfilled in the InnovA58. Respondents believed the other twelve could be improved upon.

The role of the elements of partnering on the functions of TIS could be clearly defined in the first four functions of the TIS theory. These four functions were all influenced by six to nine elements of partnering. The last three functions were not clearly influenced by the elements of partnering, as the fifth function was not found to be influenced at all, the sixth function was influenced by one element, and the seventh function was influenced by two elements. So, a clear discrepancy between the first four functions and the last three was observed.

Furthermore, the elements of (3) Collaborative Contractual Clauses, (5) Incentives, Pain/Gain Share, (11) Conflict Resolution, and (13) Open-book Economy were found not to have an influence on any of the functions of the TIS theory.

The role of each element of partnering was analysed for every of the seven functions. This resulted in an overview of 105 possible relations. Of those 105 possible relations, 34 of these relations were found present in the InnovA58. This means the role of the elements of partnering is at least present in those cases. This conclusion does not state the other 71 possible links are not there at all, this just doesn't show in the case study of the InnovA58. In any other case study, this conclusion might be different.

6.1.4 SUBQUESTION 4: "HOW CAN PARTNERING ENHANCE THE TRANSITION TO A CIRCULAR ECONOMY IN A DUTCH INFRASTRUCTURE PROJECT?"

The last subquestion was answered by interpreting the data gathered in chapter four. The data analysed showed that the elements of partnering which were, according to the respondents, present in the InnovA58, generally had a positive impact on the functions of the TIS theory they were related to. Therefore, these elements of partnering contribute to the transition to a circular economy in the Dutch infrastructure sector. Elements which were not (yet) positively fulfilled in the InnovA58, mostly negatively influenced the functions in which it was found to play a role.

The most important elements which should be payed attention to in order to enhance the transition to a circular economy are: (1) trust, (2) common understanding, (10) committed participants and (12) open and effective communication. Putting effort in improving the presence of these elements will have the most impact on the transition to a circular economy, as they are the most important elements for project success, according to literature. This is also reflected in the case study, thus leading to the conclusion that those elements are also the most important elements leading to maximum output regarding the transition to a circular economy. Overall, it can be concluded more effort in the performance of the elements of partnering in the InnovA58 will positively contribute to the functions of TIS, and by that, the transition to a circular economy. This effect is strengthened by cumulative causation, as a motor of change is a virtuous cycle. Thus, improving the performance of an element of partnering does not only directly contribute to the transition to a circular economy, but also indirectly by fuelling the motor of change currently triggered by the functions of TIS. This can be an extra motivation to focus on the elements of partnering to the project team members of the InnovA58.

Furthermore, it must be noted the transition to a circular economy is currently hampered by the focus on the Iron Triangle. The higher management should, next to the inevitable conditions of schedule and budget, also focus on common welfare, social and environmental aspects. This change in mindset will greatly contribute to the transition to a circular economy.

Thus, by focussing on the elements of partnering which will probably have the highest impact on the functions of Technological Innovation System, the InnovA58 can enhance the transition to a circular economy in the Dutch infrastructure sector. However, the contribution of partnering to the transition will only accelerate the transition when the project team is dedicated to implementing circular economic ideas. This is due to the fact that partnering is based on the interaction between the project team members and stakeholders. When not motivated to work together toward the common goal of realising a circular economy, even partnering will not provide the magical solution.

6.1.5 RESEARCH QUESTION: "WHAT IS THE ROLE OF PARTNERING IN THE TRANSITION TO A CIRCULAR ECONOMY IN A DUTCH INFRASTRUCTURE PROJECT WITH MULTIPLE STAKEHOLDERS WHICH HAS A CIRCULAR ECONOMIC AMBITION?"

The answers to the four separate subquestions served as a systematic breakdown of the main research question. Now the answers are found on those subquestions, the main research question can be answered as well.

Partnering has a definite role in the transition to a circular economy in the InnovA58. Out of the 105 possible combinations of the seven functions of TIS theory and the 15 elements of partnering, 34 combinations could be found in which an element of partnering played a role in a function of the theory of TIS. Some of these roles had a positive influence on the functions of TIS, thus enhancing the transition to a circular economy, some of them had a negative impact, thus hampering the transition. A general overview of the perceived influence of the elements of partnering on the functions of TIS is summarized in Table 8. The + signs depicts the positive influences of partnering and the – sign represents the negative influences. The 0 illustrates the cases in which the elements do play a role, however, it does not directly affect the function of TIS. The full explanation of the role of the elements of partnering on the functions of TIS can be found in Appendix F.

The influence correlates with the presence of the elements in the InnovA58, as generally, the elements present in the case positively influenced the functions of TIS and vice versa.

The role of partnering could, up until the point of writing, only be distinctively established in the first four functions of the TIS theory. Since the InnovA58 is still in the early phase of the transition, the last three functions are not yet fulfilled up to a point of full recognition, so it was proven to be impossible to describe the role of most of the elements of partnering in those functions. This was in accordance with scientific literature, as research states the first four functions are of importance in the early phase of a transition, in which the transition to a circular economy is currently in, whereas the last three functions come into play in the later phase of a transition.

Furthermore, it was found that the list of elements used to describe partnering in an innovative project like the InnovA58 might not be exhaustive. From the case study, it can be concluded the element of culture might be influential on the partnering process and thus on the transition to a circular economy. The 'scope of collaboration' might also be a valuable addition to the elements of partnering, especially in a project in which circular economy ambitions are high, due to the discrepancy in the design process of a 'traditional design process' and the design process focused on circular economy.

Although the role of partnering is evident and it contributes to the transition to a circular economy, partnering is not a panacea. The human factor in partnering must not be underestimated. Intrinsic motivation to make the project a success and enthusiasm for the ambitions of the project are proven to be very important to the implementation of the ideas of a circular economy. Partnering can prescribe the way of working together, however, without the effort of the actors in the project team, the outcome of the project will never exceed -or even reach- expectations.

▼ Table 8: ***Summary of the role of Partnering on the functions of TIS for the InnovA58***

Elements of Partnering	Functions of Technological Innovation System							
	1. Entrepre-neur-ial Activities	2. Knowledge Develop-ment	3. Knowledge Diffusion Through Networks	4. Guidance of the Search	5. Market For-mation	6. Resources Mobilization	7. Creation of Legitimacy	Present in InnovA58?
1. Trust	–	0	0	–				Dependent
2. Common Understanding	–	+	–	–				Dependent
3. Collaborative Contractual Clauses								No
4. Early Involvement of Suppliers	–	0	0	–				No
5. Incentives, Pain/Gain Share								No
6. Common Goals	+	+		+				Yes
7. Team Building Activities			+					Yes
8. Structured Meetings/ Workshop				0				Dependent
9. Facilitator		0	0	0				Dependent
10. Committed participants	+	+	+				–	Yes
11. Conflict Resolution								No
12. Open and Effective Communication		+	0	+		–	–	Dependent
13. Open-Book Economy								No
14. Continuous Improvement	0	+	0					No
15. Continuous Joint Evaluation			+	+				No

6.2 LIMITATIONS

As in any research, the limitations of the research need to be evaluated, to determine the actual value of the conclusions of the study. Therefore, the limitations regarding the literature study, the choice of the theory and the case study will be evaluated, where after the general limitations are presented, together with the limitations regarding the interpretations of the qualitative data.

6.2.1 LITERATURE STUDY

Although a thorough literature has been conducted for this study, a limitation became apparent during the execution of the literature study regarding the availability of scientific resources. Many scientific articles are published about the separate topics of partnering, the circular economy and transition theories. However, this is the first study to combine these topics of interest. Therefore, the relation between partnering and the transition to a circular economy in the construction and infrastructure sector is subjected to some extent of bias of the researcher.

6.2.2 CHOICE OF THEORY

For this study, the theory of functions of Technological Innovation System was found as the most useful theory to provide an answer to the research question. However, this presents a limitation as well. In case another theory had been chosen, the outcomes of the study would have been different as well. This also applies to the elements of partnering, as the decision to choose the list of fifteen elements by Hosseini et. al. (2018), steered the cases study towards a research only focussed on these elements. Choosing a different explanation of the concept of partnering would have influenced the outcomes of this study.

6.2.3 CASE STUDY

Due to the InnovA58 being a case that is the first of its kind, this research revolved around a single case study. Because of this study being a single case study, no comparison to other cases could be made. Therefore, all given conclusions and insights are based on one source of data. If other cases would have been present and studied as well, the conclusions could have been somewhat different. The found role of partnering in 34 of the possible relations could be explained, however, more or different relations could have been found in case other project was studied.

Also, due to partnering being an interaction between stakeholders, the data was mainly obtained from interviews. As evidence about the presence of some of the elements of partnering could not be found in project documents, not all outcomes of the study could be validated by a secondary source of data.

Furthermore, as the project of the InnovA58 is currently in the early phase of the project, no conclusions can be given on the later stages of the project.

The environment in which the project is executed might have influenced the outcomes of the study, as respondents mention collaboration is somewhat easier in Brabant, due to the culture of this province in the Netherlands. This might mean the way individuals work together in the InnovA58 might already be a form of partnering. This might cause competition between partnering as interpreted in this study, and the culture in the province of Brabant. This might negatively influence the viability of the conclusions drawn in this study.

Lastly, this study was conducted in the Dutch infrastructure sector, outcomes could have been different if the same research was performed in another country or continent.

6.2.4 GENERAL LIMITATIONS

Due to time constraints of this research, as well as the limited amount of time of the project team members of the InnovA58, two respondents who were desired to interview were not spoken during the course of this study. They could have provided some insights which are currently not included in this study.

Although the role of the researcher was anticipated before start of the case study, some bias is inevitable. Many of the conclusions and insights of the study are based on the interpretation of the researcher, therefore, in case this study was performed by somebody else, the conclusions might deviate a slightly from the conclusions in this report.

The research was conducted at the engineering company of Witteveen+Bos. Therefore, some of the data used were made available by this company and might have influenced the outcome of the study. Furthermore, due to confidentially reasons, documents of Rijkswaterstaat were not included in this study.

6.2.5 INTERPRETATIONS OF QUALITATIVE DATA

The role of the elements of partnering on the functions of the TIS theory were evaluated on the basis of the case study. Due to the qualitative approach of the case study, this evaluation is subjected to the interpretation of the researcher. The table which presents the positive, negative or neutral influence of the elements of partnering on the functions of TIS (Table 6), is the result of a second layer of interpretation of the researcher, as interpretations from the interviews were made on the basis of Table 5. Therefore, the outcomes and conclusions based on this table are, relatively speaking, somewhat subjective of nature.

6.3 RECOMMENDATIONS

On the basis of the entire study conducted, several recommendations can be formulated. These recommendations will be of scientific and practical nature and will be explained below.

6.3.1 SCIENTIFIC RECOMMENDATIONS, FURTHER STUDY

As this study is one of the first attempts to find the role of partnering in the transition to a circular economy, further study on this topic is highly advised:

- As currently the InnovA58 is the only project in its kind, it would be very interesting to study the role of partnering in the transition to a circular economy in other projects in the near future.
- The transition to a circular economy is currently in an early stage. This resulted in some specific outcomes regarding the case study, such as the lack of fulfilment in the last three functions of the TIS theory. When the transition to a circular economy has reached the stabilization phase, future studies could investigate whether the last three functions of the TIS theory are fulfilled in infrastructure projects like the InnovA58 taking place at that time. This would strengthen the scientific knowledge on fTIS theory. Of course, the role of partnering would be interesting to investigate at that point in time as well.
- The InnovA58 is currently in the pre-contractual phase. Therefore, some of the elements of partnering were not yet fulfilled in the InnovA58. Future studies in the continuation of the project may be able to link these elements of partnering to the functions of the TIS theory. Also, the influence of partnering currently found could change over time and would be very interesting to follow.
- As this study was qualitative of nature, no quantitative conclusions could be drawn. Therefore, future studies could focus on a quantitative analysis of data of the InnovA58 and similar future projects.

6.3.2 PRACTICAL RECOMMENDATIONS

Next to the scientific recommendations, there are some practical recommendations as well. These recommendations are specified as recommendations for the further course of the InnovA58, and for future projects initiated in the near future in the Netherlands.

Recommendations for InnovA58

- As support from higher management is found to be very important, it is advised the higher management of the InnovA58 realise the opportunities the circular economy can bring, and act accordingly. Therefore, a change in mindset is needed regarding the Iron Triangle. The higher management of Rijkswaterstaat must recognize the success of a project is influenced by more elements that just the three of the Iron Triangle (schedule, budget, scope). The benefits of innovation in a project like the InnovA58, as well as a focus on implementing the ideas of a circular economy must become of importance to the higher management.
- Another, however related, realization Rijkswaterstaat must embrace, is the fact the goals of the government and the even more ambitious goal Rijkswaterstaat has set itself (fully circular in 2050/2030), will not be met when innovations in infrastructural projects like the InnovA58 are not fully given a chance, which is currently the case due to the focus on the Iron Triangle. Radical changes are needed, and this can only be achieved by embracing those changes in all sectors, thus also in the infrastructure sector. Rijkswaterstaat therefore needs to take more risks that benefit the transition to a circular economy.
- As the elements of partnering which are found present in the InnovA58 mostly had a positive influence on the transition to a circular economy, it can be concluded the more elements of partnering are present, the more positive influence of partnering on the transition to a circular economy. Therefore, it is advised the InnovA58 project team makes itself familiar with the theory of partnering, to be able to incorporate the elements of partnering in the InnovA58.
- Literature states (1) trust, (2) common understanding, (10) committed participants, and (12) open and effective communication are the most important factors in successfully completing a project. This is also reflected in the case study of the InnovA58, however, these elements do not all have a positive influence on the functions of TIS. Therefore, it is advised the project team members firstly focus on these elements of partnering, where after the other elements must be put effort into.
- Specifically for the transition to a circular economy, the creation of common understanding in the InnovA58 is of high importance, due to the ambiguous nature of the explanation of the concept. Thus, the project team of the InnovA58 should pay specific attention to this element of partnering.
- As concluded, partnering can be very beneficial but is not a panacea. It is important the project team realises the actors in the project have a great influence on the outcome of the project. Therefore, they must make sure the actors involved in the project are intrinsically motivated to make the project a success. Employees of any participating company must be invited to the project based on motivation and enthusiasm towards the InnovA58 and its project goals.
- Knowledge development and knowledge sharing are two very important functions in the transition to a circular economy, they are both represented as a function of TIS. The creation and diffusion of this knowledge must therefore be one of the key goals for the project team members of the InnovA58. Also, external companies can provide much information. A triple helix collaboration between the market, knowledge institutions and governmental organizations can be beneficial to these functions regarding knowledge.
- External companies willing to collaborate must be welcomed with open arms, as they can provide much information. The inclusion of Bouw Circulair in the process is an example of this.
- The facilitator in the Circular Infra Community was perceived to be of added value to the process. The possibility of involving a facilitator in the process of the InnovA58 can be considered.
- Suppliers willing to innovate can contribute to the design process of the InnovA58. Although it might be difficult to involve suppliers in the pre-contractual phase of the project due to regulations, the project team can investigate to what extent it is possible to involve suppliers early on in the design process.

Recommendations for future projects in early phase of the project

- From this study, it became clear partnering can be of positive influence on the transition to a circular economy. Future infrastructure projects aiming for circularity can therefore use partnering to their advantage. It is recommended project teams involved in a project which desires to implement circularity make themselves familiar with the use of partnering in an infrastructure project. This can be done with the help of a facilitator which has experience with the implementation of partnering in an infrastructure project.
- Lessons learnt from the InnovA58 can help new projects realise the barriers faced in the early phase regarding the implementation of circularity. This also contributes to the third function of TIS, knowledge diffusion through networks, in the entire transition to a circular economy.
- As this study presented, the enthusiasm and intrinsic motivation of project team members is very important to the success of the project, especially for the implementation of innovations. Project team members should therefore not only be selected by their availability in their agenda, but also by personal motivation and enthusiasm for the project and its project goals.

Recommendations for Witteveen+Bos

- As Witteveen+Bos also has an advisory role in projects, they can advise projects with specific circular ambitions to engage in partnering. By being an expert in the field of partnering and the added value it can bring to the implementation of circular economy in infrastructures, Witteveen+Bos may be involved in more projects in the field of circular economy.
- Witteveen+Bos can, as an expert in partnering, also support projects in the time management of the elements of partnering. As some of the elements of partnering cannot yet be fulfilled from the beginning of the project, it is a waste of energy to try and fulfil those elements. A clear overview of which elements of partnering to focus on in every stage of the project can, together with advice on this topic, be beneficial to many (future) projects of Witteveen+Bos
- As this is the first scientific study to the role of partnering in the transition to a circular economy, many follow-up studies can be executed. For instance, the abovementioned recommendation, an overview of which elements to focus on in different stages of the project has not yet been created. Witteveen+Bos can facilitate future studies which will contribute to the more practical side of this research.

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APPENDICES

APPENDIX A - RESPONDENTS

#	Job title	Organisation
1	Policy advisor circular economy and sustainability	Municipality of Tilburg
2	Chairman	Bouw Circulair
3	Chairman	Bouw Circulair
4	Policy advisor sustainability	Municipality of Breda
5	Process Manager, responsible for InnovA58	Metropolitan Region Eindhoven
6	Circular Economy expert	Witteveen+Bos
7	Environmental Consultant and Engineer	Witteveen+Bos
8	Trainee	Rijkswaterstaat
9	Innovation Manager InnovA58	Rijkswaterstaat
10	Cunsultant Sustainable Energy	Municipality of Eindhoven
11	Circular Economy Responsible InnovA58	Rijkswaterstaat

APPENDIX B - INTERVIEW PROTOCOL

Introductie	
Introductie van interviewer, CME TU Delft	Praktische informatie + rapport
Relatie met Witteveen+Bos, RWS	
Doel van het onderzoek en interview	
Duur van het interview	
Vertrouwelijkheid informatie: naam en toenaam wordt niet genoemd in verslag of ander document	
Opzet van het interview (3 delen)	
Akkoord met opnemen?	
Vragen?	
DEEL I (5 min)	
Algemene informatie	
Achtergrond respondent, welk bedrijf, hoelang al werkzaam etc.?	Meer informatie over de respondent
Functie respondent	
Dagelijkse werkzaamheden	
InnovA58	
Hoe en wanneer bent u betrokken geraakt bij de InnovA58?	Informatie ophalen in hoeverre de respondent is betrokken bij het project, algemene indruk van het project
In welke mate betrokken bij InnovA58?	
Wat is uw rol binnen het project? / Waar bent u voor verantwoordelijk?	
Wat denkt u over het project (algemeen, maar ook betreft samenwerking en de implementatie van CE)?	
DEEL II (20 min) **Partnering**	
Bekend met het concept Partnering? Vanaf nu zal het interview zich vooral richten op partnering, hoe dit tot stand is gekomen in het project en hoe u dit ervaart.	Concept Partnering, aanwezigheid in InnovA58, elementen beschrijven
Wat vindt u van de samenwerking momenteel binnen de InnovA58?	
Uit literatuur volgt de volgende lijst van elementen die partnering beschrijven > zie tabel > Verdere vragen aan de hand van de tabel	

DEEL III (30 min)	
Tijdlijn van gebeurtenissen m.b.t. partnering	
Ik kijk voor mijn onderzoek graag naar het proces in het project, hoe dit is verlopen en welke gebeurtenissen hebben plaatsgevonden op het gebied van partnering. Na mijn interviews zal ik met behulp van event mapping inzicht proberen te krijgen in het proces van samenwerking binnen de InnovA58 en hoe zich dit verhoudt tot de transitie naar een circulaire economie.	Tijdlijn opzetten met behulp van de elementen van partnering, belangrijke momenten en verloop van opzetten grondstoffencorridor.
Kunt u (wellicht met behulp van de lijst van elementen) aangeven wanneer momenten van partnering hebben plaatsgevonden in het project van de InnovA58 tot het heden? Hoe zijn alle partners binnen dit project betrokken, hoe verloopt de samenwerking, wanneer en hoe zijn nieuwe partijen aangesloten?	
Wie waren er bij deze momenten (bijeenkomsten, gesprekken, etc) betrokken, waarom, wat was het doel van dit moment?	
Welke stappen zijn tot nu toe gezet om de grondstoffencorridor op te zetten? Zijn die binnen de tijdslijn te plaatsen?	
Draagt deze manier van samenwerking bij tot het implementeren van CE binnen de InnovA58?	
Open vragen	
Op welke momenten wordt er duidelijk dat er gewerkt wordt aan een circulair/zo duurzaam mogelijk ontwerp?	Vragen over verloop CE-transitie
Draagt, volgens uw mening de InnovA58 bij aan de gehele transitie naar een circulaire economie? Zo ja, waarom?	
Wat kunnen toekomstige projecten leren van de InnovA58?	
Verdere vragen/einde van het interview	
Wilt u nog andere zaken over dit onderwerp bespreken?	Ruimte voor vragen gerelateerd/niet gerelateerd aan dit onderzoek.
Heeft u nog vragen voor mij, over het onderzoek of het verdere verloop?	
De transcripten zullen geanonimiseerd worden en aan u toe worden gestuurd ter goedkeuring.	

Partnering in the transition to a circular economy in the Dutch infrastructure sector
Agenda

Introductie: (5 min)

Introductie interviewer

Introductie respondent

Introductie InnovA58 (Hoe bent u betrokken bij de InnovA58?)

Partnering: (20 min)

1. Bent u bekend met het concept partnering?
2. Wat vindt u momenteel van de samenwerking binnen de InnovA58, met betrekking op de circulaire doelstellingen van de InnovA58??
3. Kunt u de tabel invullen (andere A4) invullen?

Tijdlijn: (30 min)

Ik stel aan de hand van mijn interviews graag een tijdlijn op van alle, kleine of grote, momenten binnen het project van de InnovA58 waar elementen van partnering plaatsvonden. De tabel mag, (maar hoeft niet) gebruikt worden.

1. Kunt u aangeven welke momenten in de tijd belangrijk waren voor de samenwerking (Partnering) binnen het project?
2. Wie waren er bij die momenten betrokken, hoe verloopt de samenwerking, wanneer zijn partijen aangesloten, etc.?

Open vragen/afsluiting: (5 min)

1. Wat kunnen toekomstige projecten leren van de InnovA58?
2. Heeft u nog vragen/zijn er nog andere onderwerpen die u wilt bespreken?

WVTTK

Elementen van Partnering uit de literatuur	Welke elementen herkent u en beschouwt u als belangrijk in een project waar CE-doelstellingen de hoofdrol spelen? JA/NEE	Waarom?	Welke elementen zijn in het project InnovA58 te herleiden? JA/NEE	Is er verschil tussen kolom 2 en kolom 4? Zo ja, hoe denkt u dat dit komt?
Trust				
Common Understanding				
Collaborative Contractual Clauses				
Early Involvement of Suppliers				
Incentives, Pain/Gain Share				
Common Goals				
Team-Building Activities				
Structured Meetings/ Workshop				
Facilitator				
Committed Participants				
Conflict Resolution				
Open and Effective Communication				
Open-Book Economy				
Continuous Improvement				
Continuous Joint Evaluation				

APPENDIX C – QUOTATION REPORT EXAMPLE

ATLAS.ti Report

InnovA58

Quotations

Filter:
All quotations which must match all of the following rules
Is coded with Code "Early involvement of Suppliers"
Is coded with Code "Knowledge Diffusion through Networks"

Report created by Annemieke Vlaming on 21 Nov 2018

7:22 Dan ben je RWS en dan moet je toch gewoon iets kunnen bieden. Dan moet je toch gewoon kunnen zeggen…

Coding:
- Continuous Improvement
- Early involvement of Suppliers
- Incentives, Pain/Gain Share
- Knowledge Development
- Knowledge Diffusion through Networks
- Open and Effective Communication
- Trust

Content:

Dan ben je RWS en dan moet je toch gewoon iets kunnen bieden. Dan moet je toch gewoon kunnen zeggen dat mensen die deel namen aan de community die krijgen een privilege of die krijgen een voordeel. Misschien niet in dit project maar in iets anders. Dat je zegt we bouwen een website met echt goede informatie en kennis en alleen de mensen die hebben meegewerkt mogen daar op. Weet ik veel, bedenk iets. Of bedenk gewoon iets gaafs om de mensen te belonen. Zo iets van hoe meer kennis je deelt in het voortraject hoe meer punten je krijgt en dat je dat op je gunnigsvoordeel krijgt.

4:14 Dat soort dingen, en die ontstaan door zij zeggen van wij willen meer beton granulaat toevoegen, dan…

Coding:
- Common Goals
- Continuous Improvement
- Early involvement of Suppliers
- Guidance of the Search
- Incentives, Pain/Gain Share
- Knowledge Diffusion through Networks
- Open and Effective Communication

Content:

Dat soort dingen, en die ontstaan door zij zeggen van wij willen meer beton granulaat toevoegen, dan zeggen zijn dit willen wij ook wel want dat is technisch mogelijk, maar het is niet voorradig. En dan zeggen zij weer van jullie hebben de beschikking over dat beton want jullie laten een hele boel slopen en straten die open liggen, en wat gaan we met die materialen doen? Ja dan zeggen we dat weten we eigenlijk niet. Ja als jij het al niet weet waarom kom je dan bij mij. Zo ga je in gesprek en zo kom je langzamerhand kom je tot een uitkomst.

2:7 Early involvement of suppliers is ook wel belangrijk, maar er zitten ook wel weer kanttekeningen aan…

Coding:
- Early involvement of Suppliers
- Guidance of the Search
- Knowledge Diffusion through Networks

Content:
> Early involvement of suppliers is ook wel belangrijk, maar er zitten ook wel weer kanttekeningen aan. Je moet wel de juiste aan tafel hebben, en ze zitten er nooit onbevangen zeg ik altijd, iedereen wil er iets aan overhouden.

1:11 Early involvement of suppliers wel. Die is wel lastig want ze willen vaak hun kennis niet delen zond…

Coding:
- Early involvement of Suppliers
- Knowledge Diffusion through Networks

Content:
> Early involvement of suppliers wel. Die is wel lastig want ze willen vaak hun kennis niet delen zonder dat er iets voor terug krijgen.

Comment:
> Kennis niet willen delen als suppliers.

5:6 En dat was bij de InnovA wat meer. Dat ze echt hebben geprobeerd ook echt de potentiële uitvoerders…

Coding:
- Early involvement of Suppliers
- Knowledge Development
- Knowledge Diffusion through Networks

Content:
> En dat was bij de InnovA wat meer. Dat ze echt hebben geprobeerd ook echt de potentiële uitvoerders van het project daarbij te betrekken.

4:6 Ja dat hadden we gister ook, daar was ook een aanemer. Want Simone vroeg wat doen jullie aan innovat…

Coding:
- Early involvement of Suppliers
- Entrepreneurial Activitities
- Knowledge Diffusion through Networks
- Trust

Content:
> Ja dat hadden we gister ook, daar was ook een aanemer. Want Simone vroeg wat doen jullie aan innovatie, nou zegt ie, daar heb ik wel allerlei ideeen over maar dat ga ik hier niet vertellen. Logisch toch ook. Maar die ideeen komen uiteindelijk wel, in de aanbestedingsfase, dan komen dit soort dingen wel naar boven, alleen niet in deze fase.

Comment:
> Aannemers delen hun kennis niet, wantrouwen zorgt hiervoor.

7:5 Ja eigenlijk wil je niet de traditionele partijen, je wil natuurorganisaties die in een keer iets ga…

Coding:
- Committed Participants
- Early involvement of Suppliers
- Entrepreneurial Activitities
- Knowledge Diffusion through Networks

Content:
> Ja eigenlijk wil je niet de traditionele partijen, je wil natuurorganisaties die in een keer iets gaat zeggen over weet ik veel of misshien heel anders gaat denken. Of een startup met iets leuks.

3:15 Kijk dit is heel belangrijk. Dit wordt heel vaak vergeten. Dus het vroeg betrekken van toeleverancie…

Coding:
- Early involvement of Suppliers
- Entrepreneurial Activitities
- Guidance of the Search
- Knowledge Development
- Knowledge Diffusion through Networks

Content:
> Kijk dit is heel belangrijk. Dit wordt heel vaak vergeten. Dus het vroeg betrekken van toeleveranciers. Want stel dat je bij Rijkswaterstaat, dan heb je ook hele leuke workshops gehad in Utrecht en heb je met allerlei partijen gesproken maar niet met de toeleveranciers. Dan zeg je nou na twee jaar we zijn eruit. Dan gaan ze naar de aanbesteding toe. Daar staan allerlei eisen in, en dan zeggen al die leveranciers, als we dit dan 2 jaar geleden of een jaar geleden hadden geweten dan hadden wij opdracht kunnen geven aan subcontractors om andere grondstoffen aan te leveren of andere contracten aan te bieden. Dus dit is dus heel erg belangrijk. Heel erg. Om zeg maar marktpartijen te betrekken. Dus dat is de tripel samenwerking.

Comment:
> Voorbeeld van hoe early involvement of suppliers nieuwe innovaties eerder kunnen faciliteren

7:1 maar als je echt een circulair ontwerp wil maken, dan moet je het niet aan w+b vragen maar aan een h…

Coding:
- Early involvement of Suppliers
- Knowledge Diffusion through Networks

Content:
> maar als je echt een circulair ontwerp wil maken, dan moet je het niet aan w+b vragen maar aan een heleboel partijen. En dan moet je het niet perse aan de concurrenten van w+b vragen, daar gaat het me niet perse om maar meer om de partijen die na ons, met ons werk weer verder moeten, ja wij doen alleen planstudiefase. Dus je hebt de voorfase de planstudiefase, contractfase, uitvoeringsfase beheerfase. En je zou al die andere fases, die zou je aan tafel moeten hebben. Als je in het kader van circulariteit kijkt. Want je vraagt me om een circulair ontwerp te maken. Dus met wat voor partijen ben ik mee in aanraking gekomen, nou met een hele boel.

5:7 Maar bij circulair heb je het natuurlijk over materiaalgebruik en best wel veel details. Dus dat is…

Coding:

- Early involvement of Suppliers
- Entrepreneurial Activitities
- Knowledge Diffusion through Networks

Content:

> Maar bij circulair heb je het natuurlijk over materiaalgebruik en best wel veel details. Dus dat is een mismatch zeg maar tussen het circulair ontwerp en het reguliere ontwerp, het is een heel groot detail niveau verschil. Dat is ook het grootste probleem als je het hebt over. Dat zie ik nu ook bij de A6, vanuit circulair oogpunt wil je allerleu partijen betrekken. Liefst zo vroeg mogelijk. Maar die partijen zitten wel op een heel ander detail niveau dan waarop het proces zit. Iemand die inderdaad zullen we maar spreken een innovatie heeft voor geleide rails. Dat is prima om te weten, maar dat gaat pas relevant worden op het moment dat RWS besloten heeft waar geleiderails komen en dat ze een contract in de markt zetten.

Comment:

> Mismatch tussen proces van 'normaal' project en een CE gefocussed ontwerp project. Dit zit hem vooral in de detaillering.

4:29 Maar de grootste bottleneck zit hem bij de samenwerking in de keten bij RWS. Want Simone weet niet b…

Coding:

- Early involvement of Suppliers
- Guidance of the Search
- Knowledge Development
- Knowledge Diffusion through Networks

Content:

> Maar de grootste bottleneck zit hem bij de samenwerking in de keten bij RWS. Want Simone weet niet bij wie ze moet zijn om uberhaupt van die innovaties, als ze er al zijn, of daar ruimte voor is, of dat regeltechnisch kan, hoe dat in de procedure kan. Allemaal dat soort dingen moet ze allemaal nog regelen. Dus die samenwerking in die keten aan de achterkant, noemen we dat, of de horizontale of verticale keten. Die is nog veel belangrijker.

1:12 Maar ze laten het achterste van de tong toch niet zien tot ze een contract hebben getekend.

Coding:

- Early involvement of Suppliers
- Knowledge Diffusion through Networks

Content:

> Maar ze laten het achterste van de tong toch niet zien tot ze een contract hebben getekend.

3:31 Want als je wil vernieuwen dan moet je de suppliers er van tevoren bij betrekken. En hoe doe je dat…

Coding:

- Early involvement of Suppliers
- Knowledge Diffusion through Networks

Content:

> Want als je wil vernieuwen dan moet je de suppliers er van tevoren bij betrekken. En hoe doe je dat dan? Ga je dan innovatief aanbesteden of ga je een ander proces in? En de suppliers willen meestal niet met de andere suppliers praten, dan houden ze de kaarten op de borst. Hoe creëer je dan een omgeving van veiligheid dat ze dat wel willen, of in iedergeval gedeeltelijk willen. Wij hebben wel eens een workhops gehad in het Evoluon, dat ging dan over mobiliteit, met nieuwe

> ideeen er over, toen zijn we om 3 uur begonnen en tot 5 uur was het dood stil. Om 5 uur begon de borrel en toen begonnen ze te praten, want het zijn allemaal concurrenten. Dus dat is heel lastig.

Comment:

> Vraag: hoe betrek je eerder de suppliers in het project, zonder dat ze hun kennis voor zich houden.

7:16 Wat we gisteren ook bespraken over van dat moet je uitgangspunt zijn bij die grondbalans, alles erom…

Coding:

- Common Understanding
- Early involvement of Suppliers
- Guidance of the Search
- Knowledge Diffusion through Networks

Content:

> Wat we gisteren ook bespraken over van dat moet je uitgangspunt zijn bij die grondbalans, alles erom heen ontwerpen, wat nou open landschap, ja dan maar lelijk. Maar wel circulair. Zover is het nog niet.

APPENDIX D - PROJECT DESCRIPTION

Goals of the InnovA58

Five years ago, in 2013, it became clear the highway needed alterations, and thus the exploratory phase began. In 2015, it was decided by the Minister of Infrastructure and Water Management the highway needed to be broadened from two to three lanes. These broadenings will be executed between the junctions of Sint-Annabosch and Galder and between the junctions of Eindhoven and Tilburg (Rijkswaterstaat, n.d.-f), see Figure 22. In the scope of this project, the stretch in between Sint-Annabosch and Tilburg, is not included. However, in the future, this stretch of highway will also be broadened.

Together with the decision the highway would be extended by one extra lane, Rijkswaterstaat also decided innovation would be a key point of attention for the project. In 2016, The Ministry of Infrastructure and Water Management decided upon an approach for innovation management within the project. Goals and ambitions were formulated, and a preliminary set of innovation goals were presented. In the beginning of 2017, these innovations were tested in a feasibility study performed by NIBE, a research institute specialized in sustainability in the built environment. These innovations included not only technical innovations, but also several other goals and ambitions. For instance, collaboration with knowledge partners, local- and regional authorities, market participants and local residents is highly valuated, in order to create a smart, sustainable and future-proof road (Rijksoverheid, n.d.).

Currently, Witteveen+Bos is working on the first phase of the design process, as well as the Environmental Impact Analysis (EIA). This challenge will take place in the upcoming years, as the route decision is planned to be finished in 2020. After the design has been approved, a contractor will be involved in the project and the actual realisation phase will take place. The project is planned to be delivered in 2023.

Living Lab

Because innovation is a key focus point in the project of the InnovA58, one of the approaches for innovation management is to set up a so-called Living Lab. This Living Lab can act as a platform to develop and test innovations and to learn from those implemented innovations. The Living Lab has already been set up, before the actual realisation phase of the project. It focusses on four main innovation themes (Rijkswaterstaat, n.d.-g):

- Optimal Life Cycle Costs: The Life Cycle Costs (LCC) are the total sum of costs for the highway during its entire life, so taking into account the costs for realization, operation and maintenance. The InnovA58 wants to implement solutions in the design which may be more expensive to realize, but can save costs in the maintenance phase. An example might be to implement asphalt with a proven longer life time.
- Energy-neutrality and less environmental damage: The goal of the InnovA58 is not only to realize the project with neutral energy balance, but it also wants to reduce environment damage, and this cannot only be assigned to energy usage. Therefore, Circular Economic principles are implemented to reach the goal of realizing the extension of the road with minimum environmental damage. This will be done by developing a 'circular design' to minimize waste flows in the present but also in the future. Also, Rijkswaterstaat studies the opportunities to lower environmental impact by reducing for instance noise and fine dust. Examples for this goal can be found in implementing an innovative road surface, diffractors for noise or using green ecological solutions to reduce noise and fine dust.
- New services at the side of the road: Next to environmental goals, the InnovA58 also wants to develop new services alongside of the road. The provision of different kinds of information is an example, just like resting areas, relaxation facilities for trucks and charging areas for electric vehicles.
- Smart Mobility and C-ITS: With the help of innovative traffic management systems and Cooperative Intelligent Transport Systems (C-ITS), a safe traffic flow against lower costs can be realised. Another goal is to be able to accurately predict travel times during and outside of rush hours. This could be realized by implementing controlled column formation of freight traffic. The use of special apps by road users can also improve traffic flow.

All four innovation themes can be connected to the transition to a circular economy. When designing for an optimal Life Cycle Cost, needed materials have to be evaluated, and second-hand or upcycled materials become more relevant. Also, higher quality materials will be considered, as usually their life time is much longer. This will have a positive impact on the circularity of the design. Energy-neutrality and less environmental damage as a goal for the InnovA58 can be directly linked to the circular economy principles as well, as in a circular economy, one wishes to use only renewable energy sources. Furthermore, one of the goals of a circular economy is to prevent environmental damage. New facilities and services along the A58 do not directly positively influence the circular economic transition, as for these new facilities, (scarce) resources are needed, and the first principle of the circular economy is to evaluate if the good or service is really needed. However, the implementation of charging areas for electric vehicles may accelerate the transition in the automotive industry to electric vehicles. The Smart Mobility and C-ITS theme does not have a direct link as well, but, controlled column formation increases fuel efficiency and the forecast in availability on the road may prevent congestion.

Circular design

As described above, the theme of circular economy does reflect itself in the four innovation themes of the Living Lab, however, it is also an overarching goal of itself. Rijkswaterstaat has asked the company of Witteveen+-Bos to design a 'fully circular design' for the first phase of the design process. However, the term 'fully circular' brings some controversy, as Rijkswaterstaat has not clearly described what a fully circular design means for them. Also, Rijkswaterstaat does notice a 'fully circular' society is not possible, as in the report 'A Governement-Wide Programme for a Circular Economy' (2016) they quoted Netherlands Environmental Assessment Agency (2016, p. 13):

"The idea of the circular economy as a fully closed system is a mobilising ideal image. The use of primary raw materials and the creation of residual streams can probably never be completely avoided. This has to do with those raw materials that are necessary for countries that are still building up their infrastructure, and with the fact that some of the use of raw materials is inherently linear, e.g., for energy and food."

Therefore, it is unclear whether Rijkswaterstaat aims to design the InnovA58 fully circular (thus, without any waste, environmental damage or a negative energy balance), or whether it tries to bring all aspects of a circular economy to an optimum, as they do realize 100% circular will not be achieved, at least in the near future.

At least, Rijkswaterstaat has the best intentions to bring the amount of waste and energy consumption to a minimum. Also, by designing a 'fully circular' design, the materials chosen will be of a higher quality to last longer, or be of natural origin, thus bringing the environmental impact down.

Complexity

The InnovA58 is a complex project in multiple ways. Due to this complexity, the lessons learned from this project are particularly valuable, since most future projects in the Netherlands will be less complex or comparable, and thus, experience gained from the InnovA58 project will always be of use. As the term complexity is a concept described in many forms and ways, the TOE framework of Bosch-Rekveldt, Jongkind, Mooi, Bakker, & Verbraeck (2011) is used to describe the complexity of this project. This framework breaks the term complexity down into three pillars; Technical, Organizational and Environmental. See Table 9 for a summarized form of the TOE framework. The most important elements to describe the complexity of the InnovA58 found in the TOE framework will be shortly described below. As the TOE framework is a subjective framework, the elements described can be differently interpreted for everyone involved in the project. What might be complex to one stakeholder might be straightforward for another. It is tried to give an overview of these elements, but subjectivity cannot be completely avoided.

Table 9: ***Summary of the TOE Framework (derived from (Bosch-Rekveldt et al., 2011))***

Technical	Organizational	Environmental
Goals	Size	Stakeholders
Scope	Resources	Location
Tasks	Project Team	Market conditions
Experience	Trust	Risk
Risk	Risk	

From a technical point of view, the following elements describe complexity of a project:

- Goals: This first element adds to the complexity of the project by the amount of (strategic) goals, the alignment of these goals and the question whether all goals are clear amongst all project members. For the Innova58, the scope contributes to the complexity of the project, as the innovative character of the project adds many goals to the project, as well as enlarges the scope. The alignment of the goals in itself may also contradict each other, as on the one hand, more road surface is created which has a negative impact on the environment, nonetheless the project of the goal is to be of an impact on the environment as less as possible. No conclusion can be drawn so far about the clearness of the project goals amongst the project members, as no research on that has been conducted.
- Scope: The scope of a project may add complexity to a project by the largeness of the project, the amount of uncertainties in the project and the quality requirements of the scope. As the budget for the project is €405 million, the project can be described as a large project (Flyvbjerg, 2005). Due to the innovative solutions which are desired to be implemented in the project, the uncertainty also increases. Furthermore, as a requirement of the design of the InnovA58 is it to be 'fully circular' although it is proven to be very difficult for a project this size to be fully circular, further adds complexity.
- Experience: The experience of the involved stakeholders with the technical innovations used in the project and the new-ness of the implemented innovations are of influence on the complexity of a project. As the InnovA58 is the first infrastructure project of its size to implement many new technologies, both elements contribute to complexity.

The organizational elements can be described as follows:

- Size: The complexity of a project increases as the actual size of the project increases when looking at the duration, the CAPEX (Capital Expenditure) involved, amount of engineering hours needed, the size of the project location/number of locations and the size of the project team. Almost all of these elements positively contribute to the complexity of this project, as the amount of investments needed is high, the project location stretches over a length of 35 kilometres and involves two separate project locations (Rijkswaterstaat, n.d.-a). As the project is at the time of writing still in its pre-development phase, no conclusions can already be drawn regarding the size of the project team. However, as for today, the main project team of RWS working on the project consist of seven members.
- Project Team: this element describes the way the project team is set up and the difficulties it may face, e.g. different nationalities and time zones. As this is not the case for the InnovA58, this does not contribute to the complexity of the project.
- Trust: The trust within the project team and trust in the contractor involved cannot be evaluated yet, as the project is still in the pre-development phase, and no research has been conducted on the level of trust currently present in the project team.

The level of complexity of a project is increased by the following environmental factors:

- Stakeholders: The first environmental factor discusses the number of involved stakeholders, their views on the project and the political influence on the project. The InnovA58 project stretches over multiple municipalities and regions, as well as wants to implement many new innovations and wants to be energy neutral. These goals increase the number of stakeholders in a project, and thus increase complexity. There are some opponents of the InnovA58, especially considering the Anneville-oak, however, the main stakeholders in the project all work towards a common goal. Thus, this element does not greatly contribute to the complexity of the project.
- Location: The element of the location of the project discusses the remoteness of the location, the experience in the country and the local weather conditions, as well as the interference with the current site. Whereas the first three items do not apply, the project does interfere with its current location, and the project planning does have to take measures for the traffic using the A58 during construction.
- Market conditions: The market conditions, internal strategic pressure, project environment stability and level of competition, is not considered to be of large impact on the complexity of the project.

As can be concluded from above described elements of the TOE-framework, the InnovA58 project is certainly not a straightforward project. It needs to deal with a great deal of challenges divided over all three pillars from the framework. The successful completion of this project will thus be a great achievement. Therefore, the setbacks and successes in this project will provide a lot of knowledge to the project team as well as to the transition to a circular economy.

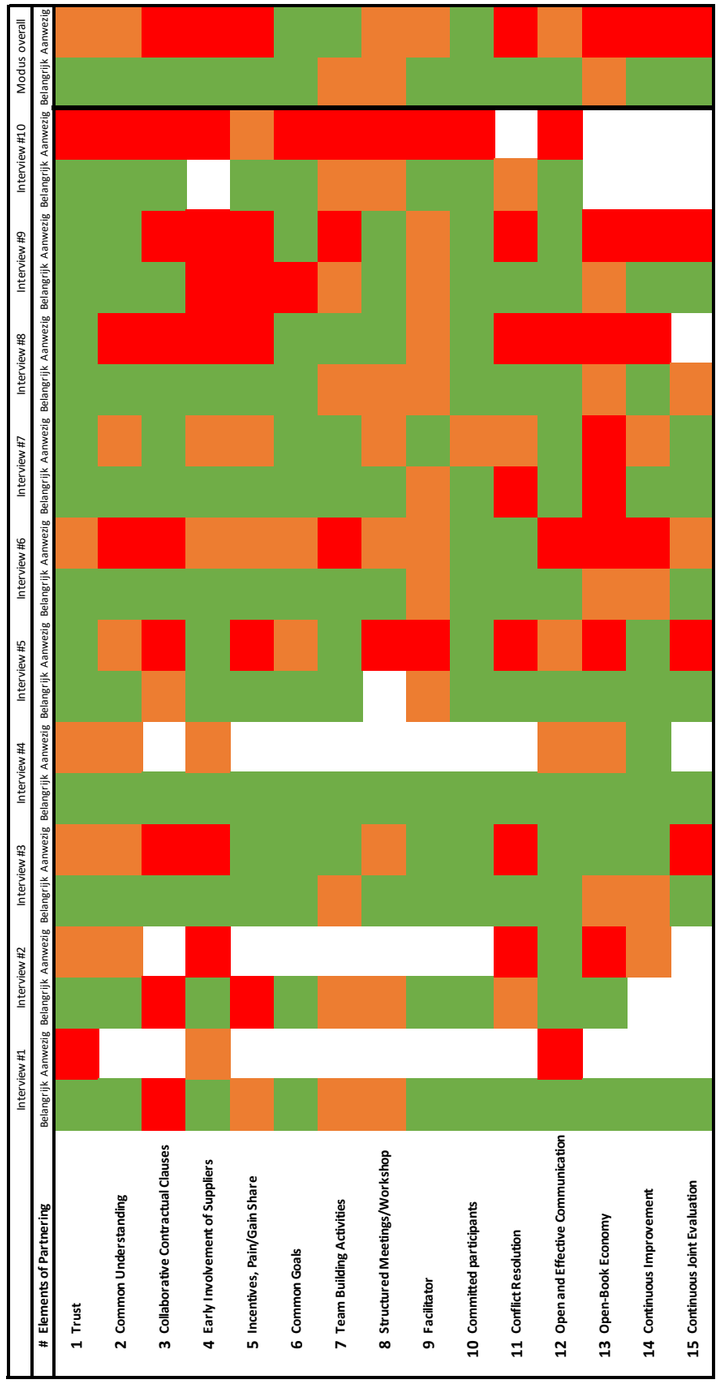
Participation and collaboration

Public participation is used in many projects, with the goal to implement changes easier and with less resistance from the local residents. It is a way to involve citizens, let them take part of the decision process and to resolve or even prevent conflicts through mutual understanding due to communication (Rojanamon, Chaisomphob, & Bureekul, 2012). Public participation has several objectives; (1) It legitimises the agency's role in the planning process, (2) It helps develop trust and confidence, (3) it can diagnose community problems and needs, (4) crates input from the community, which can result in alternative solutions to the problem, (5) it is a chance to evaluate preliminary solutions, (6) it seeks consensus, and (7) it helps overcome extreme views (you are either with us or against us) (Creighton, Priscoli, & Dunning, 1998).

For the InnovA58, these objectives are also desired, therefore, several ways to enhance public participation are executed. The local residents around critical areas such as new to be built junctions or the Anneville-oak, are involved in public participation to the greatest extent, as these sub projects can lead to the most resistance, if not well managed. Therefore, walk-in evenings are organised to present all new information, and to give local residents a stage to state their opinion. Next to information giving meetings, several input consultation series are also organised, an example of this is Team Oirschot. A selected group of inhabitants of the village of Oirschot were given the chance to design and plan a section of 3.5 kilometres A58, which lies directly next to this village. During multiple meetings and by means of the method of Social Design, an external bureau led Team Oirschot to a proposed plan of the new, 3-lane wide A58, which was presented to RWS afterwards. This plan will be taken into consideration by RWS, all though it cannot be guaranteed every detail will be copied from their plan.

Also consultation meetings with governmental organizations, local social organizations and administrative bodies surrounding the A58 were organised to give all stakeholders and local residents a voice in this project. Furthermore, the (interactive) websites of Innova58 (www.InnovA58.nl and www.a58inbeeld.nl) provides very detailed information on the progress made, so anybody interested in the project can gain a lot of insights and stay up to date.

APPENDIX E – IMPORTANCE AND PRESENCE OF THE ELEMENTS OF PARTNERING



APPENDIX F – OVERVIEW EXCEL, ROLE OF PARTNERING ON FUNCTIONS OF TIS

The overview of the role of the elements of partnering on the functions of TIS can be found in the seperate document provided.

APPENDIX G – DOCUMENT ANALYSIS

Document name	Year published	Author(s)	Source
Living Lab Circulair Ontwerp InnovA58 : Observaties en Reflecties	2018	Stefan Verweij, Wouter van den Burg, Katharina Gugerell	Verweij, S., van den Burg, W., & Gugerell, K. (2018). Living Lab Circulair Ontwerp InnovA58 : Observaties en Reflecties. Groningen: Rijksuniversiteit Groningen.
Circulair Ontwerpen in het MIRT-proces (Meerjarenprogramma Infrastructuur, Ruimte en Transport): Handelingsperspectieven voor beleidsmakers, adviseurs, ontwerpers en beheerders	2018	Rob Dijcker, Machiel Crielaard, Otto Schepers	Dijcker, R., Crielaard, M., & Schepers, O. (2018). Circulair Ontwerpen in het MIRT-proces (Meerjarenprogramma Infrastructuur, Ruimte en Transport): Handelingsperspectieven voor beleidsmakers, adviseurs, ontwerpers en beheerders.
InnovA58 Circulair Ontwerp InnovA58	2018	Witteveen+ Bos: Maarten Schäffner, Wisse ten Bosch, Jules van Haaren, Rob Dijcker, Joris van den Acker	Schäffner, M., ten Bosch, W., van Haaren, J. Dijcker, R., & van den Acker, J. (2018). Circulair ontwerp InnovA58
InnovA58, Eindrapport verkenning Innovaties	2015	Wouter van der Burg, Mado Ruys, Maaike Rimmelzwaan, Machiel Galesloot, Bastiaan Kok, Diederik Bijvoet, Leon Hombergen	van den Burg, W., Ruys, M., Rimmelzwaan, M., Galesloot, M., Kok, B., Bijvoet, D., & Hombergen, L. (2015). InnovA58, Eindrapport verkenning Innovaties
Document Participatie #1	n.d.	Rijkswaterstaat	https://www.innova58.nl/bibliotheek/documenten/default.aspx#folder=606069
Document Participatie #2	n.d.	Rijkswaterstaat	https://www.innova58.nl/bibliotheek/documenten/default.aspx#folder=606069
Document Participatie #3	n.d.	Rijkswaterstaat	https://www.innova58.nl/bibliotheek/documenten/default.aspx#folder=606069
Document Participatie #4	n.d.	Rijkswaterstaat	https://www.innova58.nl/bibliotheek/documenten/default.aspx#folder=606069
Document Participatie #5	n.d.	Rijkswaterstaat	https://www.innova58.nl/bibliotheek/documenten/default.aspx#folder=606069
Document Participatie #n	n.d.	Rijkswaterstaat	https://www.innova58.nl/bibliotheek/documenten/default.aspx#folder=606069
Document Participatie #32	n.d.	Rijkswaterstaat	https://www.innova58.nl/bibliotheek/documenten/default.aspx#folder=606069