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Provoking innovation in the innovation partnership procedure: a market perspective

J.I.D. (Daan) Brinkerink

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Amsterdam die grote stad, die is gebouwd op palen
En als dat nou eens omviel, wie ging dat dan betalen?

Provoking innovation in the innovation partnership procedure: a market perspective

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Abbreviations

IPQ	Innovation Partnership Quay Walls
IP	Innovation Partnership
IPP	Innovation Partnership Procedure
R&D	Research & Development
TRL	Technological Readiness Level
V&OR	Department for traffic and public space (Dutch: Verkeer & Openbare Ruimte)
I&A	Department for procurement and advice (Dutch: Inkoop & Advies)
GDP	Gross Domestic Product
SME	Small Medium Enterprise
OECD	Organization for Economic Collaboration and Development
PP	Public Procurement
Fte	Full Time Equivalent
NASA	National Aeronautics and Space Administration
AM	Asset Management
PDCA	Plan Do Check Act method
CSI	Complex Systems Industry
DBB	Design Bid Build
BOOT	Build Own Operate Transfer
EoS	Economies of Scale
D&C	Design & Construct
MEAT	Most Economically Advantageous Tender
CSF	Critical Success Factor

Preface

This document presents the master thesis of my studies Construction Management and Engineering at the University of Twente. In this research is presented how the municipality of Amsterdam should organize an Innovation Partnership procedure, in order to provoke innovations by market parties. This procurement procedure focusses especially on the renewal of UNESCO marked quay walls throughout the ancient city of Amsterdam.

During my research project I got to know the municipality of Amsterdam as procuring organization. As one of the largest procurement agencies in the Netherlands I was fascinated by the municipality itself: a group of professionals working very dedicated on improving the liveability in Amsterdam. In every project or procurement contract choices were made in order to increase this liveability. Furthermore I now understand the problems faced by the municipality when managing such an old city. These problems only can be solved by developing solutions whom currently do not exist. Innovation is especially important for Amsterdam, key for creating innovations is the participation of different disciplines from inside and outside the construction industry.

By now the time has come to thank all the people who helped and supported me during my master thesis. Firstly I would thank my colleagues at the department of Inkoop&Advies of the municipality of Amsterdam, especially my supervisor Francien Bouwmeister. Francien, last six months your agenda was packed. However, there was always time for 'een bakkie'. I am really grateful for your effort, advice and guiding during this project, especially on the field of active writing. From the University of Twente I would thank my supervisors: Joop Halman, Hans Boes & Bart Lenderink. Joop, last October you held your farewell speech, which marks the official 'end' of your career at the UT. Despite this official farewell, I didn't notice any farewell in your job as supervisor. I admire the dedicated feedback you gave me throughout this project: always with a smile and always increasing the quality of my product. Hans, your 'nuchtere kijk op de zaak', knowledge about the procurement contract, stages and specifically the case in Amsterdam helped me every time to think further and increase the quality of my thesis. Bart, thanks for the individual meetings we had during my thesis. Especially during the start you were the 'accelerator' who helped me to narrow down my research objectives and questions. Lastly I would thank friends and family, especially my girlfriend Jorien and my beloved parents. Jorien, thanks for listening to my, sometimes, lamentation during my master thesis. Your support was absolutely lovely, so are you as my soulmate for the past seven years. Mum & dad you owe me the biggest thank you of all. Thanks for supporting me, and giving me the opportunity to study, explore the world and becoming who I am today. But more importantly: thanks for your absolute love.

Daan Brinkerink
Haarlem, 28-3-2019

Summary

Correlation exists between innovation and economic development of countries. First world countries often encourage high levels of innovation throughout several industrial sectors. Despite the construction sector, for decades this sector is criticized with low levels of innovation in comparison to other branches like IT and automotive. This is recognizable in reality: methods used in construction often are unchanged over the past decades. The municipality of Amsterdam faces a problem with this unchanged way of working.

Around 200 kilometres of quay walls throughout Amsterdam are in a deteriorated state. On some locations the quality is extremely poor, sometimes quays start to fall apart whereby emergency measures are necessary. Over the past years quays collapsed throughout the city on several locations. Main reason for the poor state of these crucial assets are year-after-year shortages on maintenance and renewal budgets. Renewal does take place however, the current method faces several problems: high costs, long execution times and hindrance for the surrounding. But most important: current method is only capable of renewing 500m[1] of quays annually, whilst at least 2km[1] is necessary to maintain an appropriate state of quay walls. To bridge this gap the municipality provokes parties to develop new solutions. With using the innovation partnership, a procurement procedure new to European procurement law, is tried to stimulate market parties in order to develop new solutions. Within the IPQ[1] the municipality integrated several aspects to provoke innovation. However the municipality is unsure whether these aspects, and the procedure itself are actually provoking innovation. The main research question of this research is as follows:

How should the municipality organize its innovation partnership procedure to provoke effective innovation by market parties?

Within this master thesis a theoretical and empirical research is executed. In the theoretical part, a literature review is held among relevant scientific literature. From literature, opportunities are withdrawn which determine how a public agency can organize an innovative public procurement project which provokes innovation for market parties. During the literature review is specifically investigated how partnerships between public and private parties influence the innovation potential. During the empirical research, two rounds of interviews were executed. In the first round five representatives of the municipality were interviewed. Those interviews gave more understanding about the current IPQ procedure. In the second round interviews were executed with different market parties (contractors, engineering firms & Innovators) whom are interested in the IPQ. These interviews gave insight into what the innovation processes of market parties are, what aspects influence the innovation potential and what should be improved in the IPQ to provoke market parties in an innovative direction. For this research the theoretical en empirical results are combined to an optimized IPQ procedure. In this redesign the important aspects, withdrawn from both studies, are translated into a new reconstruction of the innovation partnership procedure. As final stage of this research the proposed redesign is validated among four different interviewees.

[1] Innovation Partnership for Quay walls

Within the original IPQ the municipality integrated three factors to provoke innovation for market parties:

Business case: When preparing the IPQ, the municipality determined a business case for market parties in the commercial phases. This business case consists of a framework contract of maximum eight years in which 300m[1] of quay wall per party per year is awarded.

Transparency: During the preparation of the tender documents and during the whole IPQ, the municipality tries to be transparent to market parties. One of the aspects how this is achieved is by organizing market consultations. These are used to get feedback of the market which was used in the development of the IPQ.

Freedom for market parties: Within the IPQ the municipality gave market parties freedom to translate their own ideas into innovations. This is particularly be done by determining functional requirements for market parties.

From the theoretical and empirical research three important aspects are derived whom provoke innovation in an IPQ. These are obliged to be integrated in the five subsequent phases of the IPQ: market inquiry, selection, competition, R&D[2] and commercial. The three most important aspects whom are necessary to integrate in the IPQ are:

Internal backup: It is always hard to gain backup from the internal organization when applying new procedures and ways of working. This is also the case for the municipality of Amsterdam when applying the IPQ. In such cases internal backup is highly important for the successfulness of an IPS[3]. Only when all relevant departments of the public organization support the chosen process, the actual procurement procedure can start. Three particular aspects must be arranged on forehand: procurement process, tender compensation and business case. To arrange these internal backup is needed. Market parties need certainty on these aspects to start innovating.

Financial reward: For market parties a financial reward is an important stimulator to start innovating. Correlation exists between tender compensation, business case and willingness to innovate. For the case in Amsterdam it is chosen to give parties a business case of 1km[1] quay renewal annually.

Collaboration during commercial phase: It is an underestimation that collaboration in an IPS is only important in the R&D phase. Especially during the commercial phase public agencies have to collaborate with market parties to improve and upgrade innovations. Subsequently do site related characteristics differ on each civil engineering project. Adaptions to the innovations are thus necessary when applying innovations on quay wall renewal projects throughout Amsterdam.

It can be seen that the aspects integrated by municipality, and the aspects whom are concluded from literature and empiricism differ on some aspects. This research presents a redesign of the IPQ, in which the procedure is optimized with factors that provoke innovation according to market parties. In general can be stated that the three factors presented above are crucial to provoke innovation for market parties in an innovation partnership.

[2] Research and Development
[3] Innovation Partnership

Samenvatting

Innovatie en economische vooruitgang van een land zijn gecorreleerd. Innovatie in industriële sectoren van eerste wereldlanden is hoog. Van de bouwsector wordt echter beweerd dat innovatie achter blijft ten opzichte van andere sectoren als IT en automotive. Dit is zichtbaar op bouwplaatsen, waar de wijze van werken op sommige aspecten al decennia onveranderd is. Ook de gemeente Amsterdam ondervindt op dit moment problemen met deze onveranderde manier van werken.

