Optimizing the preparation phase to a tender phase that is conducive for sustainable product innovations

An exploratory study to identify influential (external) factors

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Master Thesis

Master of Science in
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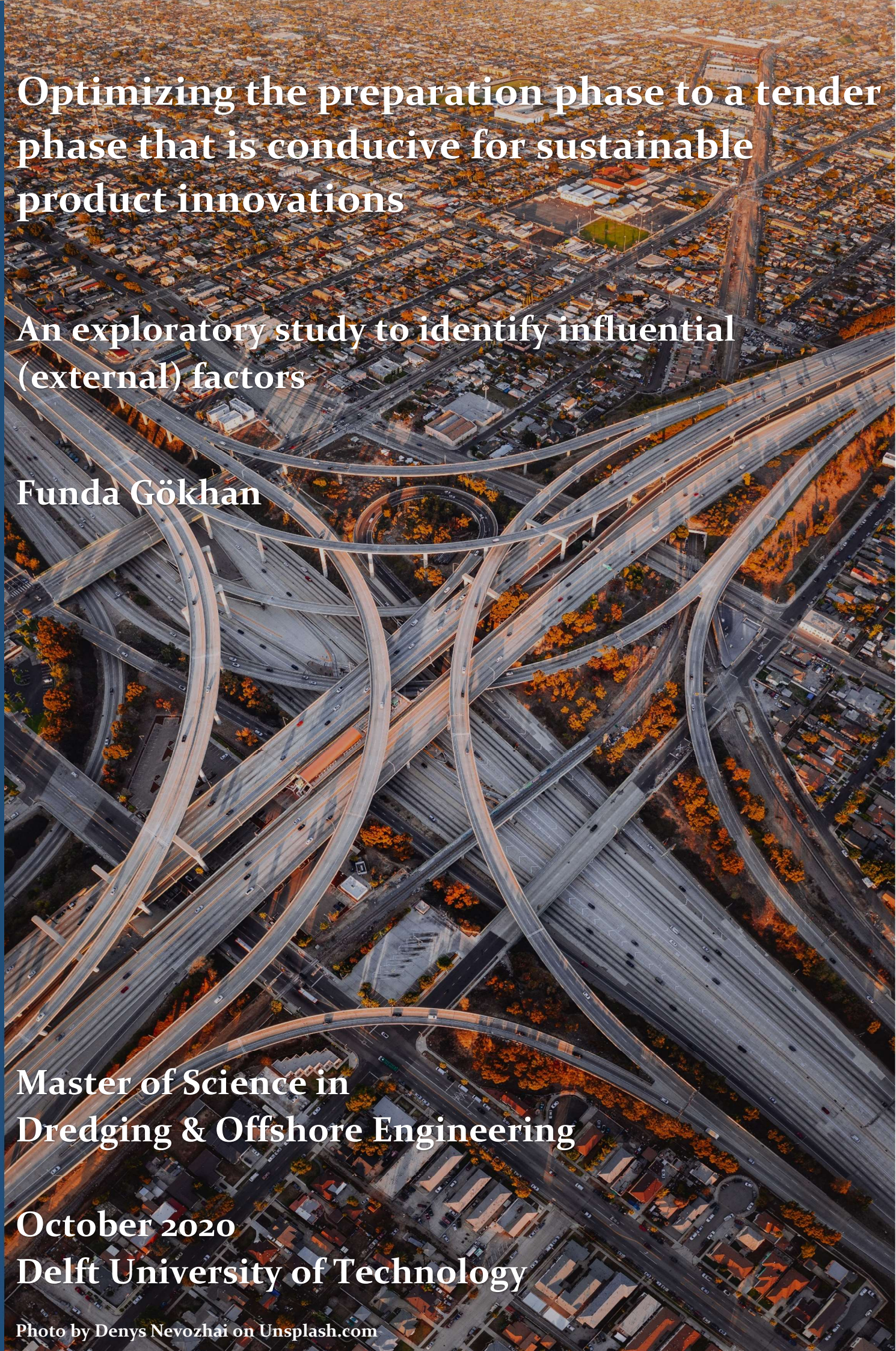

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“Remember your dreams and fight for them. You must know what you want from life. There is just one thing that makes your dream become impossible: the fear of failure”

Paulo Coelho

OPTIMIZING THE PREPARATION PHASE TO A TENDER PHASE THAT IS CONDUCIVE FOR SUSTAINABLE PRODUCT INNOVATIONS

An exploratory study to identify influential (external) factors

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by

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PREFACE

From my civil engineering study at the university of applied science and during my internship at the contractor, I became fascinated by the world of the contractor. After I decided to continue my studies, I started working for a GWW contractor in parallel with my Master Offshore and Dredging Engineering. I also worked in the Offshore Engineering sector but also in the Dredging Engineering sector. In recent years I have mainly worked in various positions with tenders within the GWW sector. At least I wanted to incorporate my personal interest in tenders into the graduation research. I was able to this for my research at Antea Group. At first sight, the subject of this research does not seem to be related to the Master Offshore and Dredging Engineering but dredging companies in the Netherlands are very active and carry out a lot of work within the GWW sector.

Because of my personal interest and my work in tenders, I was motivated during my graduation, but there were times especially in the beginning when it was hard. What made it particularly hard, that I needed to refine my idea and that of the company to a scientifically relevant topic. I would like to thank my graduation committee for their contribution.

Working during the graduation, and all the challenges that comes with this couldn't be possible without the full support of my close friends and relatives. First, I want to thank Maud because she motivated me and always believed in me to graduate. My mother and brother for their unconditional love and my father for his sacrifice for our family by coming to the Netherlands for a better future, which allowed me to study. My other brothers, sisters-in-law, nieces, nephews and the youngest ones in our family. And everyone else from acquaintances to colleagues who have endlessly listened to stories about my graduation and advised me on this.

Furthermore, I can only say, have fun reading,

F. Gökhan
October 2020
Amsterdam

SUMMARY ENGLISH

Through challenges such as climate change and the depletion of natural resources, central and decentral governments have expressed the ambition to achieve a 100% circular economy by 2050 and sustainably generated energy in the Netherlands to meet these challenges. Because of the large-scale plans, it is up to governments to stimulate companies to facilitate the necessary changes in society.

Contractors can be stimulated to offer sustainable product innovations through tenders in the GWW sector. But despite the sustainability ambitions of clients, contractors are hindered from being able to offer sustainable product innovations by clients. In order to be able to contribute to this, it is made clear how contractors can be stimulated by investigating the influential (external) factors of the tender phase that can stimulate contractors to offer sustainable product innovations with a TRL (technology readiness level) level 7-9 during the tender phase.

The aim of my research is to make recommendations to clients to optimize the preparation phase of public procurement. Here follows the main question: *How can clients optimize the procurement process of the preparation phase, in order to stimulate the offering of sustainable product innovations by contractors, during the tender phase for the GWW sector in the Netherlands?*

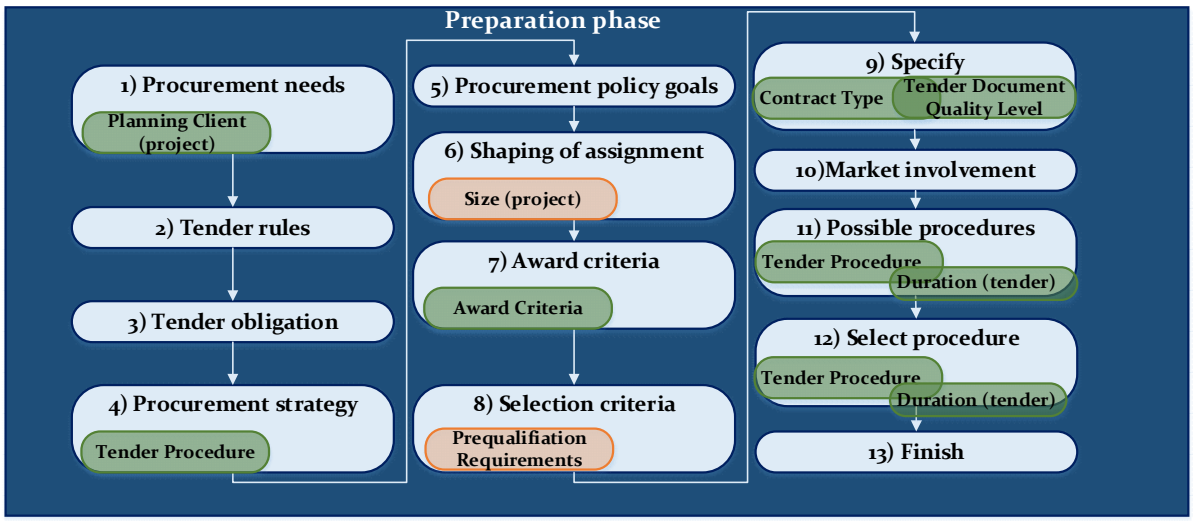
Methodology research
The applied methodology for this research consists of a theoretical and an empirical part. In the theoretical part, a qualitative literature review has been carried out. From this, an analysis framework was drawn up, in which the eight (external) factors from the tender phase were indicated. The analysis framework was then used in the empirical part, because research material was collected by conducting semi-structured interviews with contractors in order to determine the (external) factors that influence contractors. In addition to this, the findings with regard to the influential (external) factors were validated by means of a semi-structured focus group interview with all parties in the supply chain (client, contractor & consultancy and engineering firm). The findings from the interviews and from the validation were then applied to draw up recommendations for clients.

Research results
The influence of (external) factors to offer sustainable product innovations was assessed based on the answers given in the semi-structured interviews and their validation in the semi-structured focus group interview. The answers given show that for offering sustainable product innovations with a TRL level of 7-9: The time a contractor receives from the client determines whether sustainable product innovations will be offered, making the planning client (project) an influential (external) factor. Tender documents quality level is an influential (external) factor because tender management looks at whether innovations involve risks and the tender documents can be described in such a way that many risks fall to the contractor. In order to offer sustainable product innovations, a contractor needs enough time to conduct research and discuss it with the client, which makes the duration (tender) an influential (external) factor. The contract type is an influential (external) factor because the type of contract, but also the form of collaboration, price mechanism, how the requirements are specified, the contract terms and conditions determine how much freedom there is to deviate from products in order to apply sustainable product innovations. Clients determine with the choice of a tender

procedure how transparent the process is and what type of communication there is during the tender, this makes it an influential (external) factor. The choice of the client to select a certain award criteria, the design and weighting thereof is an influential (external) factor because it prevents contractors from creating added value and being distinctive when offering sustainable product innovations. Potential for new projects is also an influential (external) factor because by sharing their vision for several years clients can indicate to contractors that there are more questions ahead. The size and selection criteria are indicated as non-determining (external) factors to offer sustainable product innovations with a TRL level 7-9.

Conclusion research

The non-determining/influential (external) factors are interdependent and influence each other. Therefore, the conclusion is that the optimization of the procurement process focused on the preparation phase can be realized by deliberately taking decisions and focusing within the steps where the non-determining / influential (external) factors are categorized. It is essential to focus on TRL level 7-9, the steps of the preparation phase and the influential (external) factors as a whole. The influential (external) factor: potential for new project cannot be categorized within the current steps of the preparation phase because this is an (external) factor that focuses on the procurement policy of the client. From the results of my research, general and specific recommendations have been made that can be applied by the client, IB and contractor; these are indicated in chapter 9.



SUMMARY (DUTCH)

De centrale overheid en decentrale overheden hebben door uitdagingen als klimaatverandering en uitputting van natuurlijke hulpbronnen, de ambitie uitgesproken om te komen tot een 100% circulaire economie in 2050 en duurzaam opgewekte energie in Nederland om deze uitdagingen het hoofd te bieden. Door de grootschalige plannen is het aan overheden om bedrijven te stimuleren om de noodzakelijke veranderingen in de samenleving te faciliteren.

Aannemers kunnen met aanbestedingen in de GWW-sector gestimuleerd worden om duurzame productinnovaties aan te bieden. Maar ondanks de duurzaamheidsambities van opdrachtgevers, worden aannemers belemmerd om duurzame productinnovaties aan te kunnen bieden door opdrachtgevers. Om een bijdrage hieraan te kunnen leveren wordt inzichtelijk en duidelijk gemaakt op welke wijze aannemers gestimuleerd kunnen worden door te onderzoeken wat de invloedrijke (externe) factoren van de aanbestedingsfase zijn waarmee aannemers gestimuleerd kunnen worden om duurzame productinnovaties met een TRL (technology readiness level) niveau 7-9 aan te bieden tijdens de aanbestedingsfase.

Het doel van mijn onderzoek is om aanbevelingen te doen aan opdrachtgevers om de voorbereidingsfase te optimaliseren van overheidsopdrachten. Hier volgt de hoofdvraag uit: *Hoe kunnen opdrachtgevers het inkoopproces van de voorbereidingsfase optimaliseren, om het aanbieden van duurzame productinnovaties door aannemers te bevorderen, tijdens de aanbestedingsfase voor de GWW-sector in Nederland?*

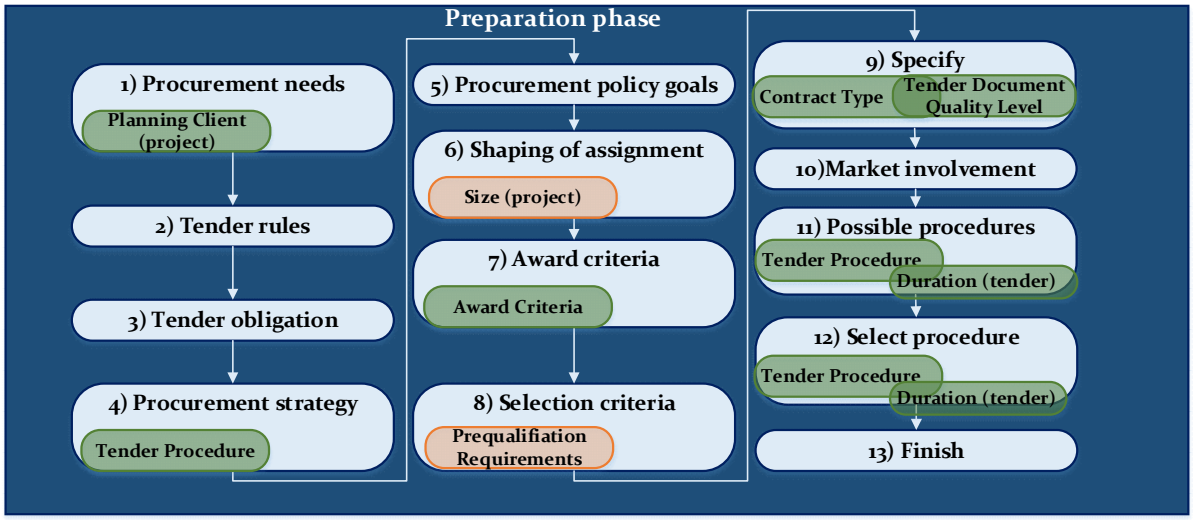
Methodologie onderzoek
De toegepaste methodologie voor dit onderzoek bestaat uit een theoretisch en een empirisch deel. In het theoretisch deel, is een kwalitatief literatuuronderzoek uitgevoerd. Hieruit is een analysis framework opgesteld, waarin de acht (externe) factoren uit de aanbestedingsfase zijn aangegeven. Het analysis framework is hierna gebruikt in het empirisch deel, doordat onderzoeksmateriaal verzameld is door semigestructureerde interviews met aannemers te houden, om te bepalen wat de (externe) factoren van invloed zijn waarmee aannemers gestimuleerd kunnen worden. Als aanvulling hierop zijn de bevindingen m.b.t de invloedrijke (externe) factoren door middel van een semigestructureerde focus groep interview met alle partijen uit de bouwketen (opdrachtgever, aannemer en advies- en ingenieursbureau) gevalideerd. De bevindingen vanuit de interviews en uit de validatie zijn vervolgens toegepast om aanbevelingen op te stellen voor opdrachtgevers.

Resultaten onderzoek
De invloed van de (externe) factoren om duurzame productinnovaties aan te bieden is beoordeeld op basis van de gegeven antwoorden uit de semigestructureerde interviews en de validatie hiervan in de semigestructureerde focus groep interview. Uit de gegeven antwoorden blijkt dat voor het aanbieden van duurzame productinnovaties met een TRL-niveau van 7-9: De tijd die een aannemer krijgt van de opdrachtgever bepaald of er duurzame productinnovaties aangeboden zullen worden, waardoor de planning opdrachtgever (project) een invloedrijke (externe) factor is. Kwaliteit (aanbestedingsstukken) is een invloedrijke (externe) factor doordat vanuit tender management gekeken wordt of innovaties risico's met zich meebrengen en de aanbestedingsstukken kunnen zodanig beschreven zijn dat er veel risico's toekomen aan de opdrachtnemer. Voor het aanbieden van duurzame

productinnovaties heeft een aannemer genoeg tijd nodig om onderzoek te doen en het door te spreken met de opdrachtgever, waardoor de doorlooptijd aanbesteding een invloedrijke (externe) factor is. Het contract type is een invloedrijke (externe) factor doordat het type contract, maar ook de samenwerkingsvorm, prijsmechanisme, hoe de eisen gespecificeerd zijn, de contractvoorwaarden en condities bepalen hoeveel vrijheid er is waarin je mag afwijken van producten om duurzame productinnovaties toe te passen. Opdrachtgevers bepalen met de keuze van een aanbestedingsprocedure hoe transparant het proces is en wat voor type communicatie er is gedurende de aanbesteding, hierdoor is het een invloedrijke (externe) factor. De keuze van de opdrachtgever om een bepaalde gunningscriteria, de inrichting en weging hiervan te selecteren is een invloedrijke (externe) factor doordat aannemers hierdoor geen meerwaarde kunnen creëren en onderscheidend kunnen zijn bij het aanbieden van duurzame productinnovaties. Potential for new projects is ook een invloedrijke (externe) factor doordat opdrachtgevers door het delen van hun toekomstvisie, aan aannemers kunnen aangegeven dat er meer uitvragen in het vooruitzicht zijn. De omvang/grootte en selectiecriteria zijn aangegeven als niet invloedrijke (externe) factoren om duurzame productinnovaties met een TRL-niveau 7-9 aan te bieden.

Conclusie onderzoek

De invloedrijke/invloedrijke (externe) factoren onderling van elkaar afhankelijk zijn en invloed op elkaar uitoefenen. Daarom is de conclusie dat het optimaliseren van het inkoopproces gericht op de voorbereidingsfase gerealiseerd kan worden door doelbewust beslissingen te nemen en te focussen binnen de stappen waar de niet invloedrijke/invloedrijke (externe) factoren gecategoriseerd zijn. Het is essentieel om de nadruk te leggen op TRL-niveau 7-9, de stappen van de voorbereidingsfase en de invloedrijke (externe) factoren als geheel. De invloedrijke (externe) factor: potential for new project kan binnen de huidige stappen van de voorbereidingsfase niet gecategoriseerd worden doordat dit een (externe) factor is die gericht is op het inkoopbeleid van een opdrachtgever. Uit de resultaten van mijn onderzoek zijn er algemene en specifieke aanbevelingen voor in de praktijk gedaan die door de opdrachtgever, IB en aannemer toegepast kunnen worden, deze zijn aangegeven in hoofdstuk 9.



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LIST OF ABBREVIATIONS

BPQR= Best Price- Quality Ratio

LP= Lowest Price

LC= Lowest Costs Calculated on the basis of Cost-Effectiveness, such as Life Cycle Costs

BVA= Best Value

IB= Consultancy and Engineering firms

TRL= Technology Readiness Level

DBM= Design Build and Maintain

PDB= Plan Design Build

MEAT= Most Economically Advantageous Tender

CD= Competitive Dialogue

CP= Competitive Negotiation Procedure

OP= Open Procedure

RP= Restricted Procedure

IP= Innovation Partnership

EC= European Commission

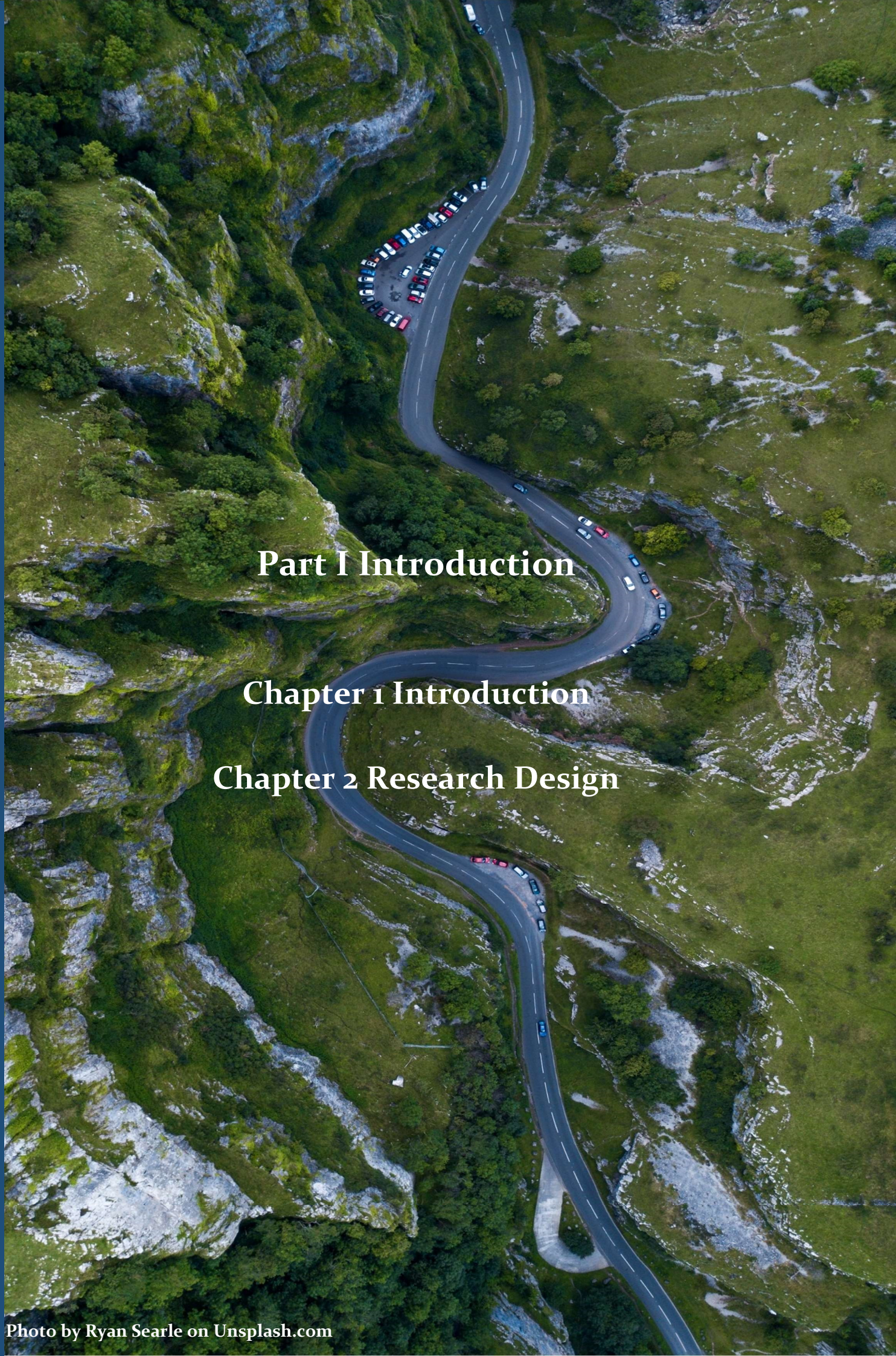
R&D= Research & Development

GP= Proportionality Guide

ARW= Procurement Regulations Work

NP= Negotiated Procedure without prior publication

CBS= Statistics Netherlands



Part I Introduction

Chapter 1 Introduction

Chapter 2 Research Design

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1 INTRODUCTION

An introduction to the subject is presented, what the problem is and the urgent need for change. Then the goal of the research, from the problem analysis and problem definition, the main question and sub-questions are formulated.

1.1 INTRODUCTION OF THE SUBJECT

Climate change and the depletion of natural resources are a challenge for many industries and national economies. These challenges have prompted customers—who may be governments or state-owned companies—to look for ways to meet them. As a result, the Netherlands is planning for 50% of its economy to be circular in 2030 and 100% in 2050. Part of that agenda is for 27% of the energy used in 2030 to be sustainably generated. In order to achieve that goal, structural changes are needed and formal transition agendas created. In the Netherlands, construction accounts for 50% of raw materials usage, 40% of total energy consumption, and 30% of total water consumption. Because the sector also accounts for approximately 35% of CO_2 emissions, the construction sector has been included as a priority in the transition agenda (Transitieteam Bouw, 2018).

These ambitions to achieve a 100% circular economy and sustainably generated energy in the Netherlands will lead to changing practices and demands to address these. And because the economy is doing well and the population is growing along with it, the infrastructure[1] will have to be adapted to the growth; to meet this reality, the infrastructure will have to work smarter and more efficiently (Arnoldussen et al., 2017), which means that the construction sector will be at the forefront.

The construction sector can play a role in increasing society's resilience to climate change and depletion of natural resources (Brandon & Lombardi, 2010). The construction sector consists of non-residential construction, housing construction, and GWW construction. It is an important sector because, according to Statistics Netherlands (CBS), it contributes 4.1% to GDP. The task of the GWW sector consists of adapting (reconstruction), maintaining the existing infrastructure, and constructing new infrastructure. The challenge is complex, from (Lenderink, Voordijk, et al., 2019) follows that traditional applications are no longer sufficient, making it necessary to develop new techniques and products.

Stimulating innovations through public procurement is an influential policy instrument[2] on the demand side and can also add value to their environment (Grandia & Meehan, 2017). In addition, stimulating sustainable innovations through public procurement can lead to economic growth of countries, regions, and private organizations, as well as overall technological development and competitiveness (Lenderink et al., 2018; OECD, 2011). The use of public procurement to promote innovation is therefore a well-known way of addressing societal challenges that we will face in the near future (Lenderink et al., 2018). Governments can use public procurement to shape innovations because of their procurement power (OECD,

[1] According to the dictionary van Dale (2020a): "the whole range of highways, railways, waterways, harbors, airports, electrical installations, cables and so on".

[2] Definition according van Nispen tot Pannerden (2011); "the means of government intervention in markets or, in broader perspective, society, in order to accomplish goals or to solve problems".

2011). In 2015, the total procurement volume of the Dutch government was approximately 73.3 billion euros, of which 6.8 billion euros for the GWW sector (Ministerie van Economische Zaken, 2016).

As governments make large-scale plans, it falls to them to stimulate businesses, harnessing their supply chains and client base to facilitate the needed changes in society. The supply chain in which tenders[3] take place consists of the following parties: clients[4], consultancy and engineering firms (IB), and contractors. Clients largely pay for the public contracts and determine the characteristics of the procurement process, whereas IB are mainly engaged because of their knowledge and expertise and to shape the procurement process for the client. The responsibility of contractors is to carry out the work and that the work meets all contract requirements. In construction, it is common for contractors to play the role of intermediary in the field of innovation knowledge because the introduction of promising innovations from suppliers and subcontractors is beneficial to their competitive position (Rose et al., 2019). The (European) procurement law applies to tenders issued by clients and thus affects the entire supply chain.

Contractors can be stimulated by tenders to offer sustainable innovations. The focus of this research is on the procurement process in the preparation phase and how it can be optimized so that contractors are encouraged to offer sustainable innovations during the tender phase.

1.2 PROBLEM ANALYSIS

Various studies have been carried out to determine the factors for successful innovations (Blayse & Manley, 2004; Gambatese & Hallowell, 2011; Hartmann, 2006). The factors found by the various studies show that they tend to overlap. There is no clear picture of which specific factors are most decisive. In 2014, Rose and Manley conducted research into product innovations in Australian infrastructure projects in order to get a clearer picture of determining factors for success. From their analysis, four contextual elements for successful innovation have been identified: relationships within the sector, procurement systems[5], regulatory conditions, and organizational resources (Rose & Manley, 2014). (De Valence, 2010) shows that the procurement method is seen as a decisive factor for the level of innovation in the construction sector and that innovation-oriented forms of procurement can promote innovations (Arnoldussen et al., 2017). According to (Aschhoff & Sofka, 2009), it is clear that public procurement has a huge impact on a company's innovation performance.

Despite the fact that the procurement system is one of the determinants of successful innovation, the following obstacles can be identified in relation to the procurement system. Firstly, clients want certainty in the application of innovations and therefore set tough

[3] According to (Verlinden-Bijlsma & Brackmann, 2016): "that, with due observance of the applicable rules, the client invites (a number of) market participants to submit an offer and, if the client wishes to award an order, awards the order to the contractor who, based on all the client's requirements and wishes, has submitted the most suitable offer".

[4] The contracting authorities which, according to the (Ministerie van Economische Zaken, 2020) Part 1.1 Procurement Act, have an obligation to put out to tender are the contracting authorities and special sector companies, whereby contracting authorities are defined as: "the State, a province, a municipality, a water board or a body governed by public law, or a partnership of these authorities or bodies governed by public law" and special sector companies such as: "contracting authority, public company or a company or body to which a special right or exclusive right has been granted by a contracting authority".

[5] The meaning of procurement according the (Oxford, 2020): "the process of obtaining supplies of something, especially for a government or an organization" and system according to the dictionary (van Dale, 2020b): "efficiently ordered coherent whole of things and their parts = system".

requirements. Secondly, it is necessary for contractors to invest, but they must be able to recoup this investment, which is often not possible within a single project. Thirdly, (quality) criteria are not sufficiently valued by the client when awarding a tender. Fourthly, when selecting the tender procedure, the obvious tender procedure is applied instead of the tender procedure that could produce the best result. These obstacles are further substantiated in section 3 on the basis of literature research. Due to the listed obstacles, in practice too few to no sustainable innovations are offered in offers from contractors. As a result, clients' ambitions in the area of sustainable innovations are not being realized (Gambatese & Hallowell, 2011).

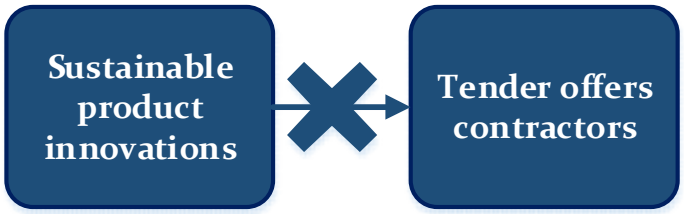

Figure 1 Own figure, problem situation.

Currently, supply and demand of sustainable innovations are not well matched. If the supply of sustainable innovations by contractors is not there during tenders, it is possible that clients' demands for sustainable innovations may not be there. But it may also have to do with the level of knowledge of the clients and IB. A great deal of scientific research has been conducted into the role of client buyer and IB to stimulate sustainable innovations (Boersma, 2018; Hofmeijer, 2017; Stiphout, 2018; van Es, 2018; Wolswinkel, 2015). A study has been carried out in the United Kingdom among contractors and suppliers on the obstacles experienced in the ability to innovate in public procurement (Uyarra et al., 2014). In Australia, research has been carried out in the road sector (Rose et al., 2019) on barriers to product innovation within the supply chain. A distinction has been made between obstacles that are experienced from the point of view of the client, the IB, the contractor, and the supplier. From a scientific point of view, it is relevant to examine all parties in the supply chain (Obwegeser & Müller, 2018).

From a contractor's point of view, no research has been done in the GWW sector in the Netherlands and there is a lack of knowledge in this area. Therefore, this research focuses on determining the influential factors of the tender phase from the perspective of contractors to offer sustainable innovations, so that the procurement process of the preparation phase can be optimized. This research can therefore make a contribution to the current state of GWW projects and, from a practical point of view, be beneficial for intended tenders from clients to purchase sustainable innovations. Because there is insight and clarity on how contractors are stimulated to offer sustainable innovations during the tender phase.

1.3 Procurement Process

The phases that procurement consists of: preparation phase, tender phase, and the execution phase of a work[6]. The preparation phase consists of a number of steps with decisions to be taken (steps outlined in detail in section 3). These decisions can prevent sustainable innovations, create conditions, and thereby limit the realization of sustainable product innovations. Think of decisions on how the tender will be assessed. Once the preparation

[6] This refers to the execution of a work as defined in (Ministerie van Economische Zaken, 2020) Part 1.1 Procurement Act: "the product of an entirety of architectural or civil engineering works intended as such to fulfil an economic or technical function".

phase has been completed, the tender phase will start. Adjusting decisions is only possible in the preparation phase, due to the general principles of procurement law (Meent & Stellingwerff Bentema, 2018). That is why the preparation phase is so crucial.

In order to clarify the applicability of the research and to define the scope of the research, a number of tender procedures have been selected. The choice to select the OP and RP procedures is because changing these procedures in such a way that innovations can be offered will have greater impact than the innovation-oriented procurement procedures as this requires relatively more time and resources, which are not always available (Lenderink, Halman, et al., 2019). The competitive dialogue (CD) and competitive negotiation procedure (CP) are regarded as innovation-oriented procurement procedures, yet they have also been selected. The lack of individual contact by contractors (Uyarra et al., 2014) is perceived as one of the obstacles to the ability to innovate in public procurement.

Ultimately, this research exists to answer the question: What influential (external) factors can stimulate contractors to offer sustainable innovations to satisfy governmental sustainability ambitions for the GWW sector in the Netherlands?

1.4 GOAL OF THE RESEARCH

The goal of the research was drawn up on the basis of (Doorewaard & Verschuren, 2015), which distinguishes between the goals of the research (external and internal) and the knowledge needed to achieve the goal.

External goal: Make recommendations to clients to optimize the preparation phase for public procurement.
Internal goal: Provide insight into the (external) factors of the tender phase by which contractors can be stimulated to offer sustainable innovations and whether parties in the supply chain can take these into account for the GWW sector in the Netherlands.

1.5 RESEARCH QUESTIONS

1.5.1 Main research question

On the basis of the identified problems in the problem analysis and the objective of the research, the main question is:

How can clients optimize the procurement process of the preparation phase, in order to stimulate the offering of sustainable product innovations by contractors, during the tender phase for the GWW sector in the Netherlands?

1.5.2 Sub-research questions

In order to answer the main research question, the following sub-questions must first be answered:

1. What is the design of the preparation and tender phase of the procurement process where influencing factors of an offer are considered?

a) What are sustainable product innovations and what type of sustainable product innovation can be offered, taking into account the technology readiness level?

b) What are innovation-friendly procurement methods?
c) What steps does the preparation phase consist of and what is the content per step?
d) What steps does the tender phase consist of and what is the content per step, taking into account the chosen tender procedures (OP, RP, CD, and CP)?
e) What are the (external) factors that influence contractors to make a bid decision during the tender phase?

2. What are the influential (external) factors of the tender phase, according to contractors, to offer sustainable product innovations?
3. To what extent can parties in the supply chain ensure that these (external) factors from the tender phase are taken into account in the preparation phase so that sustainable product innovations are offered?

2 RESEARCH DESIGN

The details and considerations for coming up with an approach to carry out the research are detailed in this chapter. This section details the approach to the research, the preparation of the research, the methods to be used to collect and analyse research material, and the research strategy (presented in a flowchart).

2.1 RESEARCH APPROACH

This research follows a practice-based model in which a situation is experienced as problematic or a desire to achieve something (Doorewaard & Verschuren, 2015). The necessary information is collected from practice and an intervention cycle can be used to solve problems, consisting of five phases: problem analysis, diagnosis, design, intervention/change, and evaluation (Doorewaard & Verschuren, 2015). In this research, the focus is on the diagnostic phase and the causes and motives with which the problem of too few sustainable innovations is interrelated (Doorewaard & Verschuren, 2015). This research tries to gain insight into what the (external) factors are in order to stimulate contractors to offer sustainable innovations. It is therefore a diagnostic background analysis, which maps out which factors cause a problem (Verschuren & Doorewaard, 2010).

In (Doorewaard & Verschuren, 2015), the following research strategies can be distinguished: survey, experiment, case study, well-founded theoretical approach, and desk research. A combination of these research strategies is possible. Adopting the strategy depends on the type of research being undertaken: width or depth, qualitative or quantitative (Doorewaard & Verschuren, 2015). The research is not about the entire procurement process but about a specific part of the preparation phase and optimizing it so that contractors are stimulated to offer sustainable product innovations during the tender phase. As a result, depth has been chosen for this research. This allows the researcher to arrive at more content, clarification, and more powerful reasoning. The situation being investigated is complex, dynamic and the findings cannot be expressed in numbers. A qualitative approach is beneficial.

The decisions ensure that a number of options are eliminated within the research strategies. All the research strategies mentioned above except the desk research are referred to as empirical research. Because the choice is for depth, it means that the survey is not suitable, with the survey research is mainly done in the width (Doorewaard & Verschuren, 2015). The experiment is often regarded as a quantitative research strategy (Doorewaard & Verschuren, 2015). The research strategies case study, well-founded theoretical approach and desk research are referred to as qualitative research. Desk research is not empirical research and the well-founded theoretical approach is typically theory-oriented research. For this research, therefore, the case study research strategy fits best (Doorewaard & Verschuren, 2015).

However, for answering 'what' questions there are 2 possibilities according to (Yin, 2014). First, the 'what' questions that are exploratory, all research strategies mentioned in Yin (2014) p.6 can be applied for this purpose. Secondly, the 'what' questions that are really of the 'how many' type, survey research or archival research is preferable, to apply a survey research to list the 'what' is more beneficial because it offers no advantage to apply a case study research (Yin, 2014). For this research, identifying what the (external) factors are in order to stimulate contractors to offer sustainable product innovations, a survey research is more suitable.

Within a survey research strategy, there are two primary methods of collecting information—via questionnaire or interview (Fellows & Lui, 2015; Fowler, 2009; Saunders et al., 2009). The output of a questionnaire is a lot of data that is numerical in nature and is easy to process by a quantitative method. Because depth has been chosen and the findings will be qualitative in nature, this research will be carried out using personal interviews as a method.

2.2 Preparation Research

2.2.1 Literature Study

The research review began with a critical and detailed assessment of the relevant literature from academic and scientific databases (Google Scholar, Scopus, TU Delft Worldcat Discovery and TU Delft Repository) to determine the level of knowledge on this subject and identify gaps that can be addressed in this research (Fellows & Lui, 2015). After this, specific relevant knowledge was found using the snowball method and the citations in existing works. In addition to the scientific literature, web sources and commercial books were used to provide insight into the procurement process. From the literature study follows the analysis framework, in which (external) factors from the tender phase are indicated that may influence contractors so that they are stimulated to offer sustainable innovations during the tender phase.

2.3 Collection of Research Material

2.3.1 Interviews

The analysis framework is used as the basis for the personal interviews. Because it is currently not possible to conduct personal interviews this creates specific disadvantages. It is more difficult to capture and observe non-verbal communication compared to a personal interview. Other disadvantages are that interviews can be time-consuming and the quality of the collected data depends on the experience of the researcher and the relationship between the researcher and the participant (Saunders et al., 2009). To prevent this, interview questions were submitted to research supervisors in advance for assessment. The advantages of personal interviews is they provide more depth on the topic (Fellows & Lui, 2015) and the researcher has control over the method of collecting research material. With this, research material has been collected for the next phase of the research to analyze and validate. The interviews are discussed in-depth in section 5.

2.4 Analysis & Validation Research Material

2.4.1 Analysis Research Material

Personal interviews were conducted in Dutch and recorded on audio via Skype and a verbatim transcript of each interview was prepared. After the elaboration, the transcriptions were sent to the participants for verification. For the analysis, it was necessary that all interviews were held and that their elaboration has been checked by the various participants. The basis for the analysis of the interviews is that what has been indicated by the various participants is assessed, are there similarities, are there differences, can deviations be named. In order to substantiate the similarities, differences, and deviations, verbatim quotations are used. Quoting the participants provides insight into the richness and details of their own words

(Hennink, 2014). This has been applied to provide insight from contractors as to what the influential external factors are to offer sustainable product innovations.

2.4.2 Validation Research Material

This study looks at the similarities and deviations of the (external) factors in the perception of the participants who were interviewed, as these may point to new findings. But also whether parties from the supply chain can take these external factors into account in the preparation phase. In order to verify this, the external factors need to be validated. The validation is done with a semi-structured focus group interview. This is a group interview in which participants interact by discussing a theme that has been clearly and precisely defined (Saunders et al., 2009). The participants were selected based on their expertise on the subject of research (Fellows & Lui, 2015). The focus group interview was recorded on audio in Dutch via Skype and transcribed verbatim. After drawing up the transcription, it was provided to the participants for verification. The findings show the extent to which parties in the construction chain can ensure that these external factors from the tender phase are taken into account in the preparation phase.

2.5 RESEARCH STRATEGY

A flow chart (Figure 2) has been set up on which the research design and research methods to be applied are elaborated.

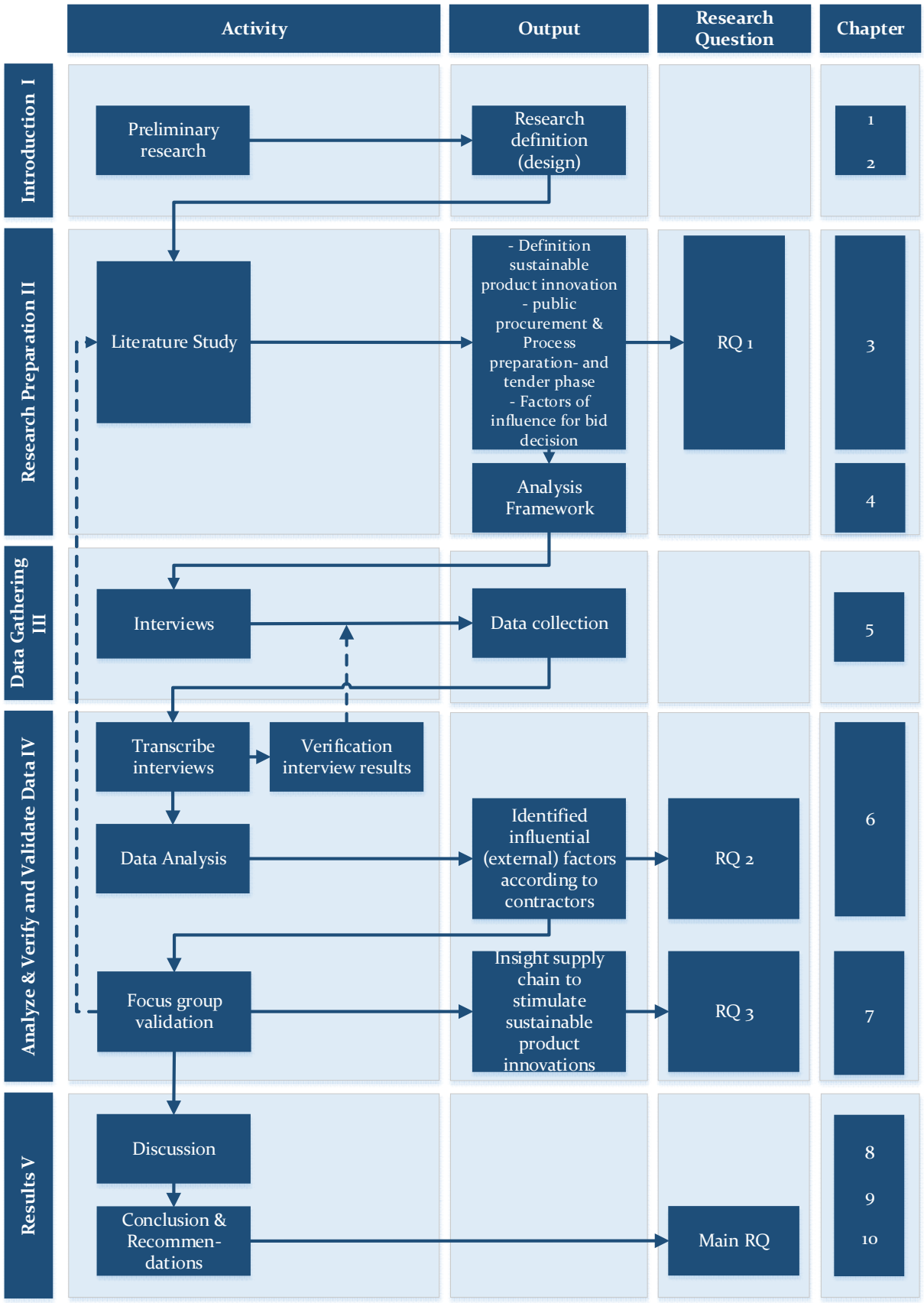

Figure 2 Own figure, research design.

Part II Research Preparation

Chapter 3 Literature Study

Chapter 4 Analysis Framework

Photo by Vnwayne Fan on Unsplash.com

3 LITERATURE STUDY

The literature study has been carried out and elaborated in 4 parts to answer sub-question 1. First, sustainable innovations have been elaborated, followed by public procurement. After this the procurement process of a client is elaborated and finally the factors of influence (determining factors for an offer) are determined.

3.1 SUSTAINABLE INNOVATIONS

It is essential to understand what sustainable innovations are, what kind of innovations there are, the degree of innovation, on what scale this is and the innovation strategy and the technology readiness level. But also, the application of sustainable innovations for the GWW sector.

3.1.1 Definition of Sustainable Innovations

In 1987, sustainable development was mentioned for the first time in the United Nations Brundtland report, which defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"(WCED, 1987). The term 'sustainability' is not a defined concept; there are many studies in the literature and this research has its own interpretation of the term 'sustainability'. Part 1.1 of the Procurement Act contains the definition of innovation[7] , but Directive 2014/24/EU Article 2 (22) also contains the definition of innovation[8]. According to (Blayse & Manley, 2004; Kulatunga et al., 2011) there is a new development being made, which improves the existing application. In the study by (Schiederig et al., 2012), the term sustainable innovation has been studied. This shows that in addition to sustainable innovations, the terms eco innovation, green innovation, and environmental innovation are also used. These terms have similar meanings and are used interchangeably. In order to distinguish these concepts, there are six characteristics to be considered: (1) type of innovation, (2) market orientation, (3) environmental aspect, (4) phase, (5) impulse, and (6) level. The research shows that the main difference is that sustainable innovations contain economic, social, and environmental aspects and this is not the case for the terms eco innovation, green innovation, and environmental innovation.

3.1.2 Sustainable Innovation Type

The OECD (Gault, 2005) describes the following types of innovations:

- Organizational innovations;
- Product innovations;
- Process innovations;
- Marketing innovations.

This research is limited to product innovations[9] in the GWW sector. In addition to the type of innovation, the degree of innovation is also an important characteristic.

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[7] (Ministerie van Economische Zaken, 2020): “the application of a new or substantially improved product, service, or process”.

[8] (Europese Unie, 2014): “the application of a new or substantially improved product, service or process, including but not limited to production, construction or construction processes, a new sales method or a new organizational method in business, workplace or external relations, inter alia, to help solve societal problems or to support the Europe 2020 strategy for smart, sustainable and inclusive growth”.

[9] According to the OECD (Gault, 2005), a product innovation is: “the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics”.

3.1.3 Degree of Sustainable Innovation

The innovation model (Slaughter, 1998) is a spectrum on which one side is incremental innovations "small changes based on current knowledge and experience" and, on the other side, is a measure of radical innovations "a breakthrough in science or technology that changes the character and nature of an industry". In between, modular innovations "a significant change in concept within a component, but leaves the links to other components and systems unchanged", architectural innovations "a small change within a component, but a major change in the links to other components and systems" and system innovations "integration of multiple independent innovations that must work together to perform new functions or improve the facility performance as a whole" are defined in the spectrum. The main difference is that radical innovations are scarce and should not account for more than 20% of all innovations within a sample (Garcia & Roger, 2002). Developing radical innovations also takes much more time, it requires an investment, and there are more risks and uncertainties (Rijkswaterstaat, 2014). Incremental innovations should account for no less than 20% of all innovations within a sample (Garcia & Roger, 2002). It appears that in addition to incremental and radical innovations, it is necessary to name another category of innovation—truly new. (Lenderink et al., 2020) has defined this as substantial innovation. The necessity of this is that innovations are labelled as radical innovations, but they are not actually. The reason for this is that these innovations have been developed with new technology and are new within the sector, but by definition are not strictly radical innovations.

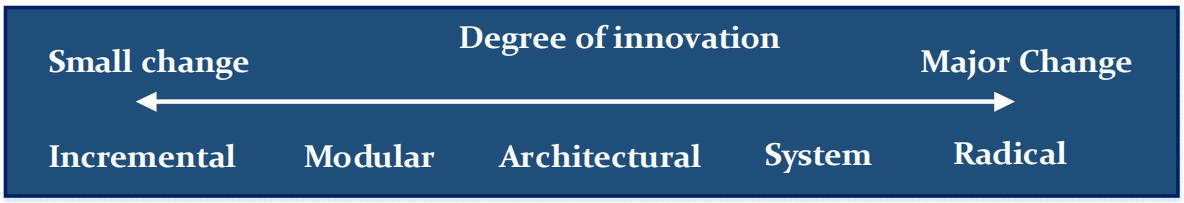

Figure 3 Own figure, degree of innovation based on (Slaughter, 1998).

The problem definition shows that a main criteria and/or sub criterion aimed at sustainable innovations are almost non-existent. When considering project innovation, clients need to assess bids based on measurable criteria, that's why it is important to divide the degree of sustainable innovations and the scale of this innovation in order to be able to assess and compare sustainable innovation of contractors in accordance with the principles of procurement law. In particular, the principles of equal treatment, non-discrimination, transparency, objectivity, and proportionality (Europese Unie, 2014) derived from freedom of movement play an important role in providing fair competition.

Degree of innovation

- Incremental innovations
- Radical innovations
- Truly new and/or substantial innovations

Likewise, the scale of innovations based on (Lenderink et al., 2020) is as follows:

- a system
- a component
- a module

3.1.4 Sustainable Innovation Strategy

Two sustainable innovation strategies can be distinguished: technology push and demand-pull (or market-pull). In a technology push, new technology is developed. This technology is then applied to a product and this product is put on the market, whereas the technology push process consists of:

Figure 4 Own figure, technology-push process (Rothwell, 1994).

The demand pull has to do with the fact that a need is formulated from the market for a new product and the new product is developed to meet the new need. The process of the demand pull (Rothwell, 1994) consists of:

Figure 5 Own figure, demand-pull process (Rothwell, 1994).

3.1.5 Technology Readiness Level (TRL)

The maturity, breaking down innovations into stages of development (Technology Readiness Level) was developed by NASA in the 1970s, with seven stages of development. Subsequently, it was then refined by NASA in the 1990s where nine stages of development can be distinguished (Mankins, 2009; NASA, 2020). This classification is still used today and is a well-known way of distinguishing the stages of development of innovations. After NASA, several bodies have adopted this classification, including the European Commission (EC). The EC has translated the stages of NASA's development (Europese Commissie, 2017a).

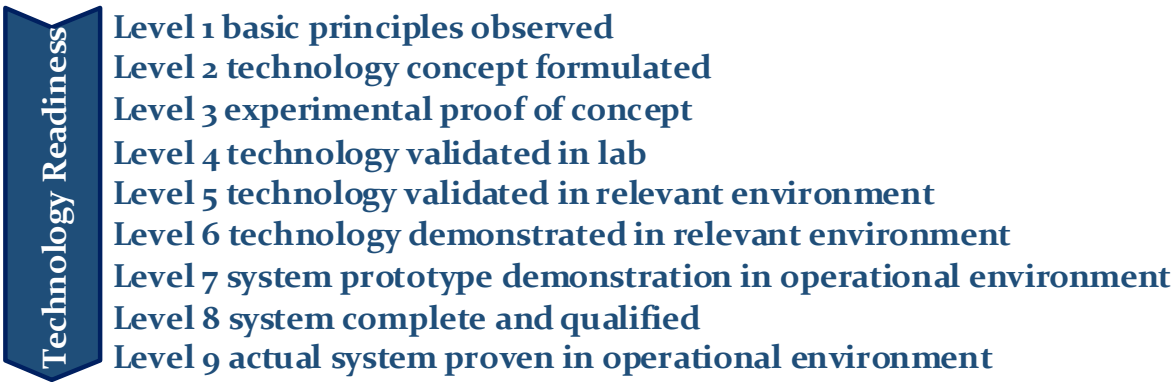

Figure 6 Own figure, TRL according (Europese Commissie, 2017a).

The difference between the different levels is that TRL phases 1 to 4 are stages of development in the laboratory. TRL phases 5 and 6 are stages of development in the relevant environment. TRL phases 7 and 8 are stages of development in the operational environment and with TRL phase 9, the sustainable development is technically and commercially ready for use.

The research by (Ebbelaar, 2019) shows that the TRL levels can be divided into two categories: 1) Products with TRL levels 1 to 6, which require research & development (R&D) before they can be applied; and 2) Products with TRL levels 7 to 9, which are almost developed but still need to be combined within a system.

(Lenderink, Voordijk, et al., 2019) has also carried out research into various types of innovation-oriented procurement approaches. Specifically:

- Developing innovations through triggers;
- Stimulating innovations within a long-term agreement;
- Initiating innovations by stimulating them within the realization of a project.

The innovation-friendly approach has not been taken into account within the research of (Lenderink, Voordijk, et al., 2019) but in order to clarify and compare the characteristics of the three researched innovation-oriented procurement approaches, the innovation-friendly approach has been included in Table 1. From this perspective (Lenderink et al., 2018), it can be noted that for each type of innovation-oriented procurement approach, other methods can be used to stimulate innovations and that these are aimed at innovations in different stages of development.

Characteristics of innovation-oriented procurement approaches	Trigger the development of innovations	Stimulate innovation within long term contracts	Stimulate the implementations of innovations	Innovation-friendly procurement
Targeted TRL	Low TRL (1-3)	Whole range or TRL (1-9)	Medium to medium/high TRL (5-8)	Medium/high to high TRL (7-9)

Table 1 Own table, based on (Lenderink, Voordijk, et al., 2019).

3.1.6 Application to GWW sector

Brundland's term of sustainability from (WCED, 1987): "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" The choice was made to summarize this as having a positive impact on the environment. (Schiederig et al., 2012) had shown that sustainable innovations contain economic, social, and ecological aspects. Where it is difficult to make these aspects practical and what it specifically means for a sustainable innovation. As a definition of product innovation, the term from (Gault, 2005) is applied, namely: "the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses".

For the purpose of this research, I adopt the following definition for a sustainable product innovation: *the introduction of a product that is new or significantly improved with respect to its characteristics or intended use, which has a positive impact on the environment*.

The degree of innovation can be divided into 3 categories: incremental innovation, truly new and/or substantial innovations and radical innovations. This, in turn, can be subdivided according to scale of innovation: from a component, within a module and as a system (Lenderink et al., 2020). In the problem definition, it has been made clear which tender procedures apply to this research (OP, RP, CD and CP). These are by definition, demand-driven procedures. In relation to this research, public procurement is a demand-side measure (Edler & Georghiou, 2007) and (Aschhoff & Sofka, 2009) show that public procurement can be a demand-side tool to stimulate innovations. For the workability of demand-driven innovation, it is necessary to adapt the procurement process of clients so that this is beneficial for innovations (Knutsson & Thomasson, 2014). However, (Herstatt & Lettl, 2004) shows that demand-driven innovations often lead to incremental innovations. By linking incremental

innovations to the TRL level the ambitions of clients in the field of sustainable innovations can be operationalized, because there is insight into the maturity of the sustainable product innovations that are needed to better match supply and demand.

(Slaughter, 1998) shows that an incremental innovation "is a small change, based on current knowledge and experience." It can be argued that an existing product makes a small change in terms of its characteristics or intended use and that the operation of the prototype as a system should be demonstrated in the operational environment according to TRL level 7 (Europese Commissie, 2017a). This is also in line with the investigation of products with TRL levels 7 to 9 (Ebbelaar, 2019). These products are almost developed but still need to be merged within a system. In addition, the research of (Lenderink, Voordijk, et al., 2019) shows that innovation-friendly procurement is focused on TRL levels 7 to 9. For this study, sustainable product innovations with a TRL level 7-9 apply.

3.2 PUBLIC PROCUREMENT

First the Procurement Act is elaborated because this applies to public procurement and the associated procurement procedures. Further it is important to understand what public procurement is, the classification hereof and the procurement approaches to stimulate sustainable product innovations.

3.2.1 Procurement Act

European procurement law applies to public contracts[10] or concession contracts. Both European and Dutch legislation and regulations have a function within procurement law. From a European perspective, the aim of European procurement law[11] is to open up all markets to public contracts for all Member States in order to achieve the Europe 2020 strategy of smart, sustainable and inclusive growth (Essers & Lombert, 2017). In particular, the principles of equal treatment, non-discrimination, transparency, objectivity, and proportionality (Europese Unie, 2014) derived from freedom of movement play an important role in providing fair competition. In order to give substance to these principles, the directives of classic public procurement 2004/18/EU and those of the special sector companies 2004/17/EU in 2016 have been replaced by improved adapted directives respectively 2014/24 EU and 2014/25/EU. These directives have been transformed by the Netherlands into the Procurement Act (AW), which has been applicable since 1 July 2016. In addition to the AW, there are two mandatory guidelines at national level, the Proportionality Guide (GP) and Procurement Regulations Work (ARW).

The AW specifies which clients have an obligation to tender, the contracting authorities and special sector companies. When reference is made to public works contracts, this refers to public contracts, special sector contracts and concession contracts. In addition, for each type of public contract it is also indicated which contracts with a certain monetary value must be put out to tender at European level, these thresholds are updated once every two years for central and decentralized authorities. The monetary value also determines the selection of the right procurement procedure. If the monetary value of the contract is below the threshold, the AW distinguishes national procurement procedures and the multiple procurement procedure.

[10] According to (Ministerie van Economische Zaken, 2020) Part 1.1 Procurement Act, public contracts: "consist of works, supplies, and services or framework agreements".

[11] This refers according to (Verlinden-Bijlsma & Brackmann, 2016): "the laws and regulations governing the process of regulated procurement".

The GP contains instructions and principles for the principle of proportionality[12], because for each monetary value on p.31 is indicated what is proportional and should be used as a starting point. The application of this principle is only aimed at the decentralized government. The content of the ARW is a description of the rules to be followed in the various tender procedures.

3.2.2 Tender Procedures

The AW deals in part 2 with classic public contracts and design contests for public contracts, part 2a concession contracts and part 3 special sector contracts and design contests for special sector contracts (Meent & Stellingwerff Bentema, 2018). The tender procedures for public works contracts are listed in Figure 7. For the purposes of this study, only the OP, RP, CP, and CD procedures apply, as these procedures allow the procurement of sustainable product innovations with a TRL level of 7-9.

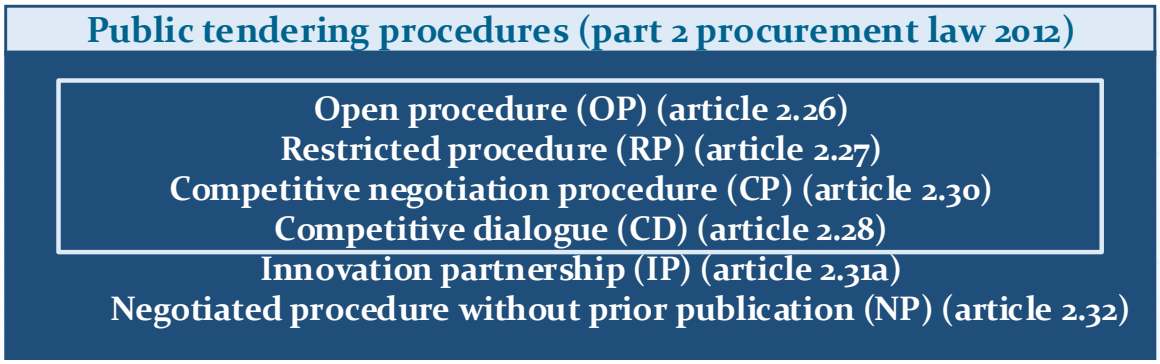

Figure 7 Own figure, procurement procedures from (Meent & Stellingwerff Bentema, 2018).

3.2.2.1 Open Procedure & Non-Open Procedure

The OP and RP are the best-known and most frequently used tender procedures (Schrijfgroep Gids Proportionaliteit, 2016). The difference between the two is that in the OP there is no limit on the number of market participants that decide to bid. The RP allows an unlimited number of market participants to register but a limited number are invited to make a bid.

3.2.2.2 Competitive Dialogue & Competitive Procedure with Negotiation

The CD & CP procedures are applied less than the OP and RP procedures, but they are suitable for the procurement of innovations (Europa decentraal, 2020a). The CP has also been added because this procedure has many characteristics similar to those of the CD. In these procedures, the objectives are fixed from the outset as opposed to an Innovation Partnership (IP). After all, with an IP there is a prior awareness that, based on the current state of the technology, it cannot be achieved. The objective of the IP is not clear from the start (Verlinden-Bijlsma & Brackmann, 2016).

3.2.3 Procuring Innovations

Public procurement refers according to (OECD, 2020): "to the purchase by governments and state-owned enterprises of goods, services and works". These purchases are made on the basis of tenders. A tender is according to (Verlinden-Bijlsma & Brackmann, 2016): "that, with due observance of the applicable rules, the client invites (a number of) market participants to

[12] The principle of proportionality according (Schrijfgroep Gids Proportionaliteit, 2016): "entails that the choices which a contracting authority makes and the requirements and conditions it sets for a tender, must be reasonably proportional to the nature and scope of the contract to be awarded".

submit an offer and, if the client wishes to award an order, awards the order to the contractor who, based on all the client's requirements and wishes, has submitted the most suitable offer". Various researchers have subdivided public procurement into different categories. Categorizing public procurement is essential, depending on whether the product in question is already freely available or still being developed. There is a difference for the procurement of existing products as less interaction will be required than when a new product needs to be developed.

3.2.3.1 Different Types of Procurement Strategies

According to (OECD, 2011), procurement is categorized as regular procurement, strategic procurement and procurement of research and development. Regular procurement is characterized by the procurement of products that are used on a daily basis (Edquist & Hommen, 2000; Yeow & Edler, 2012). In strategic procurement, products that do not yet exist but can be developed within a reasonable time (OECD, 2011) and the procurement of research and development is used to stimulate the development of new products (Lenderink, Halman, et al., 2019). It is important to distinguish between procurement strategies because different methods are used for each type of procurement strategy to stimulate innovations and innovations are required at different stages of development (Lenderink et al., 2018).

3.2.3.2 Approaches to Stimulate Sustainable Product Innovations

In (Lenderink, Halman, et al., 2019), the categorization of regular procurement, strategic procurement, and procurement of research and development (OECD, 2011) was used to distinguish the 7 different approaches that can be used to stimulate sustainable product innovations with public procurement. For regular procurement, there is one approach, for strategic procurement there are four approaches, and for procurement of research and development there are two approaches mapped out. Applicable for this research are the innovation friendly procurement approach and the procurement procedures with negotiations approach because with these approaches, sustainable product innovations with TRL level 7-9 can be offered.

1) Regular procurement and innovation-friendly procurement
- Innovation- friendly procurement

2) Strategic procurement of innovations
- Public procurement of innovatieve solutions (PPI)
- Public procurement for innovation (PPI)
- Forward commitment procurement (PCP
- Using procurement procedures which provide possibilities for negotiations with suppliers

3) Procurement of R&D
- Public procurement of innovatieve solutions (PPI)
- Innovation partnership

Figure 8 Own figure, procurement approaches according (Lenderink, Halman, et al., 2019).

For the innovation friendly procurement approach and the procurement procedures with negotiation approach from Figure 8 within the scope of this research a number of tender procedures are applicable, these are shown in Table 2.

	Innovation- friendly procurement	Using procurement procedures which provide possibilities for negotiations with suppliers
Tender Procedure	Open Procedure (OP)	Competitive Dialogue (CD)
	Restricted Procedure (RP)	Competitive Negotiation Procedure (CP)

Table 2 Own table, procurement approaches and applicable tender procedures.

3.2.3.2.1 Innovation-Friendly Procurement Approach (OP & RP)

Regular procurement is characterised by procurement of products that are used on a daily basis (Edquist & Hommen, 2000; Yeow & Edler, 2012). Based on (Lenderink, Halman, et al., 2019), it appears that stimulating innovations in regular procurement is not the goal, but can be identified as possible by-product. In (Edquist et al., 2015), innovation friendly procurement is explained as procurement which stimulates innovations but also enables innovations. There are four arguments according to (Lenderink, Halman, et al., 2019) to make regular procurement innovation-friendly:

1) Likely to improve the best price-quality ratio (BPQR) of purchased products and services;
2) Current solutions do not meet future needs;
3) Competitiveness will increase;
4) Innovation friendly procurement will have more impact.

In order to make regular procurement innovation friendly, it is necessary to make the procedures by which they are procured innovation friendly. This increases the possibility for certain products on the market (Knutsson & Thomasson, 2014) by adding innovation-oriented criteria as a specification in the tender procedure and when assessing the documents for the tender procedure (OECD, 2011). But also to adjust the procurement process so that it is favourable for innovations (Knutsson & Thomasson, 2014).

From the literature analysis of (Lenderink, Halman, et al., 2019), five methods have been identified that are favourable for an innovative outcome during tenders:

1) Market consultations
2) Specification requirements (functional)
3) Allowing alternatives
4) Award criteria based on BPQR/LC
5) Setting high quality standards

3.2.3.2.2 Tender Procedures (CD & CP) with negotiation approach

Strategic procurement involves procuring products that do not yet exist but can be developed within a reasonable time (OECD, 2011). There are procurement procedures that are suitable for this purpose; these are called innovation-oriented procurement procedures. The innovation-oriented procurement procedures in which it is possible to have individual contact and negotiate are: CD and the CP. The major difference between the two procedures is that the CP procedure is negotiated and is based on a first tender offer. As a result, the contracting

authority will have to explain its needs and requirements in more detail than for a CD procedure (Lenderink, Halman, et al., 2019). To award a CD procedure, only the main award criterion of economically most advantageous tender (MEAT) can be used, which is determined on the basis of BPQR (Europa decentraal, 2020b) and for the CP procedure this can be determined on the basis of award criteria: lowest costs calculated on the basis of cost-effectiveness, such as life cycle costs (LC) and lowest price (LP) (Lenderink, Halman, et al., 2019).

3.3 Procurement Process

In order to gain more insight, it is necessary to know how the procurement process works and how it is organized. Due to the project specific character of GWW projects it deviates from the standard procurement process.

3.3.1 Purchasing Function

The purchasing function from the (Schrijfgroep Gids Proportionaliteit, 2016) and (van Weele, 2014) are shown in Figure 9. Specification, selecting, and contracting is defined from the (Schrijfgroep Gids Proportionaliteit, 2016) as procurement and by van (van Weele, 2014) as tactical procurement. Within these process phases, the work is specified, the contractor is selected and the contract is concluded with the contractor.

Figure 9 Own figure, purchasing function (GP, 2016) and (van Weele, 2014).

Because GWW projects are not products but work, there is a difference in the process phases of ordering, monitoring and after-care. The purchasing function from the (Schrijfgroep Gids Proportionaliteit, 2016) and (van Weele, 2014) have been combined and adapted for GWW projects to Figure 10.

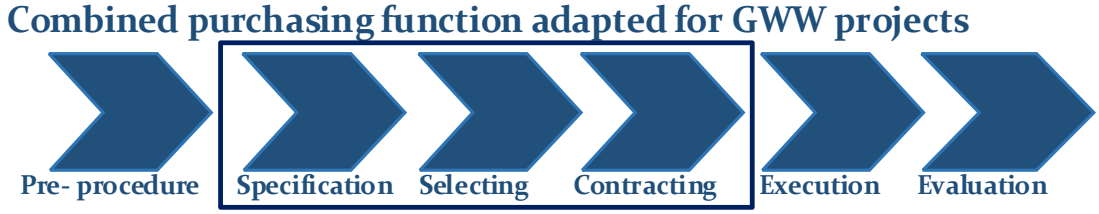

Figure 10 Own figure, procurement function combined and adapted for GWW projects.

This research focuses on the tender or tactical procurement and the process phases of

specification, selecting, and contracting. The reason for this is that from these process phases the end result is determined. The preparation phase is named by the (Schrijfgroep Gids Proportionaliteit, 2016) pre-procedure and by van (van Weele, 2014) specification, as indicated in Figure 9. However, (Essers & Lombert, 2017) has divided the preparation phase into an initial phase and a follow-up phase.

3.3.2 Procurement Process PIANOo

In practice, the procurement process of the contracting expertise centre (PIANOo, 2020a), which is part of the Ministry of Economic Affairs and Climate, is used. For this research, the procurement process of (PIANOo, 2020a) is applied.

Figure 11 Own figure, procurement phases (PIANOo, 2020a).

3.3.2.1 Preparation Phase

The preparation phase from (PIANOo, 2020a) consists of 13 steps, in which conscious, step-by-step decisions have to be taken (Schrijfgroep Gids Proportionaliteit, 2016). These decisions affect the result and thus the effectiveness of the tender (Essers & Lombert, 2017). Where the taken decisions in a certain step can be adjusted by new insights, going through these steps is an iterative process. All steps have been worked out step by step using (PIANOo, 2020a) in order to gain insight per step into the content and decisions taken within a step.

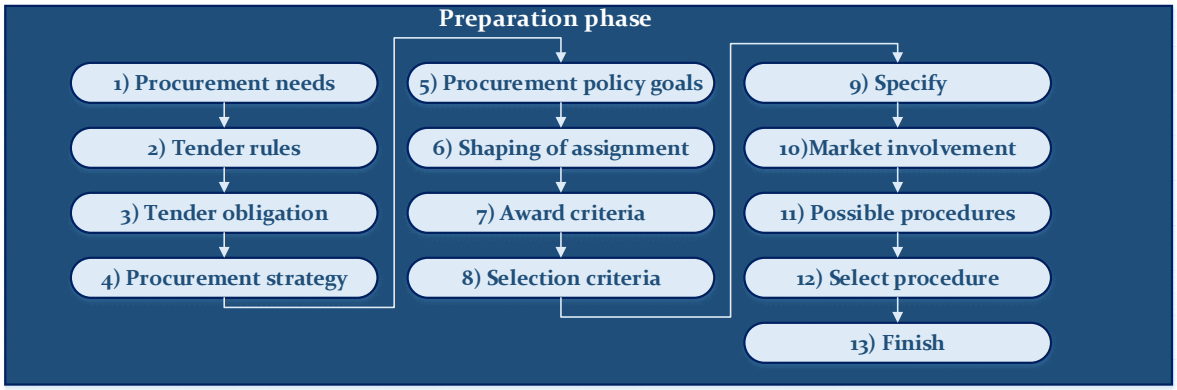

Figure 12 Own figure, preparation phase (PIANNo, 2020a).

3.3.2.1.1 Step 1 Purchasing Need

This phase starts first with identifying the procurement needs of clients, but also what are the characteristics of this, the costs of realizing it and within what time frame it should be done.

3.3.2.1.2 Step 2 Tender Rules

It is necessary to assess whether the mandatory procurement rules apply to the client. Procurement rules from the client can also apply if the client has drawn up his own procurement. If a client has formulated a procurement policy, this will include strategic objectives over a longer period of time.

3.3.2.1.3 Step 3 Tender Obligation

The value of the procurement order is first determined. If the contract value is above the threshold value, then a European tender must be put out to tender by the client. The threshold value depends on the type of client and what kind of assignment it is.

3.3.2.1.4 Step 4 Procurement Strategy

The client draws up a procurement plan for the elaboration and implementation of the procurement policy. In which it is has been worked out, how the objectives will be implemented over a shorter and longer period.

3.3.2.1.5 Step 5 Procurement Policy Goals

In this step, a client can use procurement to implement its desired goals and/or objectives which are included in the procurement policy of the client.

3.3.2.1.6 Step 6 Shaping of Assignment

Clients are free to determine the size and content of an assignment, to achieve the maximum need through procurement. By placing similar contracts on the basis of procurement, similar contracts that fit together in their entirety or in parts on the market. Taking into account the own benefits but also the benefits of the contractors (market participants). For this, it is essential to have knowledge of the market.

3.3.2.1.7 Step 7 Drawing up (sub) Award Criteria

In general, clients will invite several contractors (market participants) to submit an offer. The client must then determine in advance which method will be used to assess the best offer. In order to award a tender, the main award criterion MEAT, which is determined on the basis of award criteria[13]. Applying the BPQR as award criteria is to reward quality as added value and to what extent the offer meets the main criteria and/or sub-criteria. The LP as award criteria means that the client asks for a minimum quality. The awarding of the contract by the client is then up to the contractor who meets the minimum quality and the lowest price. Application of the LC has been newly added to the 2012 Procurement Act and was declared applicable as award criteria on 1 July 2016. Where the costs of a work are related to the entire life cycle of a work.

3.3.2.1.8 Step 8 Drawing up Selection Criteria

The client draws up exclusion grounds, suitability requirements and selection criteria in order to assess contractors (market participants) which are suitable for the execution of the contract. Where exclusion grounds relate to cases that apply to contractors (market participants) themselves and which justify the exclusion of contractors (market participants) to the tender. The suitability requirements are minimum requirements, failure to meet these requirements will result in the exclusion of contractors (market participants) from the procedure. The selection criteria explicitly relate to technical competence aspects of contractors (market participants).

3.3.2.1.9 Step 9 Specify

In order to realize the need by means of procurement, the client draws up a demand specification in which this is further clarified and detailed. The decision by the client for the technical specification[14] or functional specification[15] influences the outcome of the tender procedure. This is because the content of the demand specification determines what will be submitted, how this will be done and whether contractors (market participants) can meet the client's needs.

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[13] The award criteria according to (Ministerie van Economische Zaken, 2020) Part 1.1 Procurement Act: “best price-quality ratio (BPQR), lowest costs calculated on the basis of cost-effectiveness, such as life cycle costs (LC) and lowest price (LP)”.

[14] This refers according to (PIANOo, 2020b): “that is the exact description of the work”

[15] According to PIANOo (2020b): “describes the intended outcome of the work to be completed”

3.3.2.1.10 Step 10 Market Involvement in Specification

The way in which and how thoroughly the client gathers knowledge from the market depends on the size and character of each separate tender. Contractors (market participants) can be helpful in finding solutions to meet the needs of clients through procurement.

3.3.2.1.11 Step 11 Possible Tender Procedures

There are several tender procedures from which to choose in order to place a contract on the market. The value of the contract determines whether it is to be put out to tender at European or national level and the individual characteristics of the procurement contract determine which tender procedure is selected.

3.3.2.1.12 Step 12 Choose Tender Procedure

Choosing an appropriate procedure depends on the individual characteristics of the procurement order. The procedure that is selected is the most effective to meet the needs of the client.

3.3.2.1.13 Step 13 Complete Preparation Phase

The preparation phase ends with how the invitation to participate and the submission of the registration will take place. This then determines the beginning of the tender phase.

3.3.2.2 Tender Phase

In the preparation phase, a decision is taken to apply a specific tender procedure. In the tender phase, the process of the tender procedure is followed. The procedures (OP, RP, CD and CP) have their own process that must be followed, but this can be summarized in the following steps: (a) announcement, (b) selection, (c) exchange of information, (d) award phase, (e) and award.

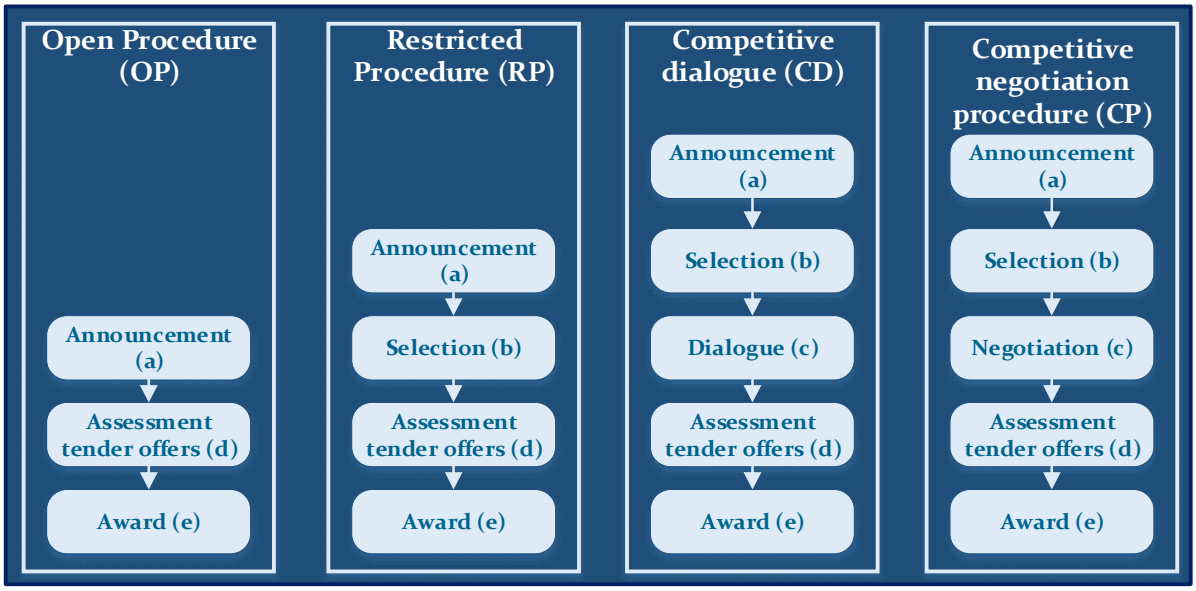


Figure 13 Own figure, steps out of the tender phase (Essers & Lombert, 2017).

3.3.2.2.1 (a) Announcement

The announcement is twofold: on the one hand, contracting authorities announce their intention to put a contract on the market and which tender procedure will be used. In addition to the notice, a description of the contract is also enclosed. On the other hand, it is an appeal to the market participants so that they can express their interest in the contract. In the case of a European tender, the announcement should be published via TenderNed, which is an online

publication platform for tenders of the Dutch government. By publishing it on TenderNed it is also automatically placed on the Tenders Electronic Daily (TED), which is a publication platform for tenders of the European Union. By placing it on TED, the contract is accessible to market participants from other Member States. In national tenders, the notice is placed on TenderNed and of course not on TED. The announcement of the contract is also used to publish tender documents.

3.3.2.2.2 (b) Selection

The application of the selection phase by contracting authorities is to assess the suitability of market participants. Suitability assessment is carried out on the basis of exclusion grounds, suitability requirements and selection criteria. Exclusion grounds relate to cases which apply to market participants themselves and which justify the exclusion of market participants to the tender. The suitability grounds are requirements that market participants must meet at least in order to realize the work. In order to limit the market participants who have been found competent after the exclusion grounds and suitability requirements, selection criteria are applied. The selection criteria explicitly relate to technical competency aspects of the company. The contracting authority first checks that the notification is on time, complete and that it meets the formal requirements. The market participants are then assessed for exclusion grounds. Since the exclusion grounds are so-called knockout criteria, it results in exclusion from the procedure. The suitability requirements are minimum requirements, failure to meet these requirements will result in the exclusion of market participants from the procedure. Market participants must comply with the suitability requirements of the contracting authority at the time of announcement and when the contract is awarded. The following is the assessment of selection criteria. After registration, points shall be allocated by the contracting authority on the basis of the selection criteria. Failure to meet one or more selection criteria may result in zero points being given. This does not result in exclusion from the procedure. The results are then ranked. On the basis of this ranking, the highest-scoring market participants are invited to make an offer during the award phase.

3.3.2.2.3 (c) Exchange of information

In the OP, RP, CD and CP procedures, it is possible to ask questions during the tender procedure to the contracting authority. Both the client and the contractor have an interest in going through the tender procedure efficiently and in keeping each other well informed. The questions are answered in writing by the contracting authority as Memorandum of Information. In the CD and CP procedure, individual consultations between the market participants and the contracting authority are also possible in comparison with the OP and RP procedures. The questions during the individual consultations may cover various topics such as discussing parts of the work, clarifying certain requirements and reporting contradictions in the tender documents.

3.3.2.2.4 (d) Award phase

In the award phase, the tender is assessed. The process is described in an award guideline. This contains information about the contract, the planning, the award criteria and the assessment system. Technical details of the contract are also included in the Tender Specifications and/or Programme of Requirements. On the basis of the MEAT, the tender is assessed during the award phase. The MEAT is determined on the basis of best price- quality ratio (BPQR), the LC and the LP. In the AW this is indicated in Section 2 Article 114 and in Directive 2014/24/EU it is indicated in Article 67 (2). A method used by contracting authorities in addition to the award criteria is the Best Value approach (BVA) or performance procurement. BVA was developed in

the 1990s by Dean Kashiwagi in the United States (PBSRG, 2020). This approach is not laid down by law as a European as well as a national tender procedure.

3.3.2.2.5 (e) Award

After market participants have submitted their bids to the contracting authority, they shall assess the various bids from different market participants at the award phase. The first step is to check whether the tender meets the formal requirements. The contracting authority shall assess the bids made by the market participants on the basis of the predetermined award criteria. Based on the rating of the bids, the results are ranked. The contract is awarded to the market participant with the most economically advantageous tender.

3.3.2.3 Execution Phase

The contract is signed at the tender phase. The contractor will carry out the work as agreed in the contract during the execution phase. The IB can be involved in the execution phase, this depends on the preparation phase and agreements made with the client. The execution phase is only named and explained to have a complete picture; it does not fall under the scope of this research.

3.4 FACTORS OF INFLUENCE (DETERMINING FACTORS FOR AN OFFER)

From the contractor's point of view, there are internal and external factors that influence the bid decision. The internal factors are also important for a contractor, but they have not been considered for this research because the research focuses on stimulating sustainable product innovations through public procurement. These are external factors that influence contractors' bid decisions.

3.4.1 External factors

In the literature, therefore, research has been done on the external factors of influence, determining an offer: bid decision factors of contractors. Most researchers made the factors transparent and ranked them in order of their influence on the bid decision of contractors. However, some of the researchers also investigated a model or framework to support the contractors' bid decision. The research by (Li et al., 2019), shows that a lot of research has been done by different researchers. The bid decision factors of 12 studies from various western and non-western countries were compared with each other. Of the 12 studies, (Leśniak & Plebankiewicz, 2015) was the most recent and carried out in Poland; there are also two studies that were carried out in the United Kingdom in 1992 and 1993, respectively. But also in the Netherlands research has been done by (Slockers, 2019) the most important external bid decision factors of tender for contractors have been determined in the non-residential building sector, based on interviews with contractors. The reason that (Slockers, 2019) and (Leśniak & Plebankiewicz, 2015) are more relevant than the other studies (Li et al., 2019) is because the (sub) award criteria are confirmed as an external factor herein. But also, that (European) procurement law applies in Poland and in the Netherlands. In the table below, only the external bid decision factors are included (Leśniak & Plebankiewicz, 2015; Slockers, 2019).

(Leśniak & Plebankiewicz, 2015)	(Slockers, 2019)
Contractual terms	Contract conditions
Value of the project	Tender documents quality level
Time of project duration	Collaboration form

Award criteria	Project planning
Time for the preparation of the bid	Award criteria
	Prequalification requirements
	Contract type
	Tender procedure
	Pricing mechanism
	Project size
	Tender duration

Table 3 Own table, bid decision factors (Leśniak & Plebankiewicz, 2015) and (Slockers, 2019).

3.4.2 Selecting the external factors

The research by (Leśniak & Plebankiewicz, 2015) was carried out among Polish construction companies and (Slockers, 2019) distinguished between medium and large Dutch contractors, where large contractors are active in the infrastructure sector in addition to the residential and non-residential building sector, making them also applicable in the GWW sector. To select external factors from Table 2, a consideration was made to combine a number of external factors. Subsequently, the description of a number of external factors was changed and when selecting the external factors, account was taken of the methods that emerged from the research by (Lenderink, Halman, et al., 2019) and that are favourable for an innovative outcome. The 5 methods are: 1) Market consultations, 2) Specification requirements (functional), 3) Allowing alternatives 4) Award criteria based on PBQR/LC and 5) Setting high quality requirements. It can be noted that method 1 is not an external factor, method 2 and 5 relate to the contract and method 3 to the tender procedure. The external factors which have been combined, selected, and described differently:

- The external factors that are combined to the external factor size (project)
  - value of the project and project size.
- The external factors that are combined to the external factor planning client (project)
  - time of the project duration and project planning
- The external factor tender documents quality level
- The external factors that are combined to the external factor duration (tender)
  - time for the preparation of the bid and tender duration
- The external factors that are combined to the external factor contract type
  - contractual terms, contract conditions, collaboration form and pricing mechanism
- The external factor tender procedure
- The external factor prequalification requirements
- The external factor award criteria

3.4.3 Description external factors

The meaning of the selected external factors has been described. Subsequently, the importance for this research and why they apply to sustainable product innovations has been indicated.

3.4.3.1 Size (project)

The financial size of a project but can also be the quantity of work within an agreement. According to (Uyarra et al., 2014) small size public procurement contracts hinder innovation and the size of a project affects the potential of a contractor to innovate (Lenderink et al., 2020). It must also be possible to recoup the investment made by a contractor (Arnoldussen et

al., 2017) or to use the innovations developed for specific projects/future projects. Recovery of development costs on a single project is usually not possible.

3.4.3.2 Planning Client (Project)

This is an overview, drawn up by the client indicating which work should be carried out when by the contractor. The overview can indicate start milestones, intermediate milestones, final milestones and other important dates. An innovation is a new development that improves the existing application (Blayse & Manley, 2004; Kulatunga et al., 2011). When an innovation is 'new' or 'significantly improved', there is a chance that the innovation may fail or fail as intended, in contrast to a proven technology. The client should be aware that a contractor has enough time to deal with a setback in the execution of an innovation (Lenderink et al., 2020).

3.4.3.3 Tender Documents Quality Level

The client draws up documents for the tender, these documents are used as a basis by the contractor to make an offer. The quality of these documents relates to the completeness of the documents, the coherence, the structure and the expected level of elaboration by the client. Questions can be asked in writing and depending on the procedure, questions can be asked individually to the client during a dialogue. An obstacle to product innovations may be according to (Rose & Manley, 2014) when it is not clear who is responsible for carrying the risk when an innovation is not functioning properly. The competence of a client can also play a hampering role (Uyarra et al., 2014). Procurement is usually left to buyers, these are not the users of the innovations, so the description in the tender does not meet the demand of the innovation (Yeow & Edler, 2012).

3.4.3.4 Duration (tender)

This indicates the duration of the tender, from the announcement to the moment the contractor has to submit his bid. If a client's objective is to purchase a sustainable product innovation, it should be taken into account that there is sufficient time for the contractor to draw up the bid (Lenderink et al., 2020). (Rose et al., 2019) also shows that too little time results in contractors offering traditional applications/solutions.

3.4.3.5 Contract Type

The contract is an agreement in which the agreements made between the client and the contractor are legally laid down on paper. Within the GWW sector there are a number of types of contracts that can be applied. The choice of the client for a certain type of contract determines the conditions, responsibility of the contractor (e.g. the execution or also the design), but also the form of cooperation and whether the requirements should be functionally or technically specified by the client. Technical specification is an obstacle to the ability to innovate in public procurement (Uyarra et al., 2014) and conflicting interests between the client and the contractor is an barrier for product innovations (Rose & Manley, 2014).

3.4.3.6 Tender Procedure

The client makes a choice to apply a certain procedure, this is the way in which a tender will be carried out. There are various tender procedures that can be applied. Clients often opt for the best known and most commonly used procedures, namely the open procedure (OP) and restricted procedure (RP) (Essers & Lombert, 2017; Schrijfgroep Gids Proportionaliteit, 2016). Structures are becoming more and more complex. The application of the usual procedures (OP & RP) by clients is not sufficient when the ambition is to procure sustainable innovations, these procedures must be modified in such a way that innovations can be offered. There are

tender procedures that are suitable for products that do not yet exist but can be developed within a reasonable period of time and for the development of entirely new products. These are called innovation-oriented procurement procedures. The innovation-oriented procurement procedures are the innovation partnership (IP), CD, CP, the pre-commercial procedure and the design contest. The use of these procedures by contracting authorities is rare, as previous experience with a particular procedure has a significant influence on procurement decisions (Eriksson, 2008). This may be a reason why clients opt for usual procedures, but the research of (Lenderink, Halman, et al., 2019) also shows that the application of innovation-oriented procurement procedures from the available time, resources and expertise is not justified. (Uyarra et al., 2014) indicated that for contractors, having no individual contact and not properly managing risks are perceived as obstacles to the ability to innovate in public procurement.

3.4.3.7 Prequalification Requirements

The application of the selection phase by contracting authorities is to assess the suitability of market participants. Selection criteria drawn up to give priority to certain size and skills ensure that SMEs are excluded and discourage them from participating in the tender (Uyarra et al., 2014).

3.4.3.8 Award Criteria

The approach to assess which bid is suitable on the basis of the criteria drawn up by the client. To award a tender, the main award criterion is the MEAT. The main award criterion MEAT is established on the basis of award criteria[16]. Figures from the European Commission show that in 55% of the cases the LP is used as award criteria and the BPQR is not used (Europese Commissie, 2017b). Despite the fact that the award criteria must be based on the BPQR, the price is often still the determining factor because the qualitative criteria often relate to the execution of the work itself (Versteeg, 2018). (Rose and Manley, 2014) also indicate that there is too much emphasis during the tender process on the execution costs of a project. The construction sector is very competitive and profits are given priority over other issues (Forgues & Koskela, 2009; Häkkinen & Belloni, 2011). In addition, research by the EIB shows that in 75% of the cases the winners had the best value for money but also the lowest price, bearing in mind that quality or innovation aspects are sufficiently taken into account (Arnoldussen et al., 2017). A research carried out by Bouwend Nederland (Procurement Institute) shows that sustainable award criteria are applied in public procurement tenders in 35% of cases in 2019. In 44% of the cases this counted for 15% or less in the award of a public procurement tender. At present, the market is insufficiently rewarded for offering sustainable innovations (Bouwend Nederland, 2019). Hardly any main criteria and/or sub-criteria are used that are aimed at sustainable product innovations because there are more risks involved. As a result, innovations are not rewarded during the tender (Rijkswaterstaat, 2019).

[16] The award criteria according to (Ministerie van Economische Zaken, 2020) Part 1.1 Procurement Act: "best price-quality ratio (BPQR), lowest costs calculated on the basis of cost-effectiveness, such as life cycle costs (LC) and lowest price (LP)".

4 ANALYSIS FRAMEWORK

From the literature study the factors influencing the contractor's bid decision were determined and selected. The meaning of the selected (external) factors have been elaborated but also explained what the importance is and why these (external) factors apply to sustainable product innovations.

4.1 ANALYSIS FRAMEWORK

These selected (external) factors were used to set up an analysis framework for this research. The analysis framework will further be used during the research and for collecting research material.

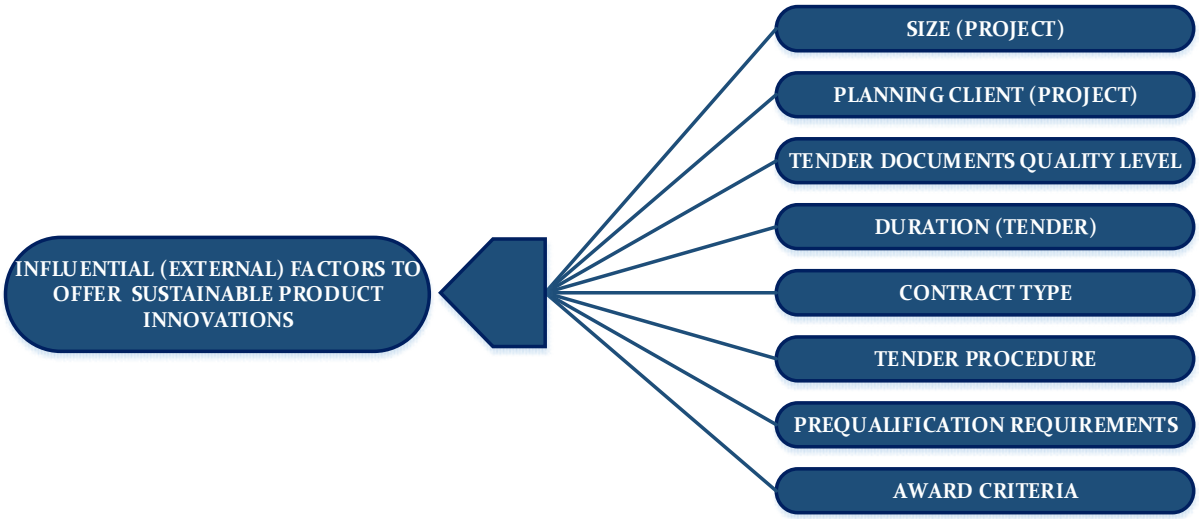
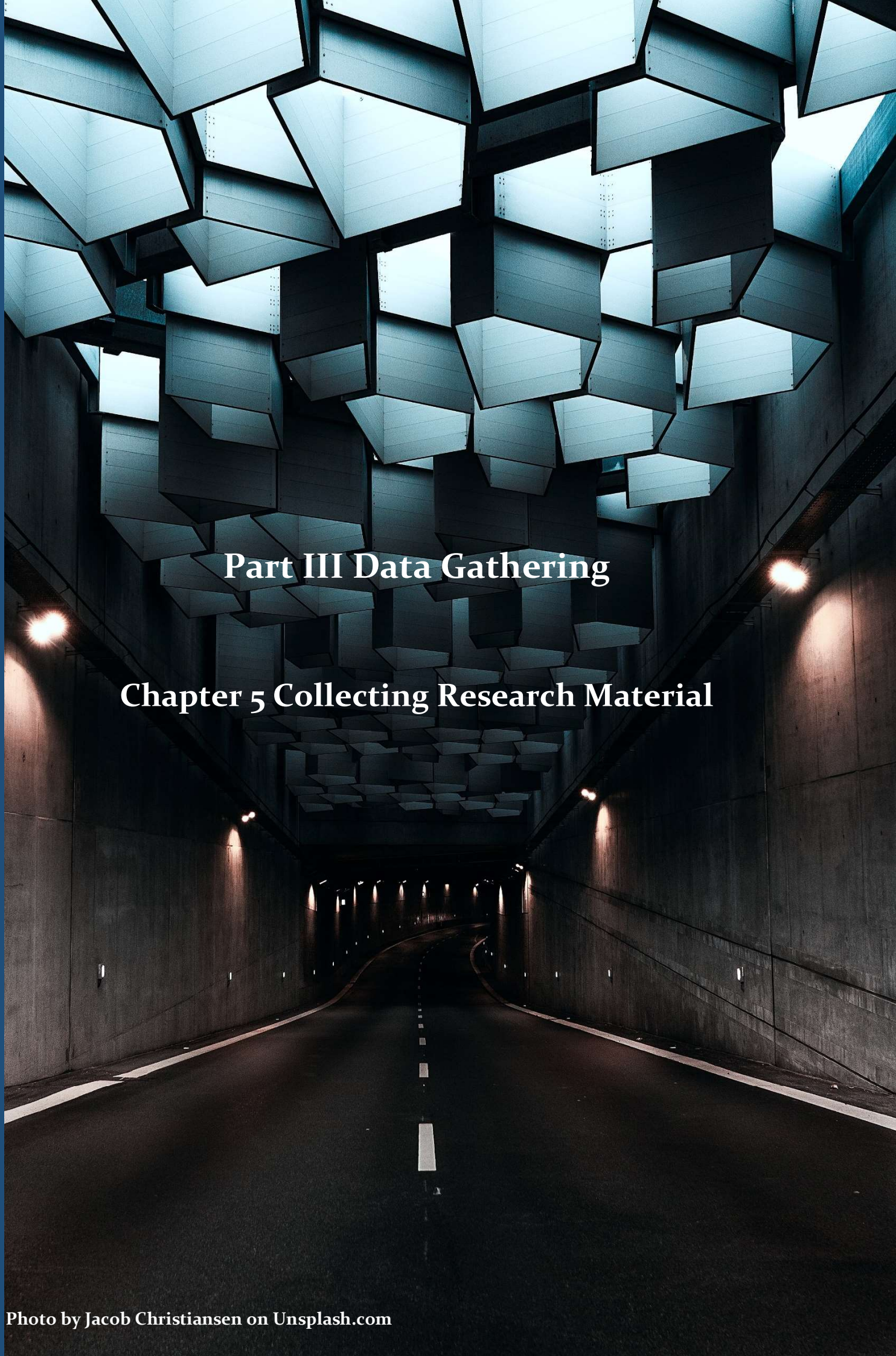


Figure 14 Own figure, analysis framework.



Part III Data Gathering

Chapter 5 Collecting Research Material

Photo by Jacob Christiansen on Unsplash.com

5 COLLECTING RESEARCH MATERIAL

5.1 INTERVIEW STUDY

For this interview study it is necessary to first select contractors from the GWW sector first. This is followed by the preparation of the interviews and the way employees of the various contractors can be selected as participants. In order to select the contractors, this section determines what a contractor is and the determination of the research population for this research, and selecting contractors, within the research population.

5.1.1 Determine Research Population

Construction companies are classified by (Pellicer et al., 2013) according to discipline, type of client, location of work, and size. For this research, the most important classification is the type of client. There are two possibilities, public or private clients. For this research only (public) clients are applicable. The Procurement Act specifies which (public) clients have a duty to tender for public contracts, the contracting authorities and special sector companies. This means that all contractors who actively participate in tenders for public contracts are relevant. The intended contractors for this study consist of small, medium, and large companies that are active and have knowledge of the GWW sector in the Netherlands. The classification of infra small, are companies with an annual turnover of up to 15 million euros, infra medium with an annual turnover of between 15 and 200 million euros and infra large with an annual turnover of more than 200 million euros (Bouwend Nederland, 2020).

According to CBS, in the 4th quarter of 2019, there were a total of 9305 companies in the GWW sector. As a research population for this study, these are too many contractors. Categorizing based on the number of employees can give a distorted picture because sub-contracting often occurs in the construction industry (Pellicer et al., 2013). A condition will be added to reduce the target group. There are several initiatives to promote sustainability in projects and/or works. One of these is the green deal GWW 2.0, which was signed in 2017 by various parties in the supply chain (clients & contractors). Seen from the client's point of view, its aim is "to ensure sustainability throughout the entire tender procedure and to develop a sustainable approach based on projects and practical experiences"(Green Deal, 2020). The ambition of the deal is clear, namely to make sustainability an integral part of GWW projects.

The contractors who signed the green deal GWW 2.0 are relevant for this research, with the exception of Besix and Hochtief. This is because Hochtief and Besix signed the deal with an entity headquartered in Germany and Belgium respectively. By signing the deal, the value and importance of sustainability is recognized by the contractors. For the classification into infrastructure medium and infrastructure large, the turnover data of the specific contractors were used and the entity with which the contractors signed the green deal GWW 2.0 has also been taken into account.

Contractors	Size	Headquarters
BAM Infra Nederland B.V.	Large	Gouda (Zuid-Holland)
Boskalis Nederland B.V.	Large	Rotterdam (Zuid-Holland)
De Vries & van de Wiel Beheer B.V. (DEME)	Medium	Amsterdam (Noord-Holland)

Dura Vermeer Group B.V.	Large	Rotterdam (Zuid-Holland)
Heijmans N.V.	Large	Rosmalen (Noord Brabant)
Knipscheer Infrastructuur	Medium	Almere (Flevoland)
Mourik Groot-Ammers B.V.	Large	Groot-Ammers (Zuid Holland)
Strukton Civiel B.V.	Large	Maarssen (Utrecht)
Van Boekel Zeeland B.V.	Medium	Zeeland (Noord-Brabant)
Aannemersbedrijf Van Kessel Wegenbouw B.V.	Medium	Geldermalsen (Gelderland)
Van den Herik Sliedrecht	Medium	Sliedrecht (Zuid- Holland)
Van Oord Nederland B.V.	Medium	Rotterdam (Zuid-Holland)
KWS (VolkerWessels)	Large	Vianen (Utrecht)
Ploegam	Medium	Oss (Noord-Brabant)
Van Hattum en Blankevoort (VolkerWessels)	Large	Vianen (Utrecht)
Martens van Oord	Medium	Oosterhout (Noord-Brabant)
Oosterhof Holman	Medium	Grijpskerk (Groningen)
Smals Dredging B.V.	Medium	Cuijk (Noord-Brabant)
De Klerk Waterbouw	Medium	Werkendam (Noord-Brabant)

Table 4 Own table, contractors from green deal GWW 2.0.

5.1.2 Select Contractors

It was decided to divide the contractors into two types: wet and dry. Due to the fact that a large number of the contractors carry out hydraulic engineering work, it was decided to classify the contractors whose expertise is dredging under the wet type. The remainder of the other contractors under dry. In order to classify the work nationally or internationally, it was determined whether the contractor/parent company has an office outside the Netherlands.

Type GWW aannemer	Contractor	Size(small, medium or large)	Province (headquarter)	Work
Wet	Boskalis Nederland B.V.	Large	Zuid-Holland	National/ International
	De Vries & van de Wiel Beheer B.V.	Medium	Noord-Holland	National/ International
	Van den Herik Sliedrecht	Medium	Zuid-Holland	National
	Van Oord Nederland B.V.	Medium	Zuid-Holland	National/ International
	Ploegam	Medium	Noord-Brabant	National
	Smals Dredging B.V.	Medium	Noord-Brabant	National/ International
	De Klerk Waterbouw	Medium	Noord-Brabant	National
	Martens van Oord	Medium	Noord-Brabant	National
Dry	BAM Infra Nederland B.V.	Large	Zuid-Holland	National/ International
	Dura Vermeer Group B.V.	Large	Zuid-Holland	National
	Heijmans N.V.	Large	Noord-Brabant	National

	Knipscheer Infrastructuur	Medium	Flevoland	National
	Mourik Groot-Ammers B.V.	Large	Zuid-Holland	National/ International
	Strukton Civiel B.V.	Large	Utrecht	National/ International
	Van Boekel Zeeland B.V.	Medium	Noord-Brabant	National
	Van Kessel Wegenbouw B.V. (KWS/VolkerWessel)	Medium	Gelderland	National/ International
	KWS (VolkerWessels)	Large	Utrecht	National/ International
	Van Hattum en Blankevoort (VolkerWessels)	Large	Utrecht	National/ International
	Oosterhof Holman	Medium	Groningen	National

Table 5 Own table, type of classification of GWW contractors.

From Table 5 a selection has been made of the following wet and dry GWW contractors.

Contractors	Size, Work & Province
Boskalis Nederland	large, national/international, Zuid-Holland
Van der Herik	medium, national, Zuid-Holland
De Vries & van de Wiel	medium, national/international, Noord-Holland
Ploegam	medium, national, Noord-Brabant
Strukton Civiel	large, national/international, Utrecht
BAM Infra	large, national/international, Zuid-Holland
Van Kessel	medium, national/international, Gelderland
Heijmans	large, national, Noord-Brabant
Knipscheer infrastructuur	medium, national, Flevoland
Oosterhof Holman	medium, national, Groningen

Table 6 Own table, selection wet and dry GWW contractors.

5.1.3 Select Contractors within Research Population

To select a contractor outside the list of contractors (Table 6) but within the research population is useful and helpful to assess whether similar findings are made about the influential (external) factors to offer sustainable product innovations. However, it is also an efficient method for the researcher to test himself in order to avoid making simple conclusions from the analysis (Seidman, 2006). In addition, Table 6 does not include an infra small contractor. Because of this, it was decided to add aannemersbedrijf van Ooijen to the list of contractors.

5.1.4 Selected Contractors

A total of 12 contractors have been selected for this research. Taking into account small, medium and large companies, wet and dry contractors, national and/or international execution of work and the location of the headquarter.

Contractors	Size, Work & Province
Boskalis Nederland	large, national/international, Zuid-Holland
Van der Herik	medium, national, Zuid-Holland
De Vries & van de Wiel	medium, national/international, Noord-Holland
Ploegam	medium, national, Noord-Brabant
Strukton Civiel	large, national/international, Utrecht
BAM Infra	large, national/international, Zuid-Holland
Van Kessel	medium, national/international, Gelderland
Heijmans	large, national, Noord-Brabant
Knipscheer infrastructuur	medium, national, Flevoland
Oosterhof Holman	medium, national, Groningen
Aannemersbedrijf van Ooijen	small, national, Utrecht

Table 7 Own table, selected contractors.

5.2 Interview Preparation

Good preparation ensures that the interviews can be carried out successfully, preparation prevents poor performance (Saunders et al., 2009). It is important to select the interview type first and then the selection of participants. This followed by the preparation of the interview questions and the protocol for the interviews.

5.2.1 Interview Type

The first thing to do is to determine which type of interview is the most suitable. According to (Saunders et al., 2009), non-structured interviews and semi-structured interviews are often referred to as qualitative research interviews.

Interview type	Interview type explanation
Not structured or in-depth interview	No list of specific questions, making it an open and informal conversation (Saunders et al., 2009).
Structured interview	List of questions managed by the interviewer, there is not much room to respond to given answers (Fellows & Lui, 2015)
Semi-structured interview	List of topics with questions to raise and discuss (Saunders et al., 2009).

Table 8 Own table, interview types and description.

For this study, a semi-structured personal electronic interview is the most obvious choice. Because interviews are held on the basis of the analysis framework, it should be possible to respond to answers from participants in order to be able to ask additional questions and collect data. Because of the interaction between researcher and participant there is a possibility that information, which is not relevant for this research, will emerge. To prevent this from happening, discussion topics and related questions are drawn up. At the end of each interview it should be checked whether all the interview topics have been discussed.

5.2.2 Selecting Participants

After the contractors have been selected and the desired interview type has been determined, the next part is the selection of participants. In order to select participants for an interview study, the sample with a maximum variation where this can relate to location and persons provides an effective basic approach (Seidman, 2006). Criteria have been drawn up with which

employees of the relevant contractors can be selected. The participant has experience with the tender process or is involved in the tender process and has knowledge and experience of sustainable product innovations. Finally, the organizational structure of contractors generally consists of a line organization where a number of departments fall under the management, specifically the staff department and the design department. The staff department, consists of an administrative and commercial department (bedrijfsbureau), the commercial department is responsible for tendering projects and the design department consists of a support, procurement and execution department, the execution department is responsible for the execution of projects (Pellicer et al., 2013). After a contract has been awarded, the contractor sets up a temporary or independent organisation for the realisation of the contract. The aim is to select participants from both the commercial (bedrijfsbureau) and the execution department. The goal is to interview the following positions of the selected contractors: head of business office (bedrijfsbureau), tender manager, project manager, sustainability and innovation consultant. The number of participants to be interviewed has yet to be determined. A lot of research has been done by researchers in this area, in order to develop guidelines for this. According to (Bertaux, 1981) "fifteen is the smallest acceptable sample size in qualitative research." On the other hand, (Creswell, 2007) indicates that between 20-30 interviews are required. While (Guest et al., 2006) states that data saturation occurs early, after a study in Africa with six interviews, 34 codes out of a total of 36 were identified and after 12 interviews, 35 out of a total of 36 codes were identified. For this study, it is considered that seven interviews are sufficient, since (Saunders et al., 2009) indicate that for the validity, understanding and insight, it does not depend on how many participants are interviewed but on the competence of the researcher in researching and analysing research the material.

5.2.3 Drafting Interview Questions

The way in which questions are articulated and formulated is influencing, how participants answer the questions. Asking good questions consists, according to (Patton, 2014) at least of the following points:

- Asking open questions;
- Asking single questions;
- Asking clearly formulated questions;
- Asking neutral questions;
- Being reluctant to ask why.

On the basis of the points listed, a protocol was drawn up for the semi-structured interviews and the associated interview questions, see Appendix B interview protocol. In addition to the interview questions, the foundation of the interviews, follow-up questions and probes questions can be distinguished. The follow-up questions are aimed at identifying markers with which a signal can be explored, but by using probes the researcher can gain more depth on a question and indicate the expected depth of the answer (Patton, 2014). The interviews will be based on the analysis framework and will take about one hour.

5.2.4 Protocol for the Interviews

The ambition of the interviews is to collect research material to assess the (external) factors on the analysis framework. To determine what, according to contractors, are the influential (external) factors to offer sustainable product innovations. The approach to determine this consists of 3 steps. The elaboration per step:

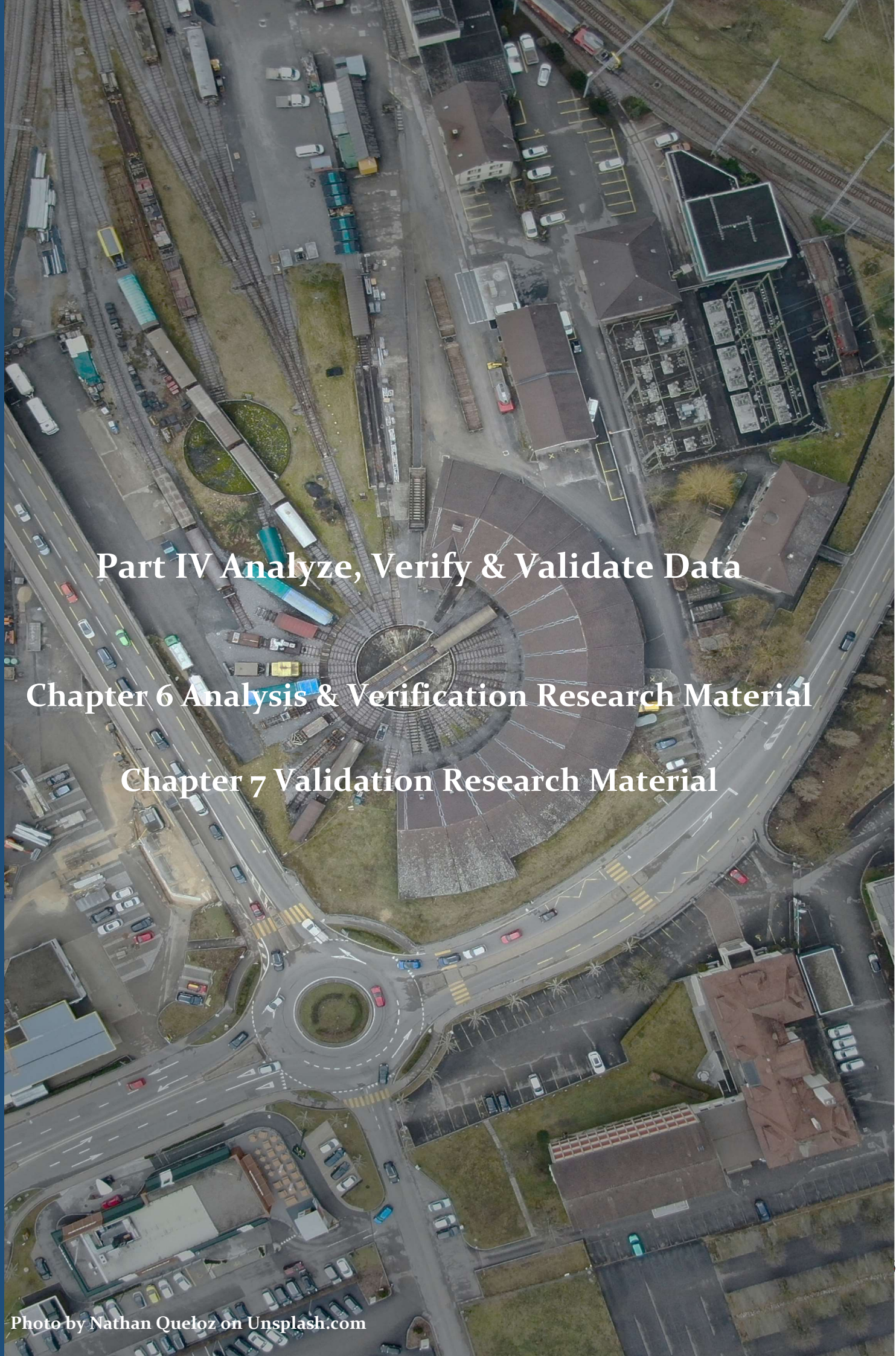
- **Step 1:** In order to collect data regarding the influence of the (external) factors, the identified (external) factors in 3.4.3 and as indicated on the analysis framework, are used as a basis to formulate questions for the purpose of the interviews.
- **Step 2:** Questions are drawn up for each (external) factor. The questions are first formulated as concept questions. Both general questions and specific questions about the (external) factors. The goal was to develop a structure for the final interview questions.
- **Step 3:** In this step, the concept questions were used as a basis to draw up the final interview questions and to request feedback from the research supervisors. The probes questions and follow-up questions are also prepared and drafted, but the execution of these questions during an interview is difficult because it depends on how an interview goes. The final interview questions are included in Appendix B interview protocol.

5.3 INTERVIEWS

The contractors in 5.1.4 were contacted by telephone or e-mail, using the criteria set out in 5.2.2. In preparation, the participants were provided with the data from the interview protocol: why the research, why the interview, interview structure, analysis framework and findings from the literature. A total of seven interviews were held, with the following participants and positions represented as indicated in Table 9. These are functions of both the commercial (bedrijfsbureau) and the execution department. The interviews with the participants were conducted in week 24 to 27. In Appendix C, the interviews and more details of the interviews are given. The details include, the position, the organization for which the participant is working, education, participant's experience in the field of sustainable product innovations, where the interview was conducted, and information about when the interview took place. After the interviews the transcriptions were given to the participants for verification.

Participant	Position	Company
Participant 1	Sustainability Coordinator	Heijmans
Participant 2	Department coordinator sustainability	Boskalis
Participant 3	Director (co-owner)	Aannemersbedrijf van Ooijen
Participant 4	Head of business office (bedrijfsbureau)	BAM infra
Participant 5	Head of project acquisition	van der Herik
Participant 6	Project Manager	Strukton Civiel West
Participant 7	Director of innovations	Ploegam

Table 9 Own table, Interview details (participants, position & company).



Part IV Analyze, Verify & Validate Data

Chapter 6 Analysis & Verification Research Material

Chapter 7 Validation Research Material

Photo by Nathan Queloz on Unsplash.com

6 ANALYSIS & VERIFICATION RESEARCH MATERIAL

Sub-question 2 is as follows: *What are the influential (external) factors of the procurement phase according to contractors to offer sustainable product innovations?* In order to answer this question it is necessary to elaborate the research material. First of all, this chapter describes the findings in practice on sustainable product innovations, then analyzes the elaboration of the (external) factors to a conclusion of findings on the (external) factors and finally the recommendations of the participants on the procurement system and other aspects.

6.1 FINDINGS IN PRACTICE SUSTAINABLE PRODUCT INNOVATIONS

6.1.1 Definition of Sustainable Product Innovation (practice)

For this study, an assumption was made for the definition of a sustainable product innovation, based on the literature study: *the introduction of a product that is new or significantly improved with respect to its characteristics or intended use, which has a positive impact on the environment.* During the interviews, the participants were asked what they consider to be a sustainable product innovation so that theory and practice can be compared. The reactions of the participants show that they have a different experience in practice than what is theoretically depicted of what a sustainable product innovation is. If this is then compared with what has been assumed for this research as a sustainable product innovation, then the similarities and differences emerge.

The similarities are particularly focused on the *positive impact on the environment* because the contractors indicate the following: contractor **A01** "*has a positive contribution to a sustainability aspect*", contractor **A04** "*reduced impact on the environment*", contractor **A06** "*low impact on the environment*" and contractor **A07** "*output on sustainability*" and *"that has become lower, that has improved".* There was an additional emphasis on the introduction of a product that is new or significantly improved in terms of its characteristics or intended use: contractor **A01** indicates "*an innovation can be a combination of a number of normal traditional solutions but can also just be a completely new solution*", contractor **A03** says they "*are great innovative things*". The differences focus on the fact that the participants are much more specific in explaining what a sustainable product innovation is and the adopted definition of sustainable innovation is not.

Participant	What do you think is a sustainable product innovation?
A01	*"An innovation that has a positive contribution to a sustainability aspect, in which very often reference is made to CO2 and MKI as the measurable things that are asked for. But also with some regularity reference is made to the ambition web and then you talk a bit more about the more difficult to measure aspects like water, space, well-being" and "An innovation can be an interplay of a number of normal traditional solutions but can also just be a completely new solution".*
A02	*"If you innovate on the subject of energy, sustainability or energy circularity and livability. When I really look at product innovation, then I really see something tangible that you can apply outside at work... cement more under material innovation".*
A03	*"Are great innovative things".*

A04	*"A product that helps reduce the impact on the environment and actually lowers it, and actually the best thing is if you have a product where you won't need primary raw materials".*
A05	*"Sustainable product innovations are re-use of circularity partly from residual products or less high-quality products and recycled products".*
A06	*"That is a product that, compared to the purchase, has a long life and low impact on the environment".*
A07	*"Sustainable product innovation is in my opinion an innovation that ensures that the output on sustainability then you can talk about material use or about emissions or about energy use that has become lower, that has improved".*

Table 10 Own table, meaning sustainable product innovation according to participants.

6.1.2 Importance of Sustainable Product Innovations for Contractors

For contractors **A01**, **A02**, **A04**, **A05**, **A06** and **A07,** it appears that it is very important to offer sustainable product innovations, because it enables contractors to distinguish themselves from their competitors, for contractor **A03** it is also important, because it is a small company, that the work largely consists of RAW contracts where it is more difficult to offer sustainable product innovations: contractor **A01** said, "*that's where your distinctiveness lies. Innovation is something you have, something your competitor just doesn't have yet, but these are the places where you can make a difference*". Basically, it is important for contractors **A01**, **A02**, **A05**, **A06** and **A07** to develop and offer sustainable product innovations during tenders, but the space must be there. Also, it must not cost more than has been invested and contractors must be able to recoup this investment: contractor **A05** "*provided that this enables us to distinguish ourselves in terms of either price or, above all, MEAT criteria, that we can create an advantage over our competitors*".

6.1.3 Approach to offering Sustainable Product Innovations

The client's tender documents are assessed first: contractor **A07** indicates "*your client's ambitions and the extent to which he wants to appreciate them ... the other analysis is what you have in house and that is what you try to match*". Next follows whether it is possible to offer a sustainable product innovation in the tender: contractor **A02** says, "*what is in the requirements of course, not only the award criteria, but also the requirements*". The next step is to assess the feasibility and costs of the sustainable product innovation: contractor **A05** "*will weigh up different variants against each other and take into account the potential qualitative score you think you can achieve with the client*". If there is sufficient support within the tender team for a specific, sustainable product innovation, this is submitted to the tender board/management. This specific sustainable product innovation can be assessed positively or negatively by the tender board/management, depending on internal requirements and the policy of the contractor: contractor **A02** said "*that sustainability must be in balance. We want it to do something on energy, but not to the detriment of circularity or livability, that's what is being looked at*". The most important decision is that a sustainable product innovation often requires an investment that has to be made, the question is whether the costs can be recouped as a whole on one tender or on one project, or whether the costs can be recouped over a number of years because the sustainable product innovation can be used on several tenders or projects. The decision on whether or not to offer a sustainable product innovation is ultimately made by the tender board/management. However, the participants can influence this both directly and indirectly. The indirect influence is more focused on increasing awareness of sustainable product innovations and the direct influence is exerted when participants themselves participate in tenders.

6.1.4 Sustainable Product Innovations already developed by contractors

There are sustainable product innovations that have already been developed by contractors, but these are not offered during tenders, a number of reasons are given: contractor **A01** mentioned legislation and regulations that specify requirements for the reuse of materials in asphalt, contractor **A02** indicated the material (washed soil ash) used by certain clients (Rijkswaterstaat) but the contractor foresees that it can also be used in for example, dike cores however, there is no cooperation from clients (water boards), contractor **A05** said the VGZ innovation legislation and regulations are a barrier but there is also the issue of some clients wanting to take the risk and others not, contractor **A06,** solar cells in cycle paths and contractor **A07** said emissions free large earthmoving equipment because the client does not rewards this in the form of a fictitious discount during tenders.

Participant	Are there currently sustainable product innovations that your organization has already developed, but cannot offer during tenders?
A01	*"Yes, but they still have a too low TRL level" and "there are also some that are not currently covered by current laws and regulations".*
A02	*"Yes, we do indeed have Beaumix, which is a washed soil ash, which comes from the incinerator".*
A03	*"No"*
A04	*"No, I can imagine that there will be innovations that have not come to fruition".*
A05	*"Yes, we have developed VZG that is a vertical sand and geotextile, that is a way to prevent piping, that instead of a retaining embankment or a sheet piling, you can apply a relatively cheap geotextile in the soil".*
A06	*"We are working on solar cells in cycle paths and we have them on the shelf and we offer them occasionally".*
A07	*"We currently have a major innovation running on the electrification of large earthmoving, large electrical machines".*

Table 11 Own table, existing sustainable product innovations according to participants

6.1.5 Contextual Elements for Successful Innovation

In 2014, Rose and Manley conducted research into product innovations in Australian Infrastructure projects, to get a clear picture of this. From this, four contextual elements identified for successful innovation: industry relations, procurement systems, regulatory conditions, and organizational resources. Participants were asked whether these contextual elements are recognizable for successful innovation. Contractors **A01**, **A02**, **A05**, **A06,** and **A07** all recognize the contextual elements for successful innovation: contractor **A01** *"the trajectory to get from an innovation to a certified innovation, that just takes a lot of time, money and energy"*. Exceptions: contractor **A04** recognizes relationships within the sector, procurement systems and organizational resources and **A03** only recognizes organizational resources as contextual elements for successful innovation.

6.1.6 Potential for New Projects

Slockers research in 2019 shows that the potential for new projects influences a contractor's bid decision, because they have a reference by applying it and they can differentiate themselves in this way. Participants were asked whether the potential for new projects is decisive. It was indicated as important by contractors **A01**, **A02, A04**, **A05,** and **A06**: contractor **A05** stated "*that VZG what I mentioned earlier, vertical sand and geotextiles, we really stepped in because we see great potential there. A lot of kilometers of dike have been rejected on that failure mechanism piping that is certainly a business model for us in which we can make a distinction in the future*

in the tender process". As an exception to this, contractor **A03** indicates that it must be a special innovation and contractor **A07** indicates that there must be a balance between costs and risks.

The decisive argument according to contractors **A01** and **A06** is the reference. For contractors **A04**, **A05,** and **A07,** the probability of success compared to the investment costs is a decisive argument. Where the relationship with the client is important for estimating the chance of success of a sustainable product innovation. For contractor **A02** his own motivation is also important and for contractors **A03**, **A05** and **A06** the image plays a role, but that is not decisive.

6.2 ELABORATION (EXTERNAL) FACTORS

6.2.1 Size (project)

The size of a project is not decisive for offering sustainable product innovations. What does matter is the choice of contract form, which is determined by the client.
Contractors **A02** and **A04** state that, in the case of a RAW contract, the client has already determined what needs to be done and applied, this restricts the application of sustainable product innovations: contractor **A04** states that *"that depends on the type of contract they choose and, of course, the size is also important, but it's more in the preconditions, to what extent you have the freedom to apply something or not. Then the project does not have to be large"*.

Another important aspect for contractors **A01**, **A02**, **A03** and **A04** is how sustainable product innovation is rewarded by the client. If there is no reward in the form of a fictitious discount, it is not practically feasible to offer a sustainable product innovation because then the costs do not outweigh the benefits because traditional solutions are often cheaper. If a client makes a conscious choice to request a work of which sustainable product innovations are a (major) part, then the client should be aware that the costs are higher than when carrying out a work with which only traditional solutions are applicable: contractor **A01** *"if only a client puts a value on it. Because if the valuation is not on it, the costs are often higher than the traditional variant"*.
Contractors **A02** and **A07** note that on a large project it is easier to apply a sustainable product innovation, because project results are less dependent on the success of the sustainable product innovation: contractor **A02** describes this as *"the larger project, the easier it becomes but also the more you can apply"*.

Contractors **A04**, **A05,** and **A06** have no preference for project size. What plays a role is the availability of a sustainable product innovation, to which part the sustainable product innovation applies and how often you can apply it. It is important to carefully examine the investment costs, which contractor **A05** points out: *"innovations often require a one-off investment before it works, the more I can deploy it, the more profitable it becomes"*.

6.2.2 Planning client (project)

The client's planning is a determining factor for contractors to offer sustainable product innovations. After all, if a client does not take sustainable product innovations into account in the planning and a work has to be carried out as quickly as possible, contractors **A01**, **A04, A05,** and **A06** would opt for traditional solutions. What is also important for contractor **A02**, is to which part the sustainable product innovation applies, as this plays a critical role. And for

contractor **A06,** when the sustainable product innovation is deployed, for example at the start of the project or at the end of the project: contractor **A04** *"in the tender, however, the consideration is always made of what is stated in the duration, it can sometimes be a limitation"*. When the client does take sustainable product innovations into account in its planning, this gives contractors **A01**, **A04** and **A05** time and space to complete and apply the development process: contractor **A04** *"Amsterdam has drawn up the cooperation agreement for asphalt, which is an example of a type of request that does lead to innovation. A deliberate choice was made for a duration of 6 years for the contract"*.

When applying sustainable product innovations, the TRL (technology readiness level) is important for contractors **A04** and **A06** before it can be deployed. This depends on whether a development process needs to be completed first, because then it may happen that it cannot be applied at this moment but only when the development process has been completed. For the client it also has an advantage: contractor **A06** puts it as follows *"a client must be included in it, be given the opportunity to understand it, to know what it means for his own organization"*.

There are no specific characteristics of planning that are decisive when offering sustainable product innovations: contractors **A05** and **A07** mention the preparation phase, contractors **A01** and **A06** mention start of execution, contractor **A02** mentions phasing and end date, contractor **A04** mentions completion date and contractor **A03** says duration. Despite the fact that the contractors have different points of view, the start of execution is an important specific feature of the planning because this date is driven by the preparation phase, in which decisions are made on the design and related sustainable product innovations to be applied.

6.2.3 Tender documents quality level

The quality of the tender documents is not decisive for contractors to offer sustainable product innovations. The quality of the tender documents is important, but in the case of a RAW contract it makes no sense, because you can't innovate because the client has already determined what needs to be done and applied, so you are limited in applying sustainable product innovations: contractor **A03** *"I relate it, back to the RAW system, we can't do much with that. If a specification is well written and a client knows what he wants and has made his wishes clear, we can't go anywhere"*.

But the quality of the tender documents is important in order to be able to test the client's requirements according to contractors **A03** and **A05**: contractor **A05** *"you do need to be able to test your innovation to see whether it meets the client's requirements"*. In addition, according to contractor **A02**, the tender documents must clearly show what a sustainable product innovation is and what the client wants in terms of sustainable product innovations: *"I want a sustainable product innovation, we really can't do anything with it"*. Contractor **A07** indicates that the quality of the tender documents rather plays an indirect role because it says more about the organization of the client. This is in contrast to contractor **A06**, who does not consider it important because one has to rely on one's own organization or one's own product.

As a decisive aspect for the quality of the tender documents, the coherence of the tender documents is indicated by contractor **A02** and **A07.** Contractor **A02** gives an addition to this, namely the coherence of the Memorandum of Information.

6.2.4 Duration (tender)

The duration of the tender is a determining factor for contractors to offer sustainable product innovations. The TRL level of an innovation is important for contractors **A02**, **A05,** and **A06** as it is important for the duration of the tender. The duration that a contractor receives from the client determines whether contractors have enough time to research the sustainable product innovations that can be submitted and then discuss them with the client: contractor **A05** says, *"depending on the level of where your innovation stands, you can deploy it immediately. It is often a good idea to have a longer tender period and preferably also to have moments of dialogue with the client to test your proposals"*. Contractor **A02** has the added expectation of the client with regard to TRL level: contractor **A02** says *"you can apply innovations with various TRL levels, does the client only expect a TRL level 8 then we can approach a lot of suppliers and then we can include it in the offer"*. On the other hand, the choice of tender procedure by the client is important because it affects the duration of the tender. The complexity of a project also plays a role in duration. For a RAW contract, the duration of a tender is less important because everything is more or less fixed. It is also disadvantageous for contractors if the duration of a tender is very long, according to contractor **A07**, because it costs too much: *"the duration should depend on the complexity of the project and the other side of a long duration is that it is very expensive"*.

The duration of a tender depends on what kind of products the client wants. When plans have to be submitted, contractors **A04**, **A05** and **A06** would like the duration to be longer: contractor **A04** *"what I experience is that tenders we carry out contain sustainability, you often see that it does help if you have more time to come up with the offer"*. But it also depends on how many innovations a client wants to have worked out according to contractor **A02**: *"it's a bit the expectation of what the client wants, what they want and also the amount of innovations. We have also been asked to offer a minimum of 4 innovations, then of course that takes more time to work it out"*. But according to contractor **A06,** the quality of the tender documents is also important for the duration of a tender: *"that is also the quality of the tender documents, because if it is high quality, if it is coherent, if it is complete then you don't need a tender procedure of months"*.

Contractors **A01**, **A03** and **A04** have not expressed a preference for the duration of time to be able to offer sustainable product innovations, but they do indicate that if a client has a certain expectation of a contractor to work it out to a certain level, more time will be needed during the tender process. Contractors **A02** and **A05** have expressed a preference for a duration of 4 months and contractors **A06** and **A07** 3 months.

6.2.5 Contract Type

The contract type of a project is decisive for contractors to offer sustainable product innovations because the type of contract, but also the form of collaboration, price mechanism, how the requirements are specified, the contract terms and conditions determine how much freedom there is to deviate from products in order to apply sustainable product innovations. Contractors **A02**, **A03**, **A04, A05**, **A06** and **A07** argue that a UAV-GC already offers room for sustainable product innovations, but that the RAW and EB (engineering and build) contracts obstruct sustainable product innovations: contractor **A07** *"we also notice that the EB projects no longer offer that opportunity because agreements have already been made by the client with the competent authority and licensors"*. In addition, contractor **A02** prefers the DBM (design, build and maintain) and PDB (plan, design and build) contracts: *"I myself am an proponent of a*

DBM, which also includes a component maintenance. For your innovation you know what it does in the long term because you have to maintain it". Contractor **A07** also expresses his preference, just like **A02,** for a PDB contract: contractor **A07** says, *"with a PDB contract you can still shape innovation, but also that the permits and the agreements with the competent authority that are made by the client at the front, that they include innovation".*

Contractors **A01**, **A03**, **A04,** and **A07** consider the form of collaboration to be decisive because contractors want a collaboration instead of a hierarchical relationship with the client and in order to further develop a sustainable product innovation a collaboration is also more beneficial: contractor **A07** says, *"the form of collaboration is important. Because that is where you have the most opportunities to position and place your product innovations properly and to show the interests and benefits for the client".* Also, the risk profile by contractor **A01** and the requirements by contractor **A02** are indicated as a decisive aspect of a contract. Then an initial selection is made based on feasibility, but also whether it fits within the philosophy and way of acting of an organization.

Contractors **A01**, **A03**, **A04**, **A05**, **A06** and **A07** have indicated their preferred form of collaboration as the construction team (bouwteam). Within this form of collaboration, choices are made jointly in the field of sustainable product innovations, but it also offers advantages because both client and contractor have more insight into each other's interests: contractor **A05**, *"the construction team is our preferred choice because then you and the client as a team are going to develop that further".* Contractor **A04** complements this and that is that a client's intention to choose the construction team should be a pure choice to develop sustainable product innovation and not to make up for lost time in order to realize the project on time. Contrary to the other contractors, contractor **A02** does not have a preference for the form of collaboration but rather for what kind of person on the other end of the client's table: *"the type of person is more important to me than the form of collaboration you are in".* Contractors **A01**, **A02**, **A03, A04**, **A05**, **A06,** and **A07** have all expressed a preference for functional specification, because here contractors have more freedom and space to apply a solution: contractor **A07** specified *"for innovations, functional specification is by far the best. Innovations are ideas that haven't come to the surface before and specifying them technically has a hampering effect".* For sustainable product innovations, the preference for contractors **A01, A05** and **A07** is not based on a fixed price, because the application of innovations involves risks and this can also have consequences for the price. Contractor **A04** and **A05** express their preference on a cost-plus basis (regiebasis), if there is a commitment to each other between the client and contractor, it can have advantages, but the disadvantage for a client is that there is no control of the money: contractor **A05** says, *"for innovations I would say a cost-plus basis, fixed price is never entirely fair because it is something new, you don't really know what is going to happen and then you either price a lot of risks, then it becomes very expensive for the client or you take it for a fixed amount that is too low, in which case you fall short yourself".* Contractors **A06** and **A07** express a preference based on target. If targets are set, both client and contractor have an interest in keeping costs within a certain bandwidth: contractor **A07** elaborates**,** *"in that respect, I believe that the target price approach best serves the interests of both parties".*

Contract conditions which obstruct work, this is indicated up to which level the client works out the design, if according to contractor **A01** and **A05** the client has worked out the DO (final design), there is little space left and this causes a limitation of design freedom. Contractor **A05** adds the following: *"if alternatives are excluded, if a DO is provided to which you are bound, this*

actually means limiting design freedom". The RAW contract and its characteristics are perceived by contractors **A01**, **A02,** and **A03** as obstructing because everything is laid down and prescribed in the RAW contract. But there are also stimulating contract conditions appointed by contractors **A05** and **A07**, these relate to risks. It is stimulating for contractors when the risks are borne by both the client and the contractor: contractor **A07** says**,** *"a client, which says in the case of an innovation, we take a part of the long-term risk"*.

6.2.6 Tender Procedure

The tender procedure is a determining factor for contractors to offer sustainable product innovations, because the choice of the tender procedure by the client determines how transparent the process is and what type of communication there is during the tender process. If the client makes a choice to apply a certain tender procedure and contact with the client is only possible by means of Memorandum of Information, contractors **A01** and **A02** consider this to be insufficient to offer a sustainable product innovation: contractor **A01** *"if you only have contact via TenderNed with questions and answers, it is very difficult to see whether someone is actually happy about it"*. But for contractors **A01**, **A02**, **A05** and **A07,** on the other hand, it is necessary to have an individual dialogue in order to be able to offer sustainable product innovations: contractor **A07:** *"in the experience we have had with innovative products, we have seen that* a *tender in which you have a number of individual dialogues with the client in which you can also present your innovation is quite crucial"*. Contractor **A06,** on the other hand, does not see any added value in having an individual dialogue because *"if you do have that dialogue, the client often does not want to provide information only that is of general interest. The moment they say that this innovation is permitted, it applies to everyone"*.

Contractors **A05** and **A07** mentioned the competitive dialogue as the preferred tender procedure to offer sustainable product innovations. In addition, contractor **A05** indicates that an innovation partnership can be a suitable form if the client only has an objective: contractor **A05** *"I think if a client really is completely blank in it and actually only has an objective, I want to strengthen the dike, I want to develop this together with the contractor from scratch in the field of sustainability and innovation then innovation partnership is the most suitable form"*. Contractor **A07** sees the BVP procedure as an obstacle to offer sustainable product innovations because there is no verifiable performance information (VPI) on innovations. Contractors **A01** and **A02** have not expressed a clear preference for a tender procedure but, both contractors have expressed a preference for procedures in which you are more in contact with the client. The preference for tender procedure of contractor **A04** are procedures where a selection phase precedes: *"we do have a preference for selection work, then the client already selects a number of market participants and our preference is that they do so on the basis of ranking"* and contractor **A06** did not mention a preference for a tender procedure. Contrary to the other contractors, the preference of contractor **A03** is a negotiated contract (onderhandse aanbestedings-procedure), which can be explained by the fact that this is a small and local contractor.

6.2.7 Prequalification requirements

Selection criteria are not decisive for contractors to offer sustainable product innovations. It is merely the first step that has to be taken in order to be able to participate in a tender, where the focus is on being able to fill in selection criteria. However, according to contractor **A07,** selection criteria can play an indirect role so that more sustainable product innovations can be offered during the tender process by understanding what kind of company a client is looking for: contractor **A07** says, *"if you want to have innovative companies, you must already have to take this into account in the selection criteria"*. According to contractor **A04**, companies

selected need insight into whether sustainable product innovations are part of the selection: *"it' is not always possible to see from the front whether it is part of the selection. Sometimes it appears from the requested references, but that is not always the case"*. The goal of the client and how this will be rewarded by contractors **A02** and **A04** is important during the selection: contractor **A02** indicated, *"the sooner we know whether a client wants and indicates sustainable product innovations. We can then look at what we already want to investigate. Guess that a client will get better offers from the"*. This prevents companies that have been selected and want to offer sustainable product innovations from being disappointed during the tender process, according to contractor **A07:** *"I've experienced selections in which selection criteria were for sustainable innovations and then it didn't come back in the award criteria*".

According to contractors **A01**, **A02**, **A03,** and **A04,** selection criteria can be perceived as hampering if they are too detailed and too complex written down by the client: contractor **A04** says, *"for an innovative work or the client is specifically looking for innovative products, if they have very strict selection requirements then it becomes difficult for participants to take part". In* addition, contractors **A04** and **A05** point out that it is also obstructive when references are requested for sustainable product innovations: **A05** specifies, *"you must have experience with the further development of a sustainable development and if you don't have that then it becomes difficult to participate"*.

According to contractors **A01**, **A02**, **A04** and **A06,** clients do not ask for specific selection criteria for the application of sustainable product innovations: **A02** *"I see little or almost never anything about innovations in selection criteria anyway"*. But for contractors **A01** and **A06** it turns out to be a difficult task as well, in what way clients should give substance to this in order to include sustainable product innovations in selection criteria: contractor **A01** says, *"an innovation can be in any field, that's difficult to put into a sort of selection criterion"*. In the future, according to contractor **A04,** clients could add a selection criterion in which the contractor submits a document in which sustainability and innovations are taken into consideration. Contractor **A01** also proposes another selection criterion, namely innovation circularity performance ladder or performance ladder, which is in line with the CO_2 performance ladder. If an innovation performance ladder or circularity performance ladder is introduced, it is possible that after a certain period of time, almost all market participants will be able to meet this, just like the CO_2 performance ladder. Increasing the warranty periods in the selection criteria is proposed by contractor **A06** because it is beneficial for sustainable product innovations.

6.2.8 Award Criteria

The award criteria are decisive for contractors to offer sustainable product innovations. The award criteria are determined on the basis of BPQR, LP and LC. The client's choice to select particular award criteria is decisive, as a result of which contractors cannot create added value and cannot be distinctive when offering sustainable product innovations. Contractor **A06** has expressed a preference for the award criterion LC. However, this award criterion is not often applied because there is still a great deal unknown about this method. Contractors **A01**, **A02**, **A03, A04**, **A05,** and **A07** have indicated the BPQR as their preferred award criterion. With this award criterion, in addition to price, quality criteria are also taken into account and contractors can distinguish themselves from their competitors and win the tender: contractor **A04** states *"then you also want it to be distinctive that this may or may not be the factor that makes it possible for you to take the contract and then preference is given to BPQR"*. Contractors

A02 and **A06** did raise a point of criticism, when awarding the contract on quality criteria the client's assessment can be subjective, when it is made measurable, the assessment is more objective and fairer. According to contractors **A01**, **A02**, **A03**, **A04, A06** and **A07,** it is not conducive to offer sustainable product innovations if a client makes the choice for the LP award criterion, because it is purely about the price, because a sustainable product innovation is often more expensive than a traditional solution, which means you exclude innovations.

According to contractors, the proportion that the quality criteria count in relation to the price comes from the design of the criteria. The weighting of the criteria aimed at sustainable product innovation and then awarding a score to assess a product innovation must be decisive enough otherwise contractors such as **A01**, **A02**, **A03, A04**, **A05,** and **A07** cannot distinguish themselves and price is still a very compelling factor: contractor **A02** says, *"I think 70% of the quality value* is *really very important. Then, of course, you're going to put a lot more effort into that. On all components and if you then look at it in relation to other elements, then it is also important"*.

Clients, when awarding tenders, do not ask for the following criteria, according to contractors: **A02** *"too little attention is paid to the quality of life…climate adaptation or biodiversity, these criteria are not yet sufficiently highlighted"* and *"how do you deal with the risks and opportunities of product innovations",* **A05** says, *"often the question is not asked of how to deal with a product innovation, for example that you can save on or reduce costs or inconvenience to the environment…on which you can use your innovation, specifically a criterion to apply an innovation often you have to search yourself for the criterion you are asked to match your solution to"*. Likewise, contractor **A07** says, *"at the moment there is really no requirement with regard to emissions, which I find quite important and that's actually because the requirement in which emissions, fairly standard, are now placed under the CO2 performance ladder"* and *"what you see is that ecology and biodiversity hardly appear in tenders"*. According to contractors **A01, A02**, **A05**, **A06,** and **A07,** clients can stop asking for the following criteria because they do not offer added value and it is already being done by the contractors. Contractor **A01** says, *"whether you should continue to ask for those standards. Do you always have to ask for a phasing?",* contractor **A02**: *"unnecessary reuse of material, because that's what we always do",* contractor **A05**: *"process-oriented questioning how do you deal with your risk management, actually just that you're about to overwrite your ISO…no advocate of asking safety as MEAT criteria because that has to be standard"* and contractor **A06** and **A07** indicate the CO2 performance ladder as superfluous criteria.

6.3 Conclusion Findings (External) Factors

The results from the analysis of the research material are indicated in the analysis framework. The analysis shows that the (external) factors—planning client (project), duration (tender), contract type, tender procedure and award criteria—are influential factors of the tender phase, which can be used to stimulate contractors to offer sustainable product innovations.

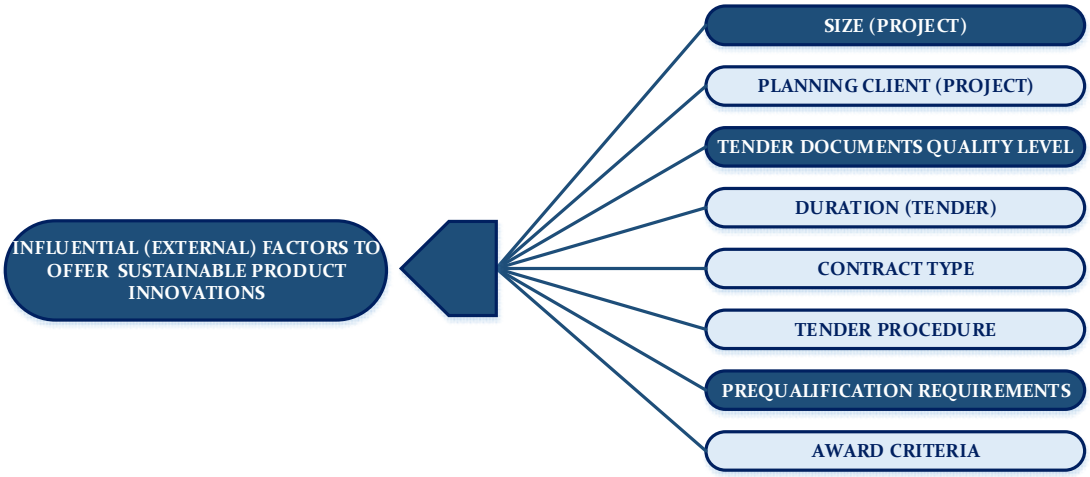


Figure 15 Own figure, influential (external) factors analysis framework

6.4 RECOMMENDATIONS PARTICIPANTS

6.4.1 Present Procurement system

Contractors have answered what needs to be changed in the future in the procurement system. Contractors **A02**, **A04**, **A05**, **A06** and **A07** indicate that sustainable product innovations should be better rewarded by the client in the call for tenders than is currently the case; contractor **A02** "*that is really still the weighting factor of the sustainable component. But also in relation to the price ratio, if you really think that's important, let it really stand out*". But contractors **A01** and **A03** propose that contractors with a sustainable product innovation should carry out a trial at a test site made available by the client. Contractor **A06** indicates that the client also needs to understand that an innovation will not succeed all at once, and contractor **A02** suggests a client should start demanding more, which means that contractors will have to innovate in order to keep up. In tenders, the offer of alternatives/ variants is almost always contractually excluded. According to contractor **A05,** it should in fact be possible to submit alternatives/variants during tenders.

6.4.2 Other aspects

This part answers the question of whether there are other aspects why sustainable product innovations are not being offered. There are advantages to making heavy equipment emission-free: there is already a development going on where companies invest money in converting equipment that is emission free. Contractor **A05** indicates that the right utilities are not available to connect this heavy equipment and that there is a role for cable and pipeline operators to make this possible. Contractor **A07** notes that if clients start to value the use of emission-free equipment more, the investments made can be recouped. Contractor **A01** and **A02** also suggest another aspect with regard to legislation and regulations, namely that these have an impeding effect. Little can be done about this in a tender, but the client can take this into account in advance during the preparation phase. The client can, for example, make a test site available. Different rules could then apply to carry out trials to determine the lifespan, such as the reuse of a guide rail that is removed and changes ownership, is then reinstalled after revaluation and does not pass CE testing.

7 VALIDATION RESEARCH MATERIAL

Sub-question 3 is as follows: *To what extent can parties in the supply chain ensure that these (external) factors are taken into account in the preparation phase so that sustainable product innovations are offered?* In order to answer this question, it is first necessary to prepare the focus group, select the participants and draw up the protocol for the focus group. This is followed by validating the (external) factors and the findings from the focus group. Then the findings of a discussion about the influential (external) factors and the preparation phase of the client.

7.1 FOCUS GROUP PREPARATION

7.1.1 Select Participants

For this research, a semi-structured focus group interview was chosen. A choice was made to involve all parties in the supply chain in order to validate the (external) factors. To this end, participants from the client, contractors and IB will be invited to participate. The objective is not that participants agree with each other but to see it from the perspective and experience of the other (Hennink, 2014). The next step is to determine how many participants the group interview should consist of. Three sources have been found in which this is indicated. First, (Fellows & Lui, 2015), indicate 6-10 participants, (Saunders et al, 2009) 4-8 participants, and (Hennink, 2014) 6-8 participants. Based on this, the choice was made to select a minimum of 4 and a maximum of 6 participants. The criteria by which the participants will be selected, the participants have experience with the procurement process or are involved in the procurement process and have knowledge and experience in the field of sustainable innovations. For the selection of participants from the client you first need to determine whether you want to select participants from central or decentralized government (municipalities, provinces, and water boards). For this research, we have chosen to approach clients of decentral governments and participants with the position, purchaser, road authority manager (wegbeheerder) and project manager. For the participants from the contractor, the contractors from 5.1.4 were approached, who were not previously involved in the study with the positions of tender manager and business office manager (bedrijfsbureau). With regard to the IB, participants were approached with the position of senior-advisor contracts of Antea Group. The participants were put together by their expertise on the subject of research (Fellows & Lui, 2015).

7.1.2 Protocol Focus Group

The ambition of the focus group is to validate the (external) factors that are conducive for contractors to offer sustainable product innovations and to answer sub-question 3. To carry this out the approach consists of five parts:

1) Introduction.
2) Influential (external) factors focus group: A choice was made to first let the participants of the focus group indicate which (external) factors from the analysis framework could be decisive for contractors to offer sustainable product innovations. The reason for this is, if the results from the interviews with the contractors are discussed first that this can influences the opinion of the participants.
3) Comparison focus group and outcomes interview contractors: In this part, the influential (external) factors that are decisive for contractors are compared with the

results from the group interview and whether there are similarities, deviations and new findings.

4) Discussion: Based on the influential (external) factors and the preparation phase.
5) Closing: Completion of the focus group.

In addition to this approach, questions and probes have been prepared for the focus group interview. The questions relate to silent and dominant participants and the probes are aimed at group probes that can be distinguished from (Hennink, 2014):

- group probe,
- group explanation probe
- diversity probe
- silence probe.

However, the execution of these questions depends on how the focus group interview goes. The approach, questions and probes are included in appendix D focus group protocol.

7.2 Focus Group Interview

The employees of clients of decentral governments, contractors from 5.1.4 and IB have been contacted as participants by telephone or e-mail on the basis of the criteria set out in 7.1.1. The data from the focus group interview protocol was provided to the participants in preparation. A group interview was held with 5 participants, 2 from the contractor, 2 from the IB and 1 from the client, with the following participants and positions represented as indicated in Table 12. The focus group interview was conducted in week 30. In Appendix E, the group interview and more details are given. The details include, the position, the organization for which the participant is working, participant's experience in the field of sustainable product innovations, where the interview was conducted, and information about when the interview took place.

Participant	Position	Company
Participant 1 (IB)	senior-advisor contracts	Antea Group
Participant 2 (IB)	senior-advisor contracts	Antea Group
Participant 3 (Contractor)	Head of business office (bedrijfsbureau)	Strukton
Participant 4 (Contractor)	Tender manager	Boskalis
Participant 5 (Client)	Purchaser	Municipality of Utrecht

Table 12 Own table, focus group interview details (participants, position & company).

7.3 Validation Influential (External) Factors

7.3.1 Influential (External) Factors from Focus Group

In section 6.2 from the analysis of the interviews, the conclusion can be found which (external) factors of the analysis framework are the influential factors. The (external) factors of the analysis framework are presented to the participants of the focus group for validation.

The participants of the focus group interview identified a number of (external) factors as influential:

- **Award criteria**, because they enable clients to show contractors what they are aiming for and what is important to them, **IB01** *"to a certain extent, all (external) factors are relevant, but the most relevant are the award criteria"*.
- **Planning of the client**, if the client does not have enough time and imposes a deadline on the contractor, contractors will rather choose to apply existing technologies and/or existing products. **A09** says, *"the planning of the client. If we have to start tomorrow then you will do it with the existing techniques/existing products"*.
- **Contract type**, the degree of freedom depends on what type of contract is chosen, in the case of a RAW the client has already determined what needs to be done and has written it down in such a way that the risks are for the account of the client, but in the case of another type of contract more risks may lie with a contractor, which can be disadvantageous because applying sustainable product innovation often involves risks, **OG01** *"the degree of innovation is mainly related to the type of contract. In a RAW contract there is no distinguishing ability in the field of innovation because we ourselves think we know what we want and write it down as such"*.
- **Duration (tender)** is also decisive, because most clients often lose a lot of time in the preparation phase and then are in a hurry during the tender, **OG01** *"we are always in a hurry, which is a limiting factor that the tender procedures should not take too long in advance"*.
- **Tender Procedure**, this is because it determines whether a contractor and the client can have an individual conversation with each other so that a contractor can verify his specific sustainable product innovation with the client, **IB02** *"Within the RAW it may not say which brand of bitumen should be in it, but perhaps that's where the crux lies, just a little deeper, that can come about in a conversation. You might be able to link that to the form of contract or tender procedure"*.
- **Tender document quality level,** is decisive because tender documents can be drawn up in a certain way, which means that a contractor has to bear more risks of an innovation, and that does not encourage innovation, **A08** *"we also look very closely at the risk involved in an innovation and the risk actually relates to two external factors that is actually the quality of tender documents and the type of contract"*.

7.3.2 Conclusion Findings Focus Group

The results of the interviews with the contractors are indicated under (b) and the results of the focus group interview are indicated under (c). The (external) factors of (b) and (c) are almost comparable, but in (c) two (external) factors have been added, the tender document quality level and potential for new projects.

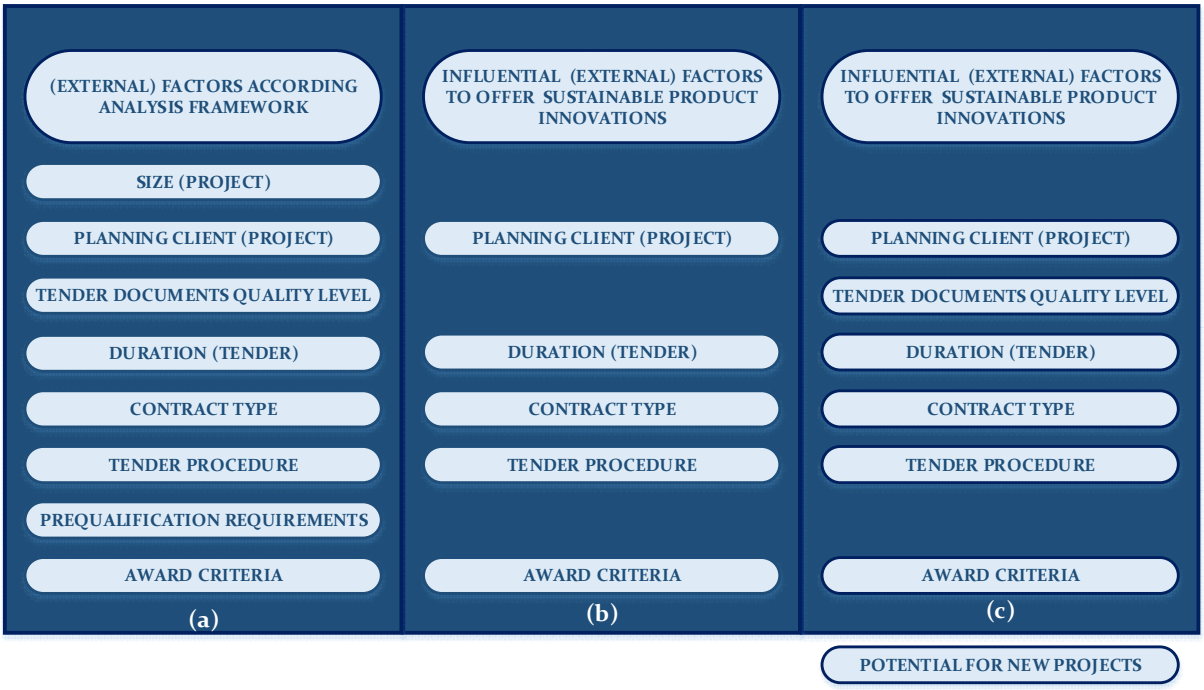


Figure 16 Own figure, comparison (external) factors focus group and interviews contractors

As far as the quality of the tender documents is concerned, it emerged from the interviews with the contractors that it was not decisive, and from the perspective of the focus group it is seen as decisive. The added (external) factor has been introduced in the focus group as a **framework** and/or **continuity** of **inquiries**, this is in line with the factor **potential for new projects** discussed in section 6.1.6, this name will be used further on in this research. The factor **potential for new projects** is not included in the analysis framework because it is not an (external) factor. The focus group indicates that it may indeed be an (external) factor because clients share their vision of the future with market participants, for example the quay renewal projects of the Municipality of Amsterdam. In this way, clients indicate that there are more questions ahead so that market participants know where they can deploy their sustainable product innovations and the costs do not necessarily have to be recouped on a single project. **A09** says, *"if these award criteria are aimed at sustainability, we only welcome this. Only then, as a client, you have to create a framework for it so that the market can put its vision into practice"*. **IB02** confirms, "*what I've also noticed in the training I've given to contractors on sustainable procurement is that they've returned to me that there's no continuity in the inquiries, or they can perhaps put their innovation on the table once and then again not. There is no continuous flow like what A09 just said with creating the framework*".

7.4 PREPARATION PHASE CLIENT

7.4.1 Categorizing (external) factors in the preparation phase

In part 3.2.2 the 13 steps of which the preparation phase consists according to (PIANOo, 2020a) are described in detail, but also the decisions to be taken within a step. This is important because in this section a link will be made with the findings from the tender phase regarding the influential (external) factors that can stimulate contractors to offer sustainable product innovations from the focus group and the 13 steps that make up the preparation phase. Non-determining (external) factors will also be considered. The influential (external) factors from

section 7.3.2 and the non-determining (external) factors are categorized in the steps of the preparation phase.

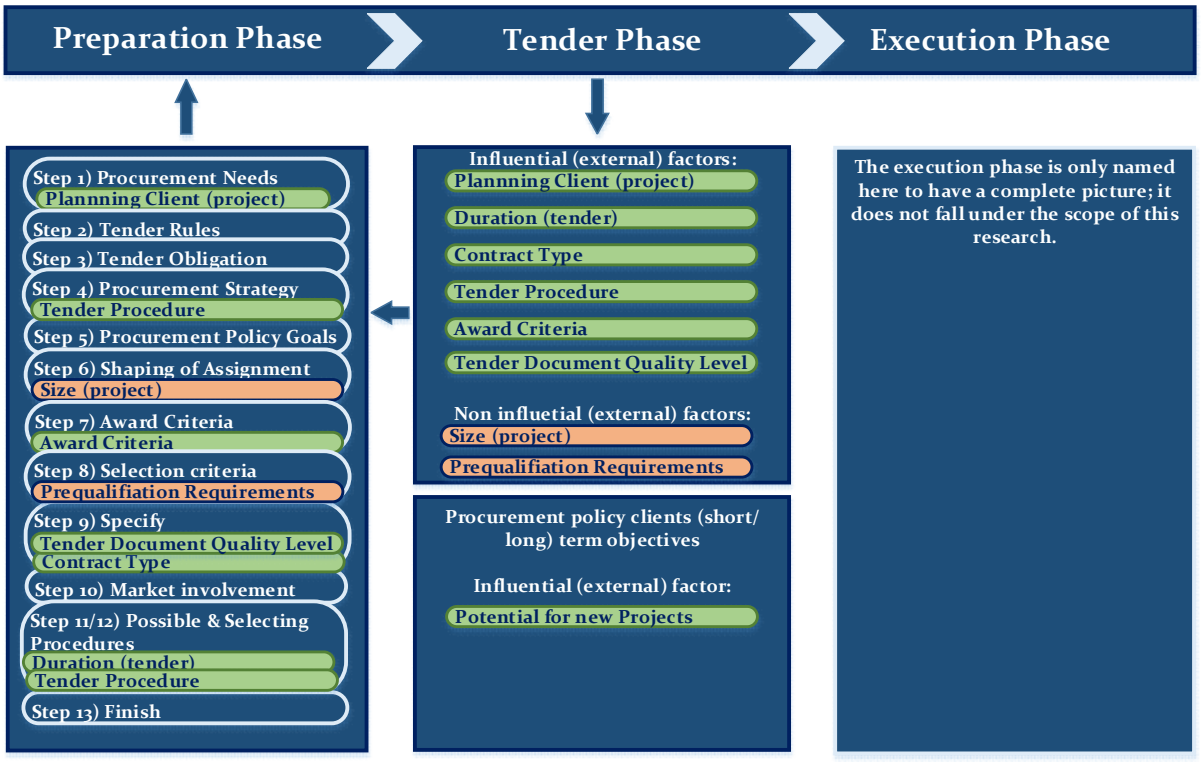


Figure 17 Own figure, procurement process & influential/non determining (external) factors

Categorizing the influential (external) factors award criteria at step 7, prequalification criteria at step 8 selection criteria and duration (tender) and tender procedure at step 11/12 are self-evident. At some steps it is not immediately clear why they are categorized at a certain step, the reason for this is explained. The planning client (project) is included in step 1 because when identifying the need, it is also determined within which timeframe it should be done. In step 4, the procurement strategy is determined for which a procurement plan is drawn up, in this procurement plan the planning of the tender procedure is a part. In step 6, the size and content of a contract is determined. In step 9, decisions are made which relate to the contract type and certain elements of the contract including functional specification or technical specification. Tender documents are also drawn up within this step. Therefore, contract type and tender document quality level are categorized here. Potential for new projects can be an influential (external) factor as indicated by the findings in 7.3.2 but cannot be categorized within the steps of the preparation phase. This (external) factor depends on the procurement policy of the client and its short and long-term objectives.

A point of attention is that although the influential (external) factors and the non-determining (external) factors are categorized within the different steps of the preparation phase, certain (external) factors are interdependent and influence each other. The tender procedure and the duration (tender), because the choice of the tender procedure affects the duration (tender). However, the choice of the tender procedure also determines whether there is a selection phase and whether pre-qualification criteria must be drawn up. The quality of the tender documents can also influence the duration (tender) and this in turn can influence the planning client (project). Also, the size (project) can influence the type of contract and this in turn can influence the award criteria.

7.4.2 Influence Parties in the Supply Chain on the Preparation Phase

7.4.2.1 Client

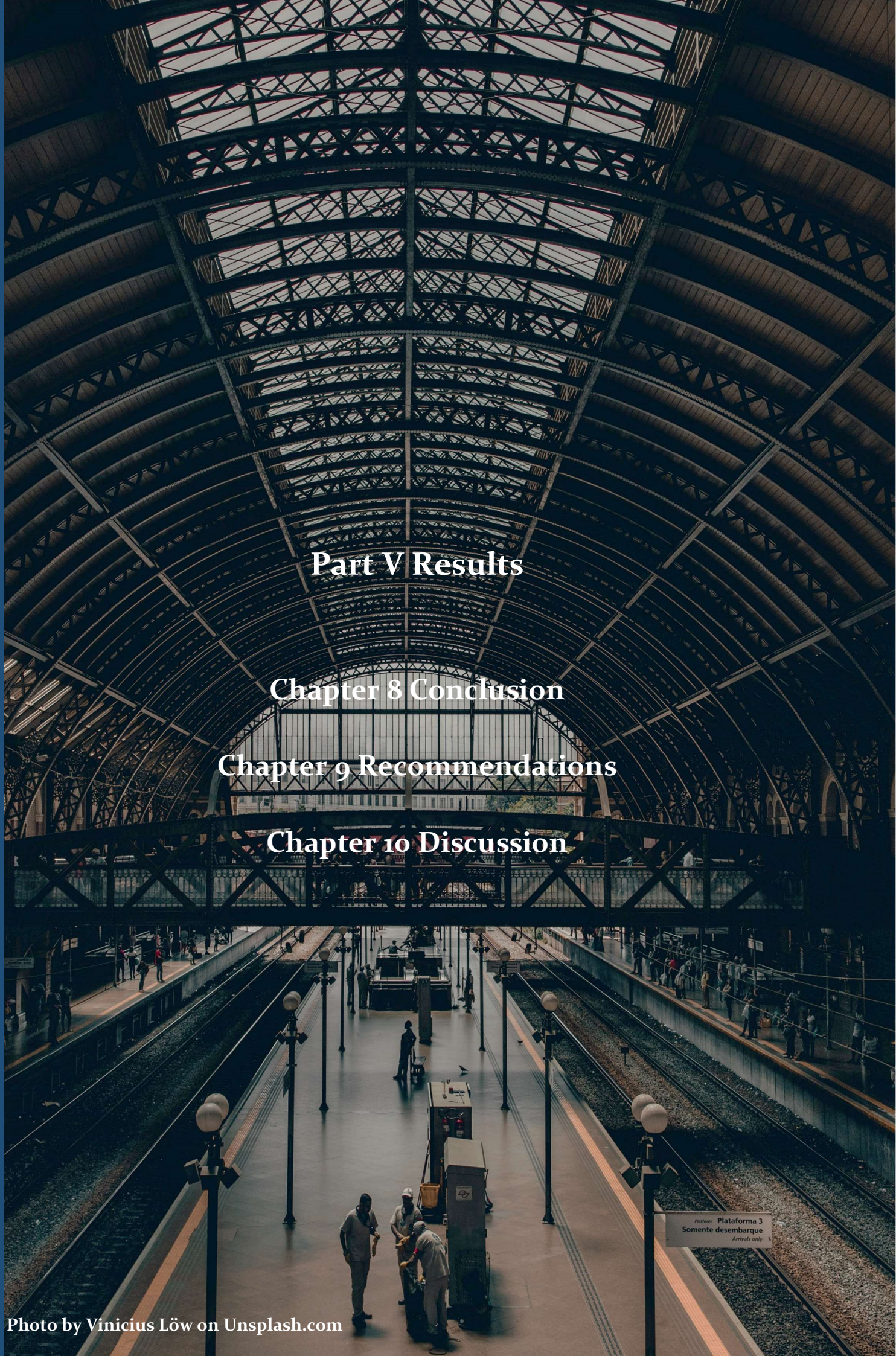
The client has influence on the steps of the preparation phase and thus also on the influential (external) factors which can stimulate contractors to offer sustainable product innovations, which are categorized within certain steps. However, this is hampered by the following points. The space that a client can give to a market participant partly depends on the internal organization of the client. If traditional solutions are prescribed within the client's internal organization for reasons of certainty or a certain financial interest, there is no point in asking market participants for innovative solutions: **OG01**: "*the degree of freedom we give in tenders is also partly related to the people you work with in the team*". On the other hand, most clients also have little time, which means that the tender procedure has to be completed quickly in order to award the contract to a contractor: **OG01** "*it always remains difficult in tenders that we are limited by time, also to go through a tender properly. But actually you want to have experience with each other as tenderer and as contracting authority*". Moreover, clients have to deal with stakeholders when applying for permits, which means that interfaces are often laid down in a design: **OG01** "*the land (in the Netherlands) requires a permit and you have to deal with stakeholders, which is why there is always something of a design on the shelf*". It also depends on the type of project for the client when applying innovative solutions, for example on a road that must be accessible 24/7 for surrounding companies then a client is reluctant to do so. Most clients do want to purchase sustainable product innovations, but sometimes they have too little experience in this, and it is not clear to themselves what is important within the themes of sustainable GWW. These clients have to go through a learning process and focus on what themes are important within the Sustainable GWW, determine the goals and targets and gain experience with these by asking these themes during tenders.

7.4.2.2 Consultancy and engineering firm

The IB has an indirect influence on the steps of the preparation phase and thus also on the influential (external) factors that can stimulate contractors to offer sustainable product innovations that are categorized within certain steps. The IB can, however, be involved in shaping the preparation phase, because the client has called on the IB for their knowledge and expertise. However, there are limits to a certain extent that an IB can steer this towards the client. If you are called in at a very late stage, everything is already fixed and it does not provide added value with regard to sustainable product innovations. On the other hand, if an IB is involved before the planning client (project) and the tender procedure have been determined, then the IB can be very influential by sharing its knowledge and experience with the client. But also, the experience of a specific sustainable product innovation if it has already been applied elsewhere and how the other client has approached it: **IB02** "*I notice that you can get people involved with knowledge, enthusiasm and conviction. But then the planning of the project and of the tender procedure must not be fixed, that you can think along with them and then you can be quite steering from within the consultancy and engineering firm*". Sometimes clients don't know what the possibilities are from the market, but already has a certain type of tender procedure or contract in mind, the IB can start a dialogue to make clear what the advantages and disadvantages of a certain type of tender procedure or contract are. Bringing knowledge and experience for sustainable product innovations from the IB to a client is hindered when there is internal resistance within the internal organization of the client: **IB01** "*you often see that the policymakers of contracting authorities who come up with that and those who carry it out in projects are not very close together*".

7.4.2.3 Contractor

The contractor has minimal to little influence on the steps of the preparation phase and thus also on the influential (external) factors that can stimulate them to offer sustainable product innovations, which are categorized within certain steps. Within the parties in the supply chain, the contractor is the least involved in the preparation phase. This is because the contractor is generally, with some exceptions, responsible for the execution of the work after it has been awarded and that the work meets all the contract requirements. Currently, contractors can only exert influence within step 10 of the preparation phase if a market consultation is organized by a client. Contractors will have to change their culture; contractors will have to move away from the usual traditions of construction if they want to exert more influence on a client's preparation phase: **A09** "*we need to visit the client more, we need to show them what we can do, instead of sitting back and waiting for the client to come up with a question about sustainability and we are going to shout what we think of it, which is happening a lot now*". That this change takes place is necessary but also largely dependent on clients. If clients develop their long-term vision on what they want to achieve in the field of sustainable product innovations, contractors can develop their own vision within this. By applying focus and targeting specific sustainable product innovations: **A08** "*actually at the moment that you rise a little more above the project level and know what the client is going to do in the coming years*". In line with this, contractors can also write unsolicited proposals if you know the client well and know that the client will face a challenge within a foreseeable period.



Part V Results

Chapter 8 Conclusion

Chapter 9 Recommendations

Chapter 10 Discussion

Photo by Vinicius Löw on Unsplash.com

8 CONCLUSION

The objective of this research is to answer the question: *How can clients optimize the procurement process of the preparation phase, in order to stimulate the offering of sustainable product innovations by contractors, during the tender phase for the GWW sector in the Netherlands?* In order to answer the main question, sub-questions have been drawn up. These questions must first be answered before the main question can be answered. First of all, a short answer is given to the sub-questions, after which the main research question is answered.

8.1 SUB- QUESTIONS

8.1.1 Sub-question 1

What is the design of the preparation and tender phase of the procurement process where influencing factors of an offer are considered?

In order to answer this sub-question, qualitative literature research was done and divided into 5 sub-questions. This was done to explain essential concepts, sustainable product innovations, innovation-friendly procurement, to define the preparation and tender phase in steps and to identify (external) factors that influence the bid decision of contractors.

8.1.1.1 Sub-question 1a

What are sustainable product innovations and what type of sustainable product innovation can be offered, taking into account the technology readiness level?

For this study, the following definition is used for sustainable product innovations: *the introduction of a product that is new or significantly improved with respect to its characteristics or intended use, which has a positive impact on the environment*. The choice that only the tender procedures (OP, NP, CD and CP) are applicable for this research therefore determines what kind of innovations can be offered. Because these tender procedures are demand-driven procedures. It has been assumed that this leads to incremental innovations. Linking the type of innovation to the TRL level is necessary to better match supply and demand. For this research, sustainable product innovations with a TRL level 7-9 apply.

8.1.1.2 Sub-question 1b

What are innovation-friendly procurement methods?

The classification of public procurement is essential because there are products that are used on a daily basis, but there are also products that are not there yet but need to be developed. The procurement differs from this because products that still need to be developed require more interaction. The following classification is used for this research: regular procurement, strategic procurement and R&D procurement. This classification is important because it indicates the maturity of an innovation and the strategy needed to procure it. For this research only regular procurement and strategic procurement are applicable because they allow sustainable product innovations with TRL level 7-9 to be offered. There are approaches that stimulate sustainable product innovations, for regular procurement this is: innovation friendly procurement approach and for strategic procurement: tender procedures with negotiation approach. A characteristic of making procurement innovation friendly is that it is possible to offer innovations and stimulates the offering of innovations for products that are used on a daily basis and for products that are not there yet but can be developed in a short period of time. The tender procedures for regular & strategic procurement and the procurement process

must be made innovation friendly. Innovation friendly means that the potential to offer certain products on the market is increased and that there are criteria to assess sustainable product innovations during the tender process.

8.1.1.3 Sub-question 1c

What steps does the preparation phase consist of and what is the content per step?

Within this research, the procurement process was selected which consists of 3 phases: the preparation phase, the tender phase and the execution phase. The preparation phase is divided into 13 steps, which must be completed by the clients. Once step 13 has been completed, the tender phase will start, after which it will no longer be possible to make changes. This makes the preparation phase a crucial phase. Because the decisions made during the preparation phase determine whether sustainable product innovations can be offered by contractors during the tender phase.

8.1.1.4 Sub-question 1d

What steps does the tender phase consist of and what is the content per step, taking into account the chosen tender procedures (OP, RP, CD, and CP)?

The decision to apply a certain tender procedure in the preparation phase means that a specific process has to be followed during the tender phase. In which the tender procedures (OP, RP, CD and CP), each have their own process but these can be summarized into the following steps: announcement, selection, exchange of information, award phase and award.

8.1.1.5 Sub-question 1e

What are the (external) factors that influence contractors to make a bid decision during the tender phase?

Literature research has shown that there are eight (external) factors that influence the bid decision of contractors. These are the following (external) factors: size (project), planning client (project), tender document quality level, duration (tender), contract type, tender procedure, prequalification requirements and award criteria.

8.1.2 Sub-question 2

What are the influential (external) factors of the tender phase, according to contractors, to offer sustainable product innovations?

These (external) factors were studied by means of a survey consisting of interviews with 7 participants working for contractors, with knowledge and experience in the field of sustainable product innovations with positions in both the commercial (bedrijfsbureau) and execution department. In order to determine the findings in practice for sustainable product innovations and the influential (external) factors, these were discussed during the interviews. The results are elaborated in chapter 6. From the interviews the following five influential (external) factors were identified: planning client, duration (tender), contract type, tender procedure and award criteria. These are the influential (external) factors that can be used to stimulate contractors to offer sustainable product innovations with TRL level 7-9 during the tender phase.

8.1.3 Sub-question 3

To what extent can parties in the supply chain ensure that these (external) factors from the tender phase are taken into account in the preparation phase so that sustainable product innovations are offered?

The findings regarding the (external) factors from the interviews with the participants have been validated. The validation was done with a focus group interview, the validation shows that in addition to the five influential (external) factors, the following influential (external)

factor should be added: tender document quality level. But there is also a new influential (external) factor introduced by the focus group: potential for new projects. After this, the influential (external) factors and non-determining (external) factors are categorized within the steps of the preparation phase. From this it appears that certain influential (external) factors are interdependent and influence each other.

Even though the influence of a client is significant because they determine the characteristics of the preparation phase, it is difficult for them to directly influence the incorporation of these influential (external) factors. The influence of IB is limited since it is called in by a client and the latter determines when this is the case. Finally, the contractor is less or almost not involved in the preparation phase unless market consultations are held and therefore have little or no influence. In comparison with contractors, clients and an IB do have more influence, but all parties in the supply chain cannot directly influence the incorporation of these influential (external) factors in the steps to be taken in the preparation phase.

8.2 Main Research Question

The main question to be answered: *How can clients optimize the procurement process of the preparation phase, in order to stimulate the offering of sustainable product innovations by contractors, during the tender phase for the GWW sector in the Netherlands?*

The main research question was formulated to gain insight into the influential (external) factors that can stimulate contractors during the tender phase, but also whether parties in the supply chain can influence this so that these (external) factors can be included in the preparation phase. By researching the design for optimizing the preparation phase of clients in order for contractors to offer sustainable product innovations with TRL level 7-9 during the tender phase. Where the influential (external) factors found: planning client (project), tender document quality level, duration (tender), contract type, tender procedure and award criteria are categorized within the 13 steps of which the preparation phase consists.

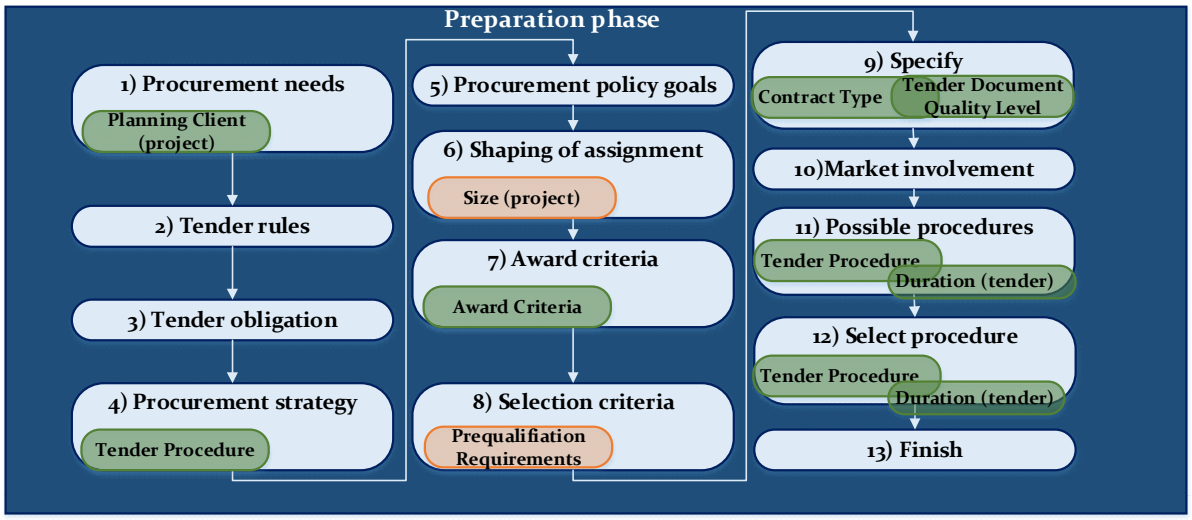


Figure 18 Own figure, preparation phase & influential/non-determining (external) factors

The research showed that the influential (external) factors can be included within steps 1, 4, 7, 8, 9, 11 and 12 of the preparation phase. This shows that the optimization of the procurement process aimed at the preparation phase can be realized by focusing within steps 1, 4, 7, 9, 11 and 12 and deliberately taking decisions within these steps on the basis of the influential (external) factors. Because non-determining/influencing (external) factors are interdependent and

influence each other, it is also necessary to focus on steps 6 and 8 and deliberately take decisions within these steps as well. The results of the research show that for TRL level 7-9 and for each (external) factor specific decisions are needed, for this the results detailed in chapter 6 are important. Therefore it is essential to emphasize on TRL level 7-9, the steps of the preparation phase and the influential (external) factors as a whole. The influential (external) factor: potential for new project cannot be categorized within the current steps of the preparation phase because this is an (external) factor that focuses on the procurement policy of the client. The results indicated in this research to optimize the procurement process of the preparation phase are exploratory in nature and should not be seen as an approach for guaranteed success in getting sustainable product innovations offered. In chapter 9, the results of my research are presented as recommendations for practice.

9 RECOMMENDATIONS

The practical recommendations are discussed in this chapter based on the results of the research. The given recommendations should therefore be seen as potential opportunities to optimize the preparation phase for clients wishing to purchase sustainable product innovations with a TRL level 7-9 and the scope of tender procedures (OP, RP, CD and CP) defined for this study. First, the general recommendations (G-RC) made to the parties of the supply chain are presented, followed by the specific recommendations (S-RC) made to the parties of the supply chain regarding the procurement process focused on the preparation phase per step, associated influential (external) factors and the non-determining (external) factors and TRL level 7-9. The recommendations were made on the basis of the results from chapters 6 & 7 and should not be viewed separately from each other but as a whole because this provides more insight into the usability and the limitations in this. But also general recommendations (G-RC-R) made by the researcher are presented.

9.1 GENERAL RECOMMENDATIONS

Based on the results of the research, the following general recommendations can be given.

9.1.1 Recommendations to clients

- G-RC1) It is recommended that sustainability & innovations really become a part of the internal organization. It is important to stimulate everyone within the organization, this can be achieved by including sustainability & innovation criteria in tenders so that they can be steered, giving it a podium. Because innovations can fail, it is also important that there is a culture within the internal organization that you can fail and that this is propagated but also included in the policy.

- G-RC2) Developing a vision for several years in the form of a procurement policy in which objectives are included with regard to sustainable product innovations is recommended. Involve contractors and IB in this, by indicating these are my long-term objectives. With this, you can show that more inquiries are on the way.

- G-RC3) Ensuring that sustainable product innovations are specifically requested and that this is awarded in such a way that contractors can be distinctive is recommended, because this ensures that contractors have to innovate in order to keep up with the competition.

- G-RC4) Organizing a testing site at a location to be specified is recommended during the preparation phase of a specific project that is being carried out, where different rules apply so that contractors can carry out tests to determine the lifespan and making more possible during the tender phase for the specific project.

- G-RC5) It is recommended that a consultation is initiated with utility companies and contractors about the necessary infrastructure for the development that is currently taking place, whereby equipment is emission-free. At the moment heavy equipment cannot be connected because the utilities are not available.

9.1.2 Recommendations to IB

- G-RC6) It is recommended to engage in a dialogue with the client, to make it clear that it is necessary for clients to develop a long-term vision. This can be developed together and applied during tenders.

- G-RC-R1) I recommend to analyze the Tender Act for the procurement of TRL level 7-8 whether there is a possibility to have dialogues between client and contractors for the tender procedures OP and RP.

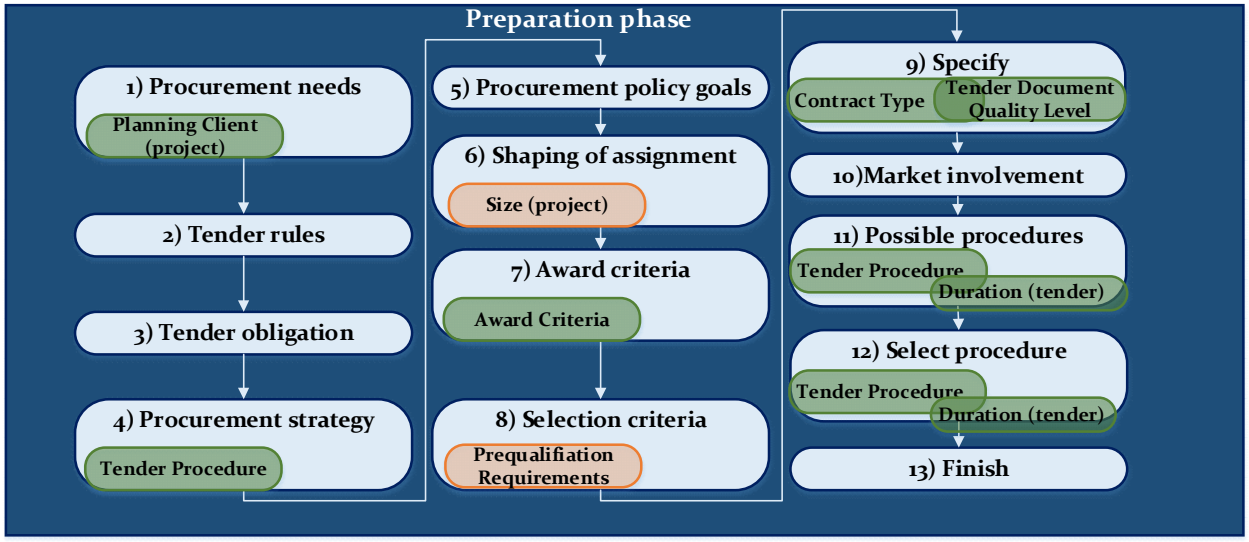
9.1.3 Recommendations to contractors

- G-RC7) It is recommended to seek dialogue with clients to make it clear that it is necessary for clients to develop a vision for several years. This will allow them to develop their own vision and make investments to develop (specific) sustainable product innovations.

- G-RC-R2) I recommend that an objection is filed with the committee of procurement experts & clients when sustainable product innovations are requested with a TRL level of 7-8 with the tender procedures OP & RP.

9.2 Specific Recommendations

Based on the results of the research, the following specific recommendations can be given for the procurement process focused on the preparation phase per step and the associated influential/non-determining (external) factors.



9.2.1 Recommendations to client

9.2.1.1 Step 1 - Planning Client (project)

- S-RC1) Explicitly take into account in the planning if the ambition is to purchase sustainable product innovations with a TRL level 7-8. The procurement, the products are already developed but still need to be merged within a system and this takes more time than applying traditional solutions/products.

- S-RC2) Ensure that enough time is taken between the final award and the start of execution, because in this period the preparation phase/design phase decisions are made

on the design and related to the sustainable product innovations to be applied with a TRL level 7-8.

9.2.1.2 Step 4 and 11&12 - Tender Procedure

- (S-RC3) Selecting a tender procedure (CD/CP) or in any case where it is possible to have individual consultations with contractors to purchase sustainable product innovations with a TRL level of 7-8 and not determine the choice of a tender procedure based on the planning client (project), if there is a too short execution period.

- S-RC4) Interaction with contractors when procuring sustainable product innovations with a TRL level of 7-8 because this offers opportunities for the contractor to present and test sustainable product innovations and that there is a dialogue with each other which makes it more likely that sustainable product innovations will be offered.

9.2.1.3 Step 6 - Size (project)

- (S-RC5) Create enough budget, if the ambition is to purchase sustainable product innovations with a TRL level of 7-9, then the costs must also be taken into account because sustainable product innovations are more expensive than traditional solutions/products.

9.2.1.4 Step 7 - Award Criteria

- (S-RC6) Use the award criteria BPKV, but also that the part of the quality counts for 70%, where the design of the criteria within this specifically focuses on sustainable product innovations with a TRL level of 7-9, that the weighting and assessment is also distinctive from the other criteria.

- (S-RC7) Ensure that when a criterion focuses on sustainable product innovations with a TRL level of 7-8, it is set up in such a way that contractors can form their ideas within it, but also that it is measurable. Measurable means that there is clarity in advance for contractors about the elaboration and achievement of the maximum score. By making it measurable, a well-considered choice can be made when awarding the contract to a contractor.

- (S-RC8) Drawing up new criteria, which are currently lacking according to contractors:
  - Dealing with the risks and opportunities of sustainable product innovations.
  - Demonstrability of sustainable product innovation that can save on costs or nuisance for the environment.
  - Emissions, meaning that it is no longer part of the CO_2 performance ladder.
  - Livability, climate adaptation, biodiversity and ecology, this means that these criteria are missing but also the combination of themes.

9.2.1.5 Step 8 - Prequalification Requirements

- S-RC9) Ensure that when a selection criterion is about sustainability and innovations, it is also consistently reflected as a criterion that is valued during the award phase.

- S-RC10) Focus when drawing up selection criteria that it clearly emerges that it is part of the selection, that it is not too detailed, that it is not too complex, that the client's goal in the field of sustainable product innovations is clear and in what way it will be awarded because then contractors will have more time to conduct research and ultimately offer it.

- S-RC11) Create selection criteria, where it is not necessary for contractors to provide reference/verifiable performance information or burden of proof because this is often not there.

- S-RC12) Establish a new selection criterion/approach specifically aimed at assessing sustainable product innovations during the selection phase.

- S-RC13) Drawing up new selection criteria, which are currently lacking according to contractors:
  - Sustainable product innovation.
  - Document/Deliverable in which vision on sustainability & innovation can be indicated.
  - Circularity performance ladder or innovation ladder.

9.2.1.6 Step 9 - Tender Documents Quality Level

- S-RC14) Define in the tender documents what a sustainable product innovation is when sustainable product innovations are procured with a TRL level 7-8.

- S-RC15) Draw up the tender documents that the requirements of a sustainable product innovation can be tested and/or that it is feasible to demonstrate that the risks will be shared for the procurement of sustainable product innovations with a TRL level 7-8.

9.2.1.7 Step 9 - Contract Type

- S-RC16) Formulating requirements based on functional specification for the procurement of sustainable product innovations with a TRL level 7-8 which gives contractors the freedom to form ideas.

- S-RC17) Establish that alternatives/variants may be submitted by contractors in a tender.

- S-RC18) Ensure that the contract type (construction team) where there is a collaboration with the contractor and no hierarchical relationship, because choices can be made together, but also together as a team a sustainable product innovation can be further developed. In this way the interests and benefits can also be mapped out for one's own internal organization.

- S-RC19) Creation of contract conditions for the procurement of sustainable product innovations with a TRL level 7-8, which makes it clear that the risks will be shared with the contractor or that certain guarantees will be applied less strictly.

- S-RC20) Use the contract type DBM and PDB for the procurement of sustainable product innovations with a TRL level 7-8 because, at DBM, a long-term innovation is deployed, but also the maintenance and PDB can be more influential at the front end to include sustainable product innovations in permit applications and the agreements made with the competent authority.

9.2.1.8 Step 11&12 - Duration (tender)

- S-RC21) Explicitly taking the duration (tender) into account so that there is sufficient time for contractors to conduct research into sustainable product innovations with a TRL level 7-8 that can be submitted and then discuss these with the client.

- S-RC22) Select a minimum duration (tender) of 3 months, but this also depends on the deliverables in the form of plans, the number of innovations requested from contractors and the consultation moments so that contractors can discuss sustainable product innovations with clients. Finding the right balance here because a long duration (tender) is also expensive for contractors.

- S-RC23) Ensure that the tender procedure that will be applied does not depend on the procedure but takes into account that more time is needed to purchase sustainable product innovations with a TRL level 7-8 because it is more complex than procuring traditional solutions/products.

9.2.2 Recommendations to IB

9.2.2.1 Step 7 - Award Criteria

- S-RC24) Search for knowledge in the area of award criterion lowest cost calculated on the basis of cost-effectiveness, such as life cycle costs to advise and assist clients when the choice is made to apply them. The application of this award criterion by a client is rare because there is still much unfamiliarity with the method.

- S-RC25) Consult the client not to apply the following criteria according to contractors, at least that a conscientious choice is made to apply certain criteria if this is specifically applicable and adds value to a project.
  - Re-use of material
  - Phasing of a project.
  - Process related questions that are ISO related.
  - Safety when executing a project.
  - CO_2 performance ladder.

10 DISCUSSION

In part, the relevance of the research from a scientific and practical point of view is discussed, the internal and external validity is discussed, the limitations of the research and as finally recommendations for further research are given.

10.1 RELEVANCE OF THE RESEARCH

The aim of the research was to provide insight into the (external) factors of the procurement phase that can be used by contractors to stimulate sustainable product innovations and whether participants in the supply chain can ensure that these (external) factors from the tender phase are taken into account in the preparation phase, with which recommendations can be made to clients to optimize the preparation phase of public procurement. The research is completed, and the scientific contribution of this research can be discussed.

10.1.1 Scientific

My research makes a scientific contribution on a few points. The problem analysis had already indicated that a lot of research had been conducted into the role of the client's buyer and IB. The client's and IB's perspective has therefore been well taken into account. However, the contractor's perspective is still lacking in the Netherlands. In the United Kingdom (Uyarra et al., 2014) and Australia (Rose et al., 2019), research has been conducted into obstacles experienced by contractors and suppliers and parties in the supply chain respectively in their ability to innovate. My research contributes to the contractor's perspective, by investigating what stimulates contractors to offer sustainable product innovations during the tender phase.

From (Rose & Manley, 2014) four contextual elements have been identified: relationships within the sector, procurement systems, regulatory conditions, and organizational resources for successful innovation. Because the situation can be very different in Australia, during the interviews with the participants it was asked whether these contextual elements are recognizable. This revealed that six contractors recognize these contextual elements and one contractor does not, this may be because it is a small contractor which makes the contextual element organizational resources more recognizable than the other contextual elements. This contributed to the fact that these contextual elements are recognizable for contractors within my research in the GWW sector.

10.1.2 Practical

In addition to a scientific contribution, this research also makes a practical contribution on a few points. Because there is insight and clarity, in what way contractors can be stimulated, this gives practical guidance to clients. This research also contributes to the practical meaning of the definition of sustainable innovation. The participants answered the question what a sustainable product innovation is, with which theory and practice have been compared. Research has also been done into whether it is important for contractors to offer sustainable product innovations. The answers show that it is important for contractors because it enables them to distinguish themselves from their competitors. But points of attention were mentioned, the recouping of investment costs and that there is room to offer sustainable innovations. The approach of contractors to offer sustainable product innovations is also important, as it has given the client insight into how this is done in practice. The final practical contribution is that a number of contractors currently have sustainable product innovations

but are not always able to offer them due to legislation, or because it is not sufficiently awarded and clients do not want to take the risk.

10.2 Validity (Internal & External)

10.2.1 Internal

The internal validity has to do with how the research was carried out. This research is a survey research which is of a qualitative nature. The method with which the research was carried out are interviews, this has disadvantages because the quality of the collected data depends on the experience of the researcher and the relationship between the researcher and the participant (Saunders et al., 2009). To prevent this, interview questions were drawn up, which were submitted to the research supervisors for assessment. Because of the interaction between the researcher and the participant, it is possible that information that is not important for this research will come forward. Interview topics and related questions are drawn up to prevent this. At the end of each interview it should be checked whether all interview topics have been discussed. The interviews are recorded and transcribed verbatim and are then provided to the participants for verification. Subsequently, the findings were validated with a focus group interview. This is also recorded and transcribed and provided to the participants for verification. All parties in the construction chain were represented in the focus group.

10.2.2 External

The external validity has to do with the generalizability of the results. The research population for this study consists of all GWW companies in the Netherlands, in order to make the group smaller a criterion has been added, namely contractors who have signed the green deal GWW 2.0, these are infra middle and infra large companies. The reason for this is that these contractors recognize the value and importance of sustainability. The findings from this research can be generalized for the research population but only if they have the same characteristics. This also applies to GWW companies in other countries, but this will have to be investigated further.

10.3 Limitations & Recommendations for further research

The (external) factors that determine a bid, bid decision factors of contractors are selected from the tender phase. Contractors were asked what are the (influential) external factors. These influential (external) factors are now clear, these factors all have an origin in the preparation phase because they are then determined. This is also the reason why it has been decided to make recommendations to clients for optimizing the procurement process. This means that the scope of this research is in fact the preparation phase, but also the tender phase because the (external) factors have been selected from this phase. However, the execution phase is not part of the scope because the research is limited in time. Furthermore, only the tender procedures (OP, RP, CD and CP) apply, this research only focuses on the GWW sector and for this research only the public clients are applicable.

Despite the fact that the interviews are well prepared, that the interview questions are drawn up and checked by the research supervisors, a limitation for the interviews may be that information emerges that does not contribute to the research, but time pressure also plays a role here. There are a limited number of questions that can be asked to the participants within one hour. The analysis of the results is done qualitatively, in which the researcher has to analyze the answers that contain differences, similarities but also contradictions. It is then up

to the researcher how the research material is interpreted. During the interviews there were conflicting opinions, if this was the case and one contractor indicated something and the other 6 did not indicate this is the contradictory is ignored or looked at how it is said by the participant, there may be differences but sometimes the same can be meant because a certain characteristic is described in a different way. This has been done carefully because it is actually interesting to look at this. In most cases the contradictions could be explained, because 4 infra large, 2 infra middle and 1 infra small contractor were interviewed and in some cases contradictions could not be explained by the researcher, where the whole context of the interview was looked at to find a solution and based on that a decision was made how to deal with the specific contradiction. The position does not influence the influential (external) factors except for the positions of director, project manager and tender manager here the focus on risks was very recognizable, the influential (external) factors were therefore named on that basis.

Recommendation for further research:

- The research that has been carried out should now be carried out with a survey in order to reach a larger target group and the results can be generated quantitatively which can then be compared with this research. The scope of the research now consisted of the GWW sector, this can be further extended to the construction sector and / or that besides the contractors also suppliers are included. The research can also be carried out in its entirety in another country.
- Doing more research into the preparation phase, this phase as a whole is still insufficiently highlighted within the scientific literature.
- Sustainable product innovations offered in the tender phase and their application in the execution phase. Are the offered sustainable product innovations really realized, what challenges are faced?
- Doing research into obstacles to product innovations that are experienced in the GWW sector by the various parties in the supply chain (client, IB, contractor and supplier).

Appendices

Appendix A References

Appendix B Protocol for the interviews (Dutch)

Appendix C Interviews (Dutch)

Appendix D Protocol for the Focus Group (Dutch)

Appendix E Focus Group Interview (Dutch)

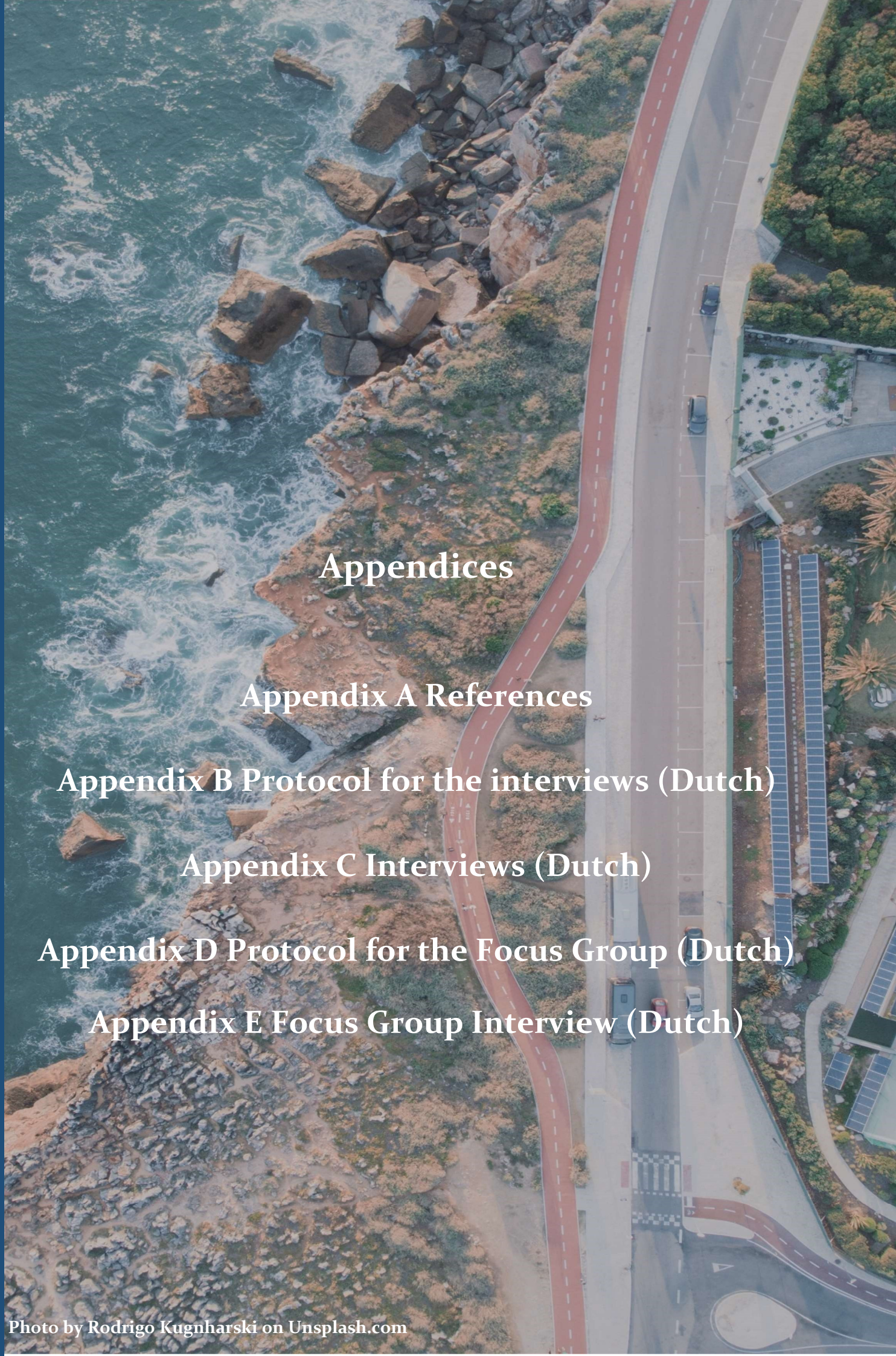


Photo by Rodrigo Kugnharski on Unsplash.com

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