Ruim 200 kilometer kademuur in Amsterdam verkeren in slechte staat. Op sommige locaties wordt dit ernstig zichtbaar: kades beginnen te verzakken waardoor noodmaatregelen nodig zijn. Op sommige locaties is afgelopen jaar gebleken dat de kwaliteit van de kades dusdanig slecht is dat zij spontaan zijn bezweken. Eerste reden voor deze verslechterde staat zijn de lage investeringen in onderhoud en renovatie over de afgelopen decennia. De huidige manier van vervangen kent verscheidene problemen: hoge kosten, lange uitvoeringsduur en hinder voor de omgeving. Maar nog belangrijker: met de huidige methode is de gemeente enkel in staat om 500m[1] kade op jaarbasis te vervangen. Terwijl zij jaarlijks ten minste 2000m[1] dient te vervangen om de kwaliteit op peil te houden. Om dit probleem op te lossen daagt de gemeente marktpartijen uit om met nieuwe oplossingen te komen. Hiertoe zijn ze gestart met een innovatie partnerschap, een nieuwe aanbestedingsprocedure in het aanbestedingsrecht. De focus van deze aanbestedingsprocedure is de markt uitdagen om met nieuwe oplossingen voor de vervanging van kademuren te komen. In het IPK[4] heeft de gemeente verscheidene aspecten geïntegreerd die de markt uitdagen om te gaan innoveren. Echter is het niet zeker of deze aspecten marktpartijen daadwerkelijk aanzet tot innovatie. De hoofdvraag in dit onderzoek is:

Hoe dient de gemeente haar innovatiepartnerschap procedure te organiseren, zodat marktpartijen worden gestimuleerd om te gaan innoveren?

In dit onderzoek is een theoretische en empirische studie uitgevoerd. Het theoretische deel bevat een literatuuronderzoek waarbij gebruik is gemaakt van wetenschappelijke bronnen. Hierbij zijn de mogelijkheden gegeven om, volgens literatuur, innovatie te stimuleren via een aanbestedingsproces. Daarnaast is onderzocht hoe een partnerschap tussen publieke en private partijen kan bijdragen aan het stimuleren van innovaties. In het empirische onderzoek zijn twee interviewrondes gehouden. In de eerste interviewronde zijn vijf werknemers van de gemeente ondervraagd over het huidige IPK. In de tweede ronde zijn tien interviews gehouden met geïnteresseerden (aannemers, ingenieursbureaus & innovators) in het IPK. Deze interviews geven inzicht in de verschillende innovatieprocessen van marktpartijen, welke aspecten het innovatiepotentieel van de marktpartijen vergroten en wat verbeterd dient te worden aan het IPK. De resultaten van de theoretische en empirische studie zijn gecombineerd en hieruit is een geoptimaliseerd ontwerp voor het IPK gekomen. In dit ontwerp zijn diverse aspecten meegenomen die innovatie bij marktpartijen stimuleren. In de laatste fase van dit onderzoek is het geoptimaliseerde ontwerp gevalideerd door in gesprek te gaan met verschillende partijen.

[4] Innovatie Partnerschap Kademuren

Binnen het IPK heeft de gemeente getracht om innovatie bij marktpartijen te stimuleren met de volgende drie aspecten:

Business case: bij het opstellen van het IPK heeft de gemeente een significante business case opgezet voor marktpartijen in de commerciële fase. Deze business case bestaat uiteindelijk uit een, maximaal acht jaar durende, raamovereenkomst waarin elke partij jaarlijks 300m^1 kademuurvervanging krijgt gegund.

Transparantie: Tijdens het opstellen van de tender documenten en gedurende het IPK probeert de gemeente transparant te acteren naar marktpartijen. Eén van de aspecten hoe dit wordt getracht te bereiken is door het organiseren van marktconsultaties. Deze consultaties zijn bedoeld om feedback te verkrijgen vanuit de markt en deze te vertalen in het IPK.

Vrijheid voor marktpartijen: Binnen het IPK heeft de gemeente marktpartijen vrijheid gegeven om eigen ideeën te vertalen naar innovaties. Dit is voornamelijk gedaan door functionele eisen op te stellen voor marktpartijen in het IPK.

Tijdens het empirische en theoretische onderzoek zijn drie belangrijke factoren naar voren gekomen jegens het stimuleren van innovatie middels een IPS. Deze dienen in de vijf opvolgende fasen (marktbenadering, selectie, competitie, O&O[5] en commercieel) van het IPK te worden geïntegreerd. De drie meest belangrijke aspecten zijn:

Interne steun: Voor publieke organisaties is het lastig om steun voor nieuwe procedures en methodes te verkrijgen bij alle afdelingen. Het verkrijgen van interne steun zorgt ervoor dat zeken goed met elkaar kunnen worden afgestemd. Marktpartijen hebben duidelijkheid nodig over het aanbestedingsproces, de tendervergoeding en de business case. Om dit te regelen is steun nodig van alle afdelingen die betrokken zijn bij het traject.

Financiële prikkel: Voor marktpartijen is een financiële prikkel een belangrijke factor binnen een aanbestedingsprocedure. Binnen een IPS[6] kan een financiële prikkel op twee manieren worden gegeven: een directe tendervergoeding of door een rendabele business case. Deze twee aspecten zijn gecorreleerd aan de bereidwilligheid van marktpartijen om te gaan innoveren. In het herontwerp van het IPK is ervoor gekozen voor een business case van 1 km^1 per partij per jaar.

Samenwerking tijdens de commerciële fase: Samenwerking tussen opdrachtgever en opdrachtnemer dient zich in het IPK niet te beperken tot de O&O fase. Na deze fase dienen innovaties te worden geoptimaliseerd gedurende het uitvoeren van projecten. Samenwerking tussen beide partijen is cruciaal om dit soepel te laten verlopen. Daarnaast is het waarschijnlijk dat de omgevingsfactoren van elk project verschillend zijn, daardoor is het noodzakelijk om op projectbasis aanpassingen te doen aan de ontwikkelde innovaties.

De aspecten die de gemeente heeft geïntegreerd in het IPK en de aspecten die volgens dit onderzoek moeten worden geïntegreerd verschillen op sommige punten. In dit onderzoek wordt een alternatief ontwerp van het IPK gepresenteerd. Dit ontwerp is volledig gefocust op het stimuleren van innovatie voor marktpartijen. De aspecten die hier boven staan beschreven dragen hier het zwaarst aan bij.

[5] Onderzoeks- en ontwikkel
[6] Innovatie Parnterschap

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1 Introduction

Innovation is one of the most important factors determining the economic state of a country. Especially in the construction sector innovation tends to be behind on other sectors like automotive and IT. Most spending in the construction sector is done through infrastructure investments by public organizations. Therefore, public procurement promises to be an important instrument enhancing innovation in the construction sector.

The municipality of Amsterdam is one of those public agencies who procures construction work to the civil engineering market. The agency has the responsibility to manage all infrastructural assets in the city of Amsterdam. Hereby the engineering department is responsible for the planning, management and maintenance of infrastructure within municipal boundaries. The department of Traffic and Public Space (Dutch: Verkeer en Openbare Ruimte or V&OR) is responsible for the status of all infrastructure within the municipality. The engineering department tenders and controls all civil construction works on behalf of V&OR. Along with this responsibility falls the function as lead buyer for civil engineering works and services, for which the procurement & advice (Dutch: Inkoop & Advies) group is responsible. On a yearly basis the municipality invests around €850 million in civil engineering works and services (Gemeente Amsterdam, 2017). This research project will be carried out within the procurement & Advice group of the engineering department.

In 2018 the municipality started with the innovation partnership procedure to search for new methods on the renewal for quay walls. In this procurement method market parties (engineering firms, contractors and innovators) are challenged to develop innovative ideas for renewal. Innovative methods are needed because current methods cannot cope with the substitution demands as required. Within this report research has been conducted within the innovation partnership for quay walls. It is aimed to provide an answer on the question how the municipality should organize an innovation partnership procedure, whereby market parties are provoked to develop innovations for quay walls.

1.1 Reading guide

This report is structured into 8 chapters, whereby in chapter 2 the conceptual research design is given, presenting what is going to be researched during the thesis. Chapter three presents the technical research design, elaborating on how the research is executed. Chapter four presents the answer on the theoretical research questions and concludes with a theoretical framework. Chapter five presents the results from the empirical study. Chapter six presents a redesign of the procurement procedure of Amsterdam, taking into account the theoretical and empirical results. In chapter seven the redesign is validated among four interested parties. Finally is in the last chapter the conclusion given based on the theoretical, empirical and validation research. Furthermore are recommendations both, for the municipality of Amsterdam as for further research presented.

2 Conceptual research design

Chapter two focusses on the conceptual design of the research. Firstly a background study including the problem statement is performed. The background study consists of a basic literature review and orientating conversations with the municipality. Secondly the objectives for the research are provided, followed by the research questions.

2.1 Research Background

Amsterdam struggles with the renewal of quay walls, especially in the city centre area. 200 kilometres of quay walls are in a deteriorated state and need replacement. The uncertainty around the exact state of quay walls is a major problem for the municipality. Quay walls were initially designed for lower traffic loads and intensities than they currently face. Additionally, inspection did not take place for years and little (to no) attention was paid to maintenance. Reasons for this were shortages or non-existence of budgets. Board members of the municipality shifted their attention to other projects in the city, resulting in less budgets available for quay wall maintenance or renewal. The poor status was revealed due to recent collapses at different locations in the city. Due to this, the politics and public attention has risen (Keijl, 2018; NOS, 2018).

The recent developments caused a change in the attitude of the municipality towards quay walls. It was decided that renewal is needed to bring the status of 200 kilometres of quay walls back to an appropriate level. Currently a method exists to renew quay walls. However, there are three major problems with this method.

First, the current method is extremely costly: between €25.000 and €45.000 per m^1 (Gemeente Amsterdam, 2017). Over last decades the municipality did not renew enough quay walls. Therefore replacement in a large part of the city is needed at the moment, requiring enormous investments by the municipality. These investments put pressure on municipal budgets.

Second, the current method takes too much time: two years for an average renewal project (+- 150 m^1). This puts pressure on scaling the renewal process to city level. With the current method it is hard to execute multiple projects at once.

Finally, the current method causes extreme hindrance for the surrounding, streets and parking lots need to be closed for a long period. The definition of hindrance is at the moment indistinctly described by the municipality. The problem of hindrance is closely related to the long execution time. Furthermore it is hard to indicate hindrance in quantitative numbers.

To solve these problems, current renewal methods do not satisfy. New methods are thus needed for quay wall renewal. The municipality started a procurement method to find new solutions for quay wall renewal: the innovation partnership. This procurement procedure aims to develop product and process innovations for the renewal of quay walls. The partnership consists of five official phases (see Figure 1), in which market parties are challenged to (further) develop their innovation. Awarding procedures determine which parties pass to the next phase.

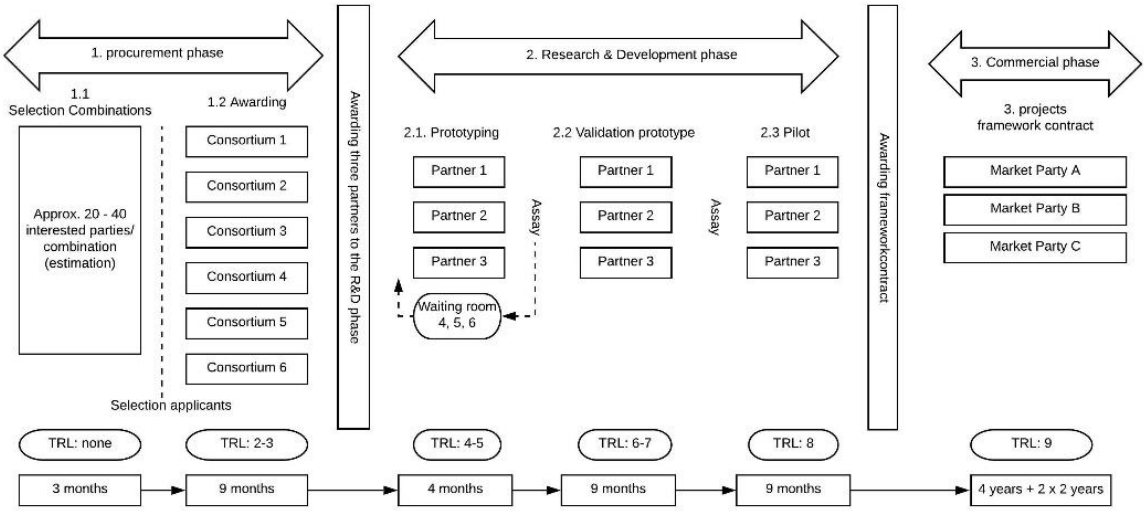

Figure 1: Process description Innovation Partnership

The municipality converted the view of market parties into the procurement procedure. Two market consultations were held whereby the municipality asked market parties to reflect on the procurement procedure. Finally, market parties were invited to reflect onto the procurement procedure. However the municipality perceived a reservedly attitude of market parties. Those were suspicious to share their opinion towards the innovation partnership procedure.

The aim of the partnership is to find new methods for the renewal of quay walls in the city of Amsterdam with a 50% time, hindrance and cost reduction. Furthermore the method should be scalable to city level, meaning that the new method must be able to be used at several places within the city centre. The background information presented above is a conclusion of a more intensive study in which the exact problem of this research is determined. The results of this study can be found in Figure 2

The municipality put high effort in constructing and preparing the innovation partnership procedure. Therefore the claim of the municipality is to have a clear vision about the content of the innovation partnership and how market parties must run through the innovation partnership procedure. Input from market parties was gathered during two market consultations. Those aspects resulted in the innovation partnership procedure as it is nowadays. However, it still remains unsure whether current innovation process counteracts or stimulates the internal process of market parties in order to develop effective innovations. The theoretical framework will further elaborate on this procurement procedure.

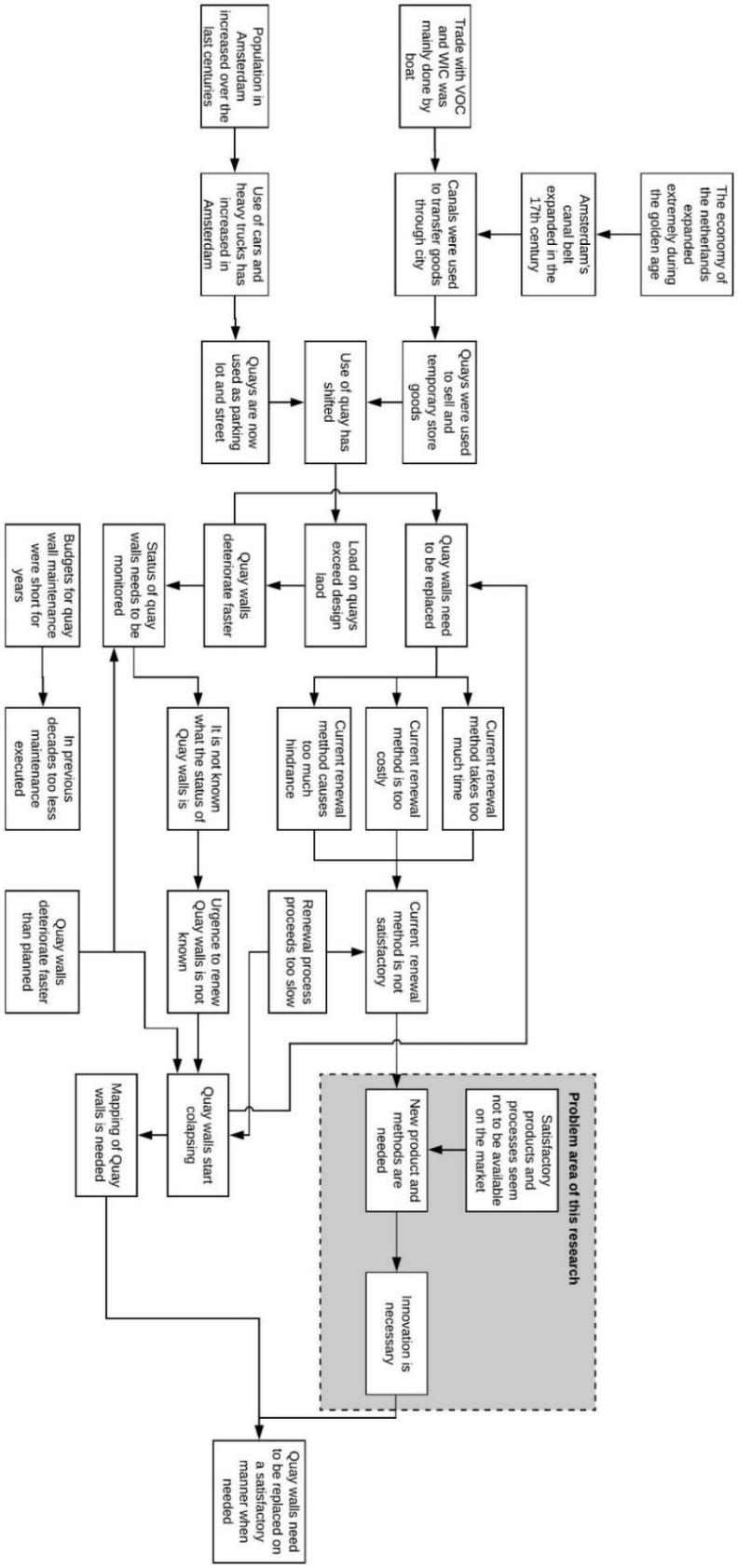

Figure 2: Problem-Cause diagram of the Quay Wall problem of the Municipality of Amsterdam

2.2 Problem description

The previous sections describe the background for this research. Several problems can be derived from this background study. These problems could be the basis for further research and are presented in Figure 2. This figure shows how the problems in this research are related to each other, in a structured way. Three specific problems are investigated within this research:

1. Satisfactory products and processes seem to be unavailable on the market: Current renewal comes with four major drawbacks. Market parties present only the non-satisfactory method. So it seems that no product and process is yet available for satisfactory renewal of quay walls.
2. New products are needed: New products are needed which meet the municipality's requirements.
3. Innovation is necessary: New products are not coming out of nowhere. Developments are necessary to foster innovation in the construction market. Nowadays market parties do not feel the urgency to innovate. Therefore the municipality must foster innovation within the civil engineering market.

Above mentioned problems are the problems faced by the municipality at this stage. The innovation partnership procedure is a strategy to solve these problems. This procedure is relatively new in procurement law. Therefore 'best practices' do not exist. Three market consultations and several market meetings were held to obtain the view of the market. However the attitude of the market parties can be characterized as reserved. Full understanding about the view of market parties towards the procedure is thus hard for the municipality. The next section elaborates further on the research problem.

2.3 Problem statement

The following problem statement is made as a result of the background study and problem description:

It appears uncertain whether the municipality provokes innovation for market parties to an effective extend using the innovation partnership procedure as currently prepared.

2.4 Research objective

This section contains the objective of and within this research. Both are derived from the research background and the problem description.

2.4.1 Objective of this research

The objective of this research is beyond the scope of the research. Accomplishment is dependent on different stakeholders within the research. The objective of this research can be seen as a contribution to a higher goal to which this research might contribute.

The objective of this research is to optimize the way the municipality requests innovation in their tenders.

2.4.2 Objective within the research

The objective within this research can be influenced by the researcher. This objective is thus directly the influenced by the researcher.

The objective in this research is to provide improvements to the innovation process, requested and facilitated in the innovation partnership procedure, in order to provoke innovation by market parties with the aim to reduce hindrance, costs and lead time by 50% and increase scalability.

2.5 Research question

This section presents the research question. Firstly the main research question is presented followed by the sub research questions. These are divided in theoretical and empirical research questions, which are answered using literature and empirical data respectively. The main research question within this research is:

How should the municipality organize its innovation partnership procedure to provoke effective innovation by market parties?

2.5.1 Sub research questions: Theoretical

1. What are opportunities and barriers to stimulate innovation through a public procurement procedure from a market perspective?
2. What are opportunities and barriers to stimulate innovation within a partnership between municipality and market party?
3. What factors can be influenced by a public agency to provoke innovations for market parties?
4. What are recent innovations in the construction of quay walls and due to what process were these developed?

2.5.2 Sub research questions: Empirical

5. What is the current innovation partnership process of the municipality of Amsterdam?
6. What are, according to the municipality, effective innovations in the innovation partnership for quay walls?
7. What are the choices made by the municipality, within the innovation partnership for quay walls, to provoke innovation?
8. What is the current innovation process market parties follow internally to develop innovations?
9. What are possibilities, according to market parties, for public agencies to organize a public procurement procedure whereby innovation is one of its targets?
10. What are, according to market parties, specific partnering characteristics in a public procurement process for innovation?
11. What are, according to market parties, advantages and disadvantages of market parties to innovate in the innovation partnership for quay walls?

2.6 Relevance of the research

This section elaborates on the relevance of this study. Relevance is studied on a scientific and practical level. The scientific level is defined by the extent to which the research follows up on other research. The practical level consists of elaborating on the relevance to the external organization, or to what extend the municipality benefits from this research.

2.6.1 Scientific relevance

Scientific relevance is often determined by a gap found in literature. A can then be executed to narrow this gap. This section determines whether there is a gap in literature regarding the objective of this research. Furthermore, it describes whether and how the research is relevant to science.

According to several sources (Winch G. , 1998; Reichstein, Salter, & Gann, 2005; Bröchner, 2010; Liu & Fellows, 2012) the level of innovation is low within the construction industry. For decades industry reforms tried to change this tide. However the effect of those reforms seems low (Pries & Dorée, 2005). Research by Winch (1998) concludes that the construction industry consists of an innovation superstructure and an innovation infrastructure. The superstructure is formed by clients, regulators and professional institutions. Those parties are demanding innovations. However execution of innovations is formed by the innovation infrastructure. Formed by trade contractors, specialist consultants and component suppliers (Winch G. , 1998). Partnering between those two parties is essential for successful innovation in the construction industry (Loosemore, 2015). Partnering is however not the only factor fostering innovation in construction. Public procurement is also an important instrument to foster innovation in the construction industry (Dorée & Holmen, 2004; Rijt, Hompes, & Santema, 2010)

Public procurement and partnering between market and public agency are thus important for innovation in the construction industry. This is further sustained by the theory of Winch (1998). It states that the innovation superstructure and infrastructure have to move closer together. Regulations can help to foster the level of innovation throughout the industry. (Winch G. , 1998).

Innovation in the Dutch construction market can be seen as technology driven rather than market-driven. One third of all construction innovations are related to new regulations (Pries & Dorée, 2005). Market behaviour and the role of the client in fostering innovation are extra important for construction innovation. Especially because the client is able to take the role as champion or promotor of innovations within the construction sector (Edler & Yeow, 2016). Changing procurement and tendering procedures fosters the innovative behaviour with market parties (Rijt, Hompes, & Santema, 2010). However this change also has a downside. Larger contractors seem to be in favour to react on the changes in the market, and adapt themselves more easily to the new procedures. Whilst SME's (Small Medium Enterprises) in construction face the risk of being pushed out of the market (Boes & Dorée, 2008).

When bringing the innovation superstructure and infrastructure closer together, the client can take the role as innovation promotor or champion. Especially important for innovation are factors as promoting team dynamics and team action within the innovation procedure (Kulatunga, Kulatunga, Amaratunga, & Haigh, 2011). Working together seems the only possible way in stimulating and fostering innovations within the construction sector (Blayse & Manley, 2004).

As is stated in the section above several research studies conclude with the fact that public procurement and partnering are enablers for innovation in the construction industry. Research also provides specific factors which can foster innovation in the construction industry. However, research is mainly focused on those two elements separately. Moreover most research used a top-down approach. The view of the market was not taken into account whilst establishing important factors to foster innovation. This research provides a framework of how innovation can be fostered in a public procurement procedure using partnering between market and public agency. Especially the role of market parties will be taken into account while validating the framework.

2.6.2 Practical relevance

This research provides improvements to the current innovation procedure of the innovation partnership. It gains more insight into how market parties are provoked to become innovative. The practical relevance of this study is threefold:

The innovation partnership is a new procurement method. At current date this method is rarely used in the Netherlands and even in Europe. Best practices on how to use the procurement method are hard to find and mostly not existing. For the municipality it is extremely important that this procurement method succeeds in successful innovations. The problems around quay walls are urgent and renewal is needed at short term. A successful innovation partnership results in successful innovations and solutions for the quay wall problem. This research ensures that market parties are maximally provoked through the chosen innovation procedure.

Secondly the conversation between the municipality and market parties is a no-go area during tender procedures. It is the task of the municipality to create and maintain a level playing field during tenders. Such a conversation disturbs the level playing field between market parties. However for the municipality it is also important to incorporate the view of market parties, especially into the documents created prior to this tender procedure. The procedure of the municipality must provoke a maximum amount of innovative behaviour. Only that can result in sufficient innovations. Impartial research interweaves the view of market parties into the with the view of the municipality. The research is thus beneficial for the municipality because it gains insight into a no go area for them.

Lastly tender procedures are often defined by one party. Also in this case the procedure is determined and prepared by the municipality. In the preparation phase the aim is to incorporate the view of market parties by organizing market consultations and market meetings. However the preparation phase is still internally executed by municipal representatives. Therefore the determination of the procedure can be classified as a top-down approach. Such an approach is relatively quick. However several black boxes exist in which assumptions are made whereby it is unknown how the system inside actually works. One of those black boxes is the way market parties are stimulated by a certain innovation procedure. How innovative behaviour in these parties is stimulated remains unknown. This research contributes to the view of market parties related to this process and tries to unravel this black box whereby the view of market parties is incorporated.

2.7 Limitations and delimitations

This research has some limitations and delimitations. Limitations are factors of the research that cannot be controlled such as conditions or influences. Delimitations define the boundaries of the research. These are especially important for other researchers implementing the results of this research into further research.

2.7.1 Limitations

1. Interviewees are questioned using an interactive interview method. Follow-up questions are asked by the researcher in the interviews. Furthermore the answer of market parties relies heavily on their view towards new public procurement procedures and their status in this procedure. Their view might even change over time and so might the answers to the questions. Repetition of this research is thus hard.
2. The attitude of market parties was reservedly during market consultations and meetings. It is not known whether these parties will be open to the research during interviews. This limits the possible outcomes of the research.

2.7.2 Delimitations

1. Only one case study –The innovation Partnership for Quay walls- is being examined during the research. Different market parties and municipality representatives will be interviewed however all related to one case. Therefore it is hard to draw general conclusions based on one case study, and future researchers must be critical whilst implementing the results. This single case study is chosen because of the relevance to construction management.
2. This research will conclude on how the municipality should improve the innovation process they request in tenders. These results are based upon literature and interviews with market parties which are validated among representatives of the municipality. However it is unknown whether the conclusions actually result in a more effective innovation process. This implementation is not researched because of time constraints in the research.

3 Technical research design

This chapter presents the technical research design. Whereas the previous chapter presented *what* is going to be investigated in this research, this chapter presents *how* that will be achieved.

3.1 Research process framework

This section describes the research process framework, presented in Figure 3. This framework presents the different steps taken to achieve the research objective.

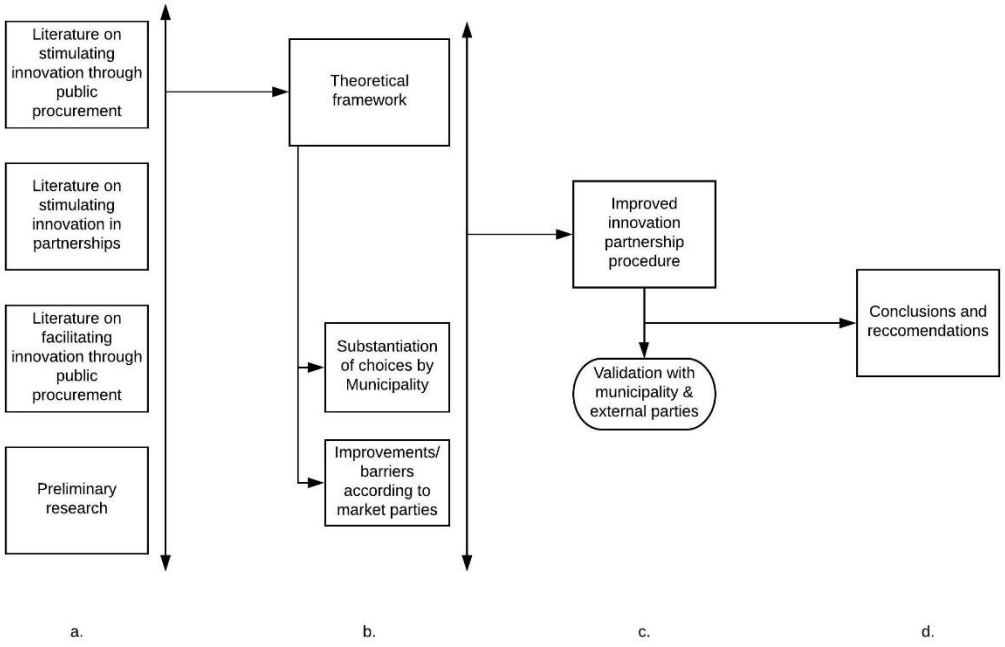

Figure 3: Research process Framework

The research process framework consists of four successive steps executed during the research project. Each step needs to be finished in order to start with the next step in the research project. The different steps in the research framework are elaborated in Table 1.

Table 1: Description of the different phases in the research

Phase	Description
ad a.	This phase consists of a literature review. Literature is reviewed in the field of stimulating innovation through public procurement, stimulating innovation through partnerships and facilitating innovation through public procurement. Together with the preliminary research a framework is constructed. Which shows how innovation on these aspects can be stimulated according to literature.
ad b.	Empirical data is gained during this phase. Firstly interviews will be held with representatives of the municipality. These interviews aim to validate the arguments and choices in the innovation partnership for quay walls. Secondly market parties are interviewed. These interviews gain insight into how the current procurement can be improved according to the market parties.
ad c.	Data from literature and interviews is combined using the research framework. Subsequently a list is constructed of all possible improvements to the current innovation procedure. These are translated into an improved innovation partnership procedure. The outcomes are validated with representatives of the municipality and external parties.
ad d.	The last phase draws conclusions for the research. In the conclusion the main research question is answered. Furthermore recommendations for the municipality and further research are given.

3.2 Research Plan

Figure 4 presents the research plan of this research. The research plan is a schematic overview of the several phases of the research, which shows what input is needed for the phases, what the research activities are and how this is presented in the chapters of this report.

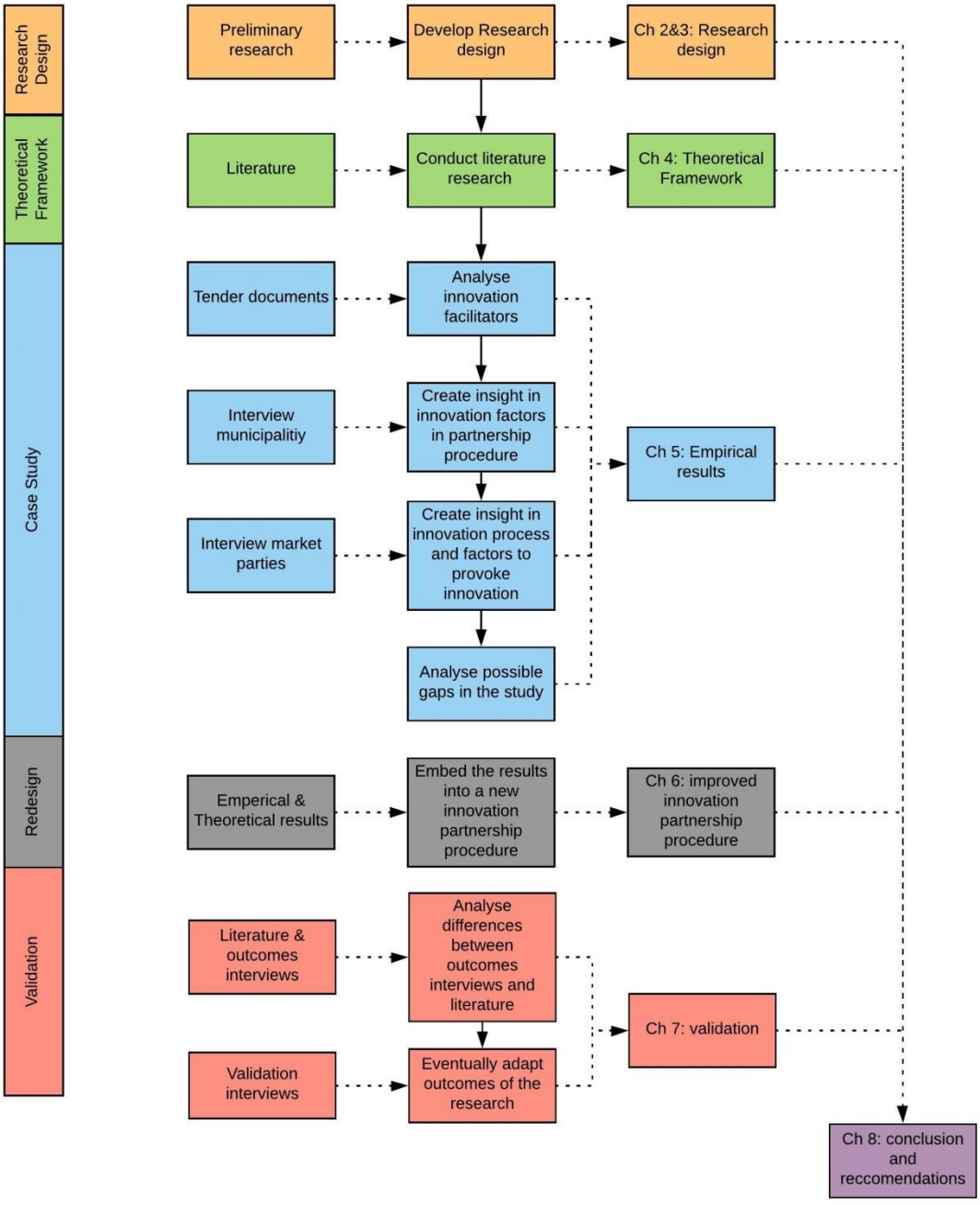

Figure 4: Schematization of the research plan

3.3 Methodology

As can be seen in the previous section consists this master thesis of four sub sequential phases: theoretical framework, case study, Design and validation. In the following paragraphs briefly is described what the methodology is in the several phases. A more detailed description can be found in Appendix B.

3.3.1 Theoretical framework

In the theoretical framework scientific literature is used to answer the theoretical research questions. Hereby is mapped what current important (scientific) knowledge is regarding the subject of this research.

3.3.2 Case study

During the case study qualitative interviews are executed among representatives of the municipality and 10 market parties (contractors, engineering firms & innovators) interested in the IPQ. In the interviews with the municipality is achieved to gain more insight into what choices are made by the municipality in procurement procedure. The interviews with market parties give a reflection on the current procurement procedure, as well possibilities to improve this procedure.

3.3.3 Redesign

In the redesign are the results of the previous phases, theoretical framework & case study, combined to redesign the IPQ. Hereby are these results interpreted by the researcher and translated to a redesign of the innovation partnership procedure.

3.3.4 Validation

The last step of this research consists of a validation study. In the redesign the results of the empirical and theoretical part are interpreted by the researcher and translated into a new design. However it is important to validate whether this redesign is feasible to execute, logically sound and complete. In the validation part interviews are executed to investigate this.

4 Theoretical framework

The aim of this chapter is to answer the theoretical research questions presented in section 2.5. In each section one theoretical research question is answered. The introduction of each section presents what exact information is being researched. Within the first section a broader perspective on innovation in the construction sector is described. This information is important for the other theoretical research questions as well. The innovation partnership procedure of the municipality of Amsterdam consists of roughly four stages:

1. **Market inquiry:** in which the aim is to increase interest among market parties and gain feedback to the procurement procedure.
2. **Selection:** in which parties are selected for the R&D phase of the procurement procedure.
3. **R&D:** in which market parties develop actual innovations for the quay wall problem of the municipality of Amsterdam.
4. **Follow-up projects:** in which market parties execute projects, using their innovations, under a framework contract for the municipality of Amsterdam.

During this literature research, opportunities and barriers are found in several sections for provoking innovation using public procurement. The central topic of this research is the innovation partnership procedure, and more specifically this procedure for quay wall renewal in Amsterdam. These opportunities, barriers and possibilities are described for the four project stages.

4.1 Public Procurement as innovation stimulator

This section aims to answer the first theoretical research question: *What are opportunities and barriers to stimulate innovation through a public procurement procedure from a market perspective?*

To do so this section starts with a more generic overview of innovation, specifically on innovation in the construction sector. This information is important for further research and to gain a broader insight into innovation practice. Secondly is narrowed down towards how innovation can be stimulated through public procurement. Finally barriers and opportunities to stimulate innovation through a public procurement procedure are investigated.

4.1.1 Characteristics of innovation

Innovation is broadly defined in research, on abstract level is stated that "*Innovation is the creation of new products, services or business processes. Creating wealth or social welfare*" (Loosemore, 2015). Innovation is important for the status of a country. Lack of innovation stifles economic growth, while a high level of innovation is beneficial to the GDP of a country (Schilling, 2013).

In a more practical sense the definition of innovation is different: "*Innovations are new creations of economic or societal significance mainly carried out by firms (but not in isolations). They may be new products or new processes"* (Edquist & Zabala-Iturriagagoitia, 2012). This definition refers to the meaning of innovation on project level, therefore is this definition used in the research.

Edquist & Zabala-Iturriagagoitia (2012) state that two kinds of innovations exist: product- and process innovations. Product innovations are embodied in the output of an organization as goods and services, often seen by introducing new products or technologies. Process innovations on the other hand, improve effectiveness or efficiency of a certain process, beneficial for the effectiveness and efficiency of a production process (Schilling, 2013). Another distinction in innovation science is between radical and incremental innovations. Radical innovations are very new to an industry, different from prior solutions, hard to foster and requiring more resources (especially time and finance related) (Saastamoinen, Reijonen, & Tammi, 2018). Incremental innovations make relative minor changes to existing practices. These are easier to foster and require less resource input. However no clear boundary exists between radical and incremental innovations. In reality this distinction may include other types of innovation and Technological Readiness (Schilling, 2013).

4.1.2 Innovation in Construction

The level of innovation in the construction sector is criticized in literature. It is claimed that the productivity of the sector compared to other sectors (e.g. manufacturing) lags behind. A reason for this is the product oriented construction industry, resulting in minor productivity raises (Winch, 1998).

The construction industry can be seen as a complex systems industry (CSI). Fostering innovations in this type of industry is hard. The characteristics of such an industry are (Miller, Hobday, Leroux-Demers, & Olleros, 1995):

- Many interconnected customized elements organized in an hierarchical way;
- Non-linear and continuously emerging properties where small change to one element of the system can lead to changes elsewhere in the system;
- A high degree of user elements in the innovation process.

In the CSI a large number of tailored components are produced by temporary organizations. Using one-off, small batch processes. In construction products are one of a kind and produced without prototyping. Whereas modelling and simulation are important factors in the decision making process. It can be concluded that the construction industry is a CSI (Barlow, 2000).

Innovation in a CSI is hard, but not impossible. An important factor to foster innovation is communication and interaction between all parties involved in the innovation process. In construction parties fail to do so, resulting in low innovation rates (Winch, 1998). The CSI can be imagined as Figure 5 (Miller *et al.*, 1995). The industry roughly consists of three different parties:

1. **The innovation superstructure:** demanding a change which is only possible to achieve by innovations. Also responsible for setting legal boundaries.
2. **The innovation infrastructure:** working on behalf of the innovation infrastructure, carrying out the actual innovations.
3. **System integrators:** connecting the superstructure and infrastructure, fostering innovations within the industry (Miller, Hobday, Leroux-Demers, & Olleros, 1995).

Innovation is only able to increase when the super- and infrastructure are brought closer together. Systems integrators have to bring these closer together, foster interaction between them and champion innovations throughout the sector (Winch, 1998).

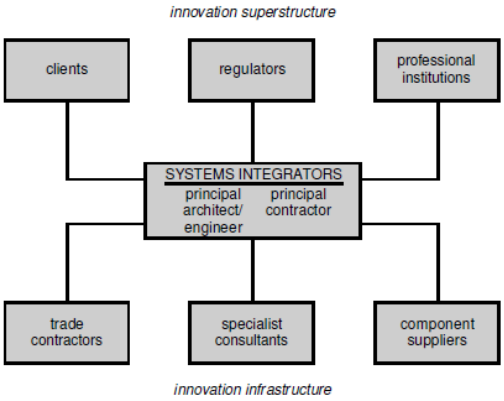

Figure 5: The Complex System Industry of construction (withdrawn from Miller et al., 1995)

The reason that the infra- and superstructure have to be brought closer together are loose couplings between those parties. Marked by, especially, short term relationships on project basis. Because different parties have to work together on each project, loose couplings decrease the likelihood of innovation. Therefore becomes learning over projects hard. Innovation can only take place when contractor and client work closely together on multiple projects (Dubois & Gadde, 2002). Subsequently the couplings on contract basis and between the procurement and construction phase must be tighter. These facilitate the establishment of innovation during the design phase, and eventually execution phase.

Contradictory literature claims that the comparison between innovations in different sectors is hard to make. In construction levels of innovation are often compared to manufacturing, especially the car industry. However when looking at innovation in the car industry throughout the value chain, this is mainly limited to the manufacturing stage. Other stages, like repair and maintenance, are not innovative at all. The value chains of the construction and car industry differ heavily from each other, hard comparison is therefore not to make (Winch, 2003; Loosemore, 2015).

Subsequently when comparing, innovation is often measured only at large companies. Contribution of SMEs is neglected in research. In comparison to the car industry has construction a high level of SMEs. Especially this group is important for innovation in construction. When comparting these sectors, contribution of this group must be taken into account (Barrett, 2008).

Finally is stated that construction consists of many 'hidden' innovations, lowering the total level of innovation. Innovation in construction is mostly not the result of R&D budgets, it occurs inside companies fostered by ideas of people. These innovations are hard to detect, therefore it is hard to mark the exact level of innovations in construction (Chan, Liu, & Fellows, 2014).

The Netherlands

The Dutch construction sector has some specific characteristics. Firstly most innovations occur from the supplying industry, on average 40% of all innovations in the sector originate from other branches. These innovations can be described as incremental (Pries & Dorée, 2005). Main reason for this are the inward-looking construction firms in the Netherlands. The aim is to improve their technology and develop new products rather than being more efficient and improve their process. New products are thus developed however efficiency is not improved (Pries & Dorée, 2005).

Secondly company size does not matter regarding innovative power. For years smaller companies seemed to be in favour to develop innovations (Pries & Dorée, 2005). Most subcontractors and suppliers are SMEs, therefore is argued that most innovation origins from smaller companies. Most important source for innovation are changing regulations (Pries & Dorée, 2005).

The municipality of Amsterdam tenders a large part of their projects on lowest price. A large drawback related to this is the lack of innovation and loss of quality (Favie, Abdalla, & Maas, 2007). The phenomena of lowest price tendering and the effect on innovation stimulator is further studied in the next section. When tendering for lowest price effectiveness of the sector is mostly not improved (Favie, Abdalla, & Maas, 2007; Rijt, Hopes, & Santema, 2010)

4.1.3 Innovation through public procurement

Competition is a key element for establishing innovation. Governments can use regulations like public procurement to influence competition. Important is that more competition might lead to disruptive innovation. When developing innovations co-operation is important because risk and costs can be shared (Waarden, 1996).

In construction stimulation of innovation can be done by two instruments: demand- and supply side (Rothwell & Zegveld, 1981). In recent decades the main instrument to stimulate innovation was on the supply side, currently the shift turned towards the demand side (Flanagan, Uyarra, & Laranja, 2011). One of those instruments is public procurement. The next section elaborates further on this instrument. In all OECD countries demand-side innovation policy instruments are gaining ground over supply side driven policy. Past research showed the ineffectiveness of those instruments. Supply-side instruments are therefore stimulated by the OECD (OECD, 2015).

In the fragmented construction sector innovation is challenging. Construction is a joint activity executed by many different parties and people on one project. Participants in an innovation process must be on the same line whilst implementing innovations (Barlow, 2000).

Public procurement (PP) is defined as the purchase by governments and state-owned enterprises of goods and services (Uyarra, Edler, Garcia-Estevez, Georghiou, & Yeow, 2014). On average 29% of total government expenditures is done through public procurement. Making it an important demand side policy instrument to stimulate (OECD, 2015). However this potential is often not used in practice. Between 2010 and 2012, 14 to 36% of the companies incorporated innovation activities as part of a public procurement contract (Appelt & Galindo-Rueda, 2016).

Moreover suffers the public sector suffers from an innovation deficit. Caused by aversion towards experimentation, risk and failure. Tender specifications are too complex and interaction with suppliers and end-users does not take place. Public agencies poor risk management forms a main barrier towards innovation through PP (Uyarra, Edler, Garcia-Estevez, Georghiou, & Yeow, 2014)

In the previous section was claimed that lowest price tendering is one of the main causes for the lack of innovation in construction. Lowest price as only criterion in public PP stifles innovation. The market is dedicated to offer the lowest price possible and cut innovation budgets (Dulaimi & Kumaraswamy, 2000). Recently the European Union presented less restrictive procurement methods, increasing the possibility of new and more innovative ways of procurement (OECD,

2015). In those new methods public procurement is seen as a vehicle to foster innovation (Rothwell & Zegveld, 1981; Zelenbabic, 2015; Seaden & Manseau, 2001).

Two general procedures regarding procurement can be distinguished. Regular public procurement procedures are used by public agencies to buy "Off-The-Shelf" goods or processes. Parties are chosen based on criteria as quality and price (Edquist & Zabala-Iturriagagoitia, 2012; Lichtenberg, 1988). However when a public agency needs a product or service which is not available on the market, innovation is needed. Innovative public procurement procedures offer possibilities to foster innovation in a certain sector. Hereby the public agency places an order to fulfil certain desired functions. Innovation in these procedures is not the main object but seen as necessary to satisfy to the desired requirements (Edquist & Zabala-Iturriagagoitia, 2012; Aschhof & Sofka, 2009). PP is seen as an important source for innovation. It counteracts towards market and systematic innovation failures, resulting in less innovation activity (Edler & Georghiou, 2007).

PP seems promising for fostering innovation. However barriers exist (Zelenbabic, 2015):

- Lack of skills and capabilities of PP professionals;
- Lack of management skills;
- Risk associated with innovation;
- Public sector risk-averse culture;
- Obstacles related to different procurement organizational models;
- Financial constraints;
- Silo budgeting;
- Absence of technology champions;
- Lack of senior management support;
- Lack of influence of procurement department within organization.

Recent research shows that these procedures are not utilized often. New public procurement procedures, developed to foster innovation, eventually fail to do so. Mainly because the lack of participants in the procedures. A significant amount of potential participants is needed to gain a sufficient level of innovation from the procurement procedure (Haugbolle, Pihl, & Gottlieb, 2015).

PP in the Netherlands is important to foster innovation. It is aimed that between 47% and 70% of the firms who innovate do so because of PP (OECD, 2015). Changing regulations in the industry remains the most important factor for innovation in construction (Pries & Dorée, 2005).

4.1.4 Barriers

In literature various barriers towards fostering innovations through PP. This section identifies these barriers. These are explained from the four stages of the IPP of the municipality of Amsterdam.

1. **Market inquiry**

Focus of innovative companies

Innovative companies focus on national level public agencies rather than local level. Lowering the amount of innovative power for local public agencies (Tammi, Reijonen, & Saastamoinen, 2017);

Quality of public agencies

Public agencies fail to have knowledge on the field of PP, management and risk associations with innovations. This results in a higher chance of a failed procurement procedure (Zelenbabic, 2015);

Complex Process
PP itself is already a complex process. The instrument is full of contradictions, adding another factor into the instrument leads to an even more complex system. This might result in failure of the innovation through the procedure (Lember, Kalvet, & Kattel, 2011; Cave & Frinking, 2007; Nyiri, Osimo, & özcivelek, 2007). Subsequently transaction costs are increased whilst another goal is added in a PP. Leading to less available budgets for innovation (Lember, Kalvet, & Kattel, 2011).

2. Selection

Problems of SMEs
SMEs have resource constraints to access procurement contracts for innovation. Whereby the group of parties available for a procedure becomes smaller, resulting in less competition between parties (Saastamoinen, Reijonen, & Tammi, 2018). Subsequently SMEs and non-profit organizations find large contract sizes and communication problems between supplier and procurer problematic (Uyarra, Edler, Garcia-Estevez, Georghiou, & Yeow, 2014).

Problems of local governments
Local governments have a lack of orientation towards innovation and a lack of budget and skills. Lowering the successfulness of gaining innovations through PP (Nyiri, Osimo, & özcivelek, 2007).

Focus on capabilities
Market parties focus mainly on technical capabilities when trying to innovate. Whilst other capabilities seem to be more important in an innovation process. Such capabilities are for instance: organizational relationships and managerial qualities. These are seen as necessary for a successful innovation process and are often underestimated by the market (Geroski, 1990).

Amount of parties in procurement process
When procurers add an extra dimension to a PP, the amount of interested companies is often reduced. Market parties need special investments to apply for these tendering procedures. Whilst the amount of available parties is reduced, so is the likelihood of successful innovations. A significant amount of parties needs to be available in the procedure to enhance competition (Lember, Kalvet, & Kattel, 2011; Haugbolle, Pihl, & Gottlieb, 2015).

3. Research & Development

Price of innovations
In the beginning the price of innovative products is usually higher than for existing products. Public agencies must be able to incorporate the higher price into their own strategy (Zelenbabic, 2015);

Regulations
Controversy exists among regulations and innovations. Some laws and regulations such as patents have a positive effect on innovation, while others have not. Regulations do have a positive effect on the innovation process within firms (Waarden, 1996). More specifically form national regulations a barrier for the freedom of public agencies developing an IPP (Lember, Kalvet, & Kattel, 2011). There exists a balance because parties are often fostered to innovate because of new regulations (Pries & Dorée, 2005). These regulations can be dedicated to new norms and standards (Waarden, 1996). It must be watched closely whether regulations do not block innovation.

4. **Follow up projects**

Scepticism

Managers, of public and private parties, are usually sceptic towards innovation projects. Counteracting on the successfulness of innovation projects. (Zelenbabic, 2015; Caerteling, Halman, Song, Dorée, & van der Bij, 2013).

4.1.5 Opportunities

The next sections present the opportunities to foster innovation while using PP. These are related to the IPP of the municipality of Amsterdam.

1. **Market Inquiry**

Early engagement

A public agency has to organize close and early engagement with market parties within the PP. This aspect as well the communication during the engagement is crucial (Zelenbabic, 2015).

Demand pull mechanism

PP is a demand pull mechanism. Therefore public agencies are able to express their exact needs in functional and performance terms. Subsequently public agencies can set barriers or standards regarding the quality of innovations. Securing the suitability of the innovations (Lember, Kalvet, & Kattel, 2011). Procurement innovation counteracts to market and systematic innovation failures stimulating investment in the desired direction (Ghisetti, 2017).

2. **Selection**

Knowledge of parties involved

Parties involved in the innovative procurement procedure must have extensive expertise on procurement procedures and law. Lack of knowledge to this results in negative understanding of national procurement law affecting the project in a negative way (Zelenbabic, 2015).

Specifications

Specific functional requirements are important in the in the innovation process. The public agency must formulate requirements in a functional manner, where market parties have the freedom to innovate. However requirements must be so specific that they fulfil the exact need of the public agency. Technical characteristics should not be specified by the procurer (Edquist & Zabala-Iturriagagoitia, 2012; Zelenbabic, 2015).

3. **Research & Development**

Testing ground

When market parties develop innovations mainly from scratch. It is hard to develop such an innovation fitting exactly to the need of a public agency. Testing grounds are therefore important whereby parties are able to test their innovations in real-life situations (Rothwell, 1984).

Political support

Political support contributes to the success of the innovation procedure. In that case resources will be available to support the procedure as well as one force directing (Zelenbabic, 2015);

Promotion of learning
A public agency must enable an environment both, market party and public agency, can learn over time. Learning for all stakeholders should be promoted in the PP (Lember, Kalvet, & Kattel, 2011).

4. Follow up projects

Technological champion
Public agencies have to function as technological champion during an innovation procedure. Enabling learning and carrying the innovative behaviour of the agency by the sector and people within the organization (Zelenbabic, 2015).

4.1.6 Concluding remarks

The aim of this section was to answer the following theoretical research question: *What are opportunities and barriers to stimulate innovation through a public procurement procedure from a market perspective?*

Over the past decades different articles payed attention towards the subject, leading to the following statements:

- When developing innovations market parties have to pay attention to management qualities and inter organizational relationships, instead of only technical capabilities;
- Competition is important when fostering innovation, therefore a significant amount of parties has to be available;
- The public agency must have orientation, budget and skills towards the PP. Whereby they have the freedom and knowledge about regulations when developing such procedure. During the procedure a public agency has to change their risk averse behaviour;
- Innovation champions are necessary to support the change innovation brings. Champions must be capable of withstanding managers with an innovation averse attitude;
- Specification of requirements must be done by public agencies on a functional and performance level only;
- During the procurement procedure is it important that the public agency delivers a testing ground for innovations, and stimulate learning among stakeholders;
- Lastly can from this section be concluded that **partnering** between public agency and market is an important factor for provoking innovation within the market.

4.2 Partnering as innovation stimulator

This section focusses on the aspect of partnering as innovation stimulator for market parties. The section answers the following theoretical research question: *What are opportunities and barriers to stimulate innovation within a partnership between municipality and market party?*

To do so firstly an overview is given about partnership and the construction industry. Secondly the focus lies on the different barriers and opportunities for stimulating innovation through a partnership between municipality and market party.

4.2.1 Partnerships and construction

Previously it is claimed that the construction industry can be seen as a CSI. The large amount of companies involved in one project is an important characteristic for this. Parties involved in a construction project can be seen in Figure 6 (Blayse & Manley, 2004).

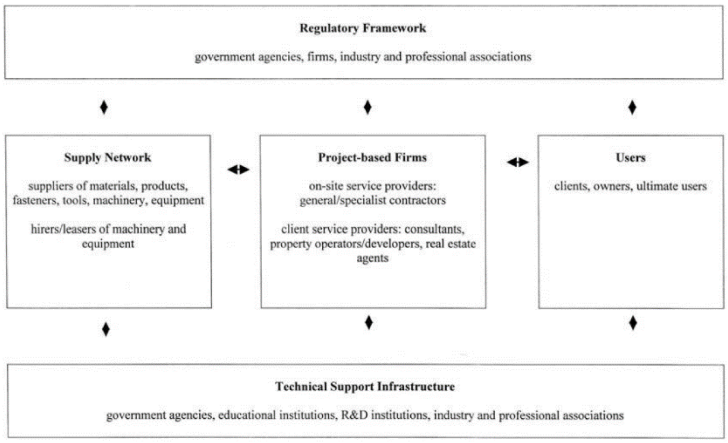

Figure 6: Participants in one construction project (Blayse & Manley, 2004)

Innovation in this system is hard: all participants must interact with each other and agree upon each other's choices (Marceau, et al., 1999). Partnerships between contractor and client are seen as a solution to solve this problem. This concept is often referred as 'partnering' in construction (Beach, Webster, & Campbell, 2005; Bygballe, Jahre, & Swärd, 2010).

The definition of partnership varies throughout literature. In this research the following definition is used: *"A partnership can be described as a long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resource"* (Bygballe, Jahre, & Swärd, 2010) Partnering relationships are established for a longer period than normal construction relationships between contractor and client. These longer relationships set preconditions for innovative behaviour by contractors and designers (Nam & Tatum, 1997). Because construction projects are often made in a one-off nature with a unique combination of contractors and engineers, partnering in construction is hard. Limiting the degree to which can be utilized. The relationship between parties over projects is crucial for innovation and must be tightened (Dubois, & Gadde, 2002; Dorée, & Holmen, 2004).

Two types of partnering can be distinguished: project partnering – in which parties join forces to accomplish goals within one project, and strategic partnering – long-term commitment to at least two parties within the partnership. Long term strategic partnerships are the ultimate way to ensure innovation behaviour between parties. Involvement of more than only the main contractor is needed in successful partnerships with innovation. This is because most innovation in the construction sector comes from suppliers and sub-contractors (Bygballe, Jahre, & Swärd, 2010) During a partnering project the role of the contractor is different than in a traditional project. A contractor typically is involved in the design phase (Kadefors, Björlingson, & Karlsson, 2007).

4.2.2 Barriers

Several barriers were found in literature towards partnering between a public agency and market party. These are elaborated are elaborated in the next sections, linked to the IPQ.

1. **Selection**

Resistance of employees

Inexperience and resistance by employees of contractors regarding innovation and partnering are seen as major barrier towards innovation (Ozorhon, Abbott, & Aouad, 2014).

2. **Research and Development**

Exchanging knowledge

Exchanging knowledge between firms in a partnership is important when fostering innovation. However information must also be absorbed by other parties, 'absorptive capacity' is an important factor to use the gained knowledge appropriately (Barlow, 2000).

Availability of sub-products

Sub-products are needed for innovations, these are often not available on the market. Development of these products is not at the same speed as the innovation process, hindering the amount of innovation (Ozorhon, Abbott, & Aouad, 2014).

Mutual resource investments

Both, public and private parties, have to invest in the partnership when innovating. Nowadays investments are mainly done by the client whereas contractors gain profit from the innovation process (Chan, Liu, & Fellows, 2014).

3. **Follow-up Projects**

Goals during partnership

An innovation process is often a lengthy process over several years. During a partnering innovation process it is important that objectives of the parties involved are on the same line. This is hard because individual objectives change over time (Barlow, 2000).

4.2.3 Opportunities

Below the opportunities for stimulating innovation through partnering are pointed out. These are explained for the phases of the innovation partnership procedure.

1. **Market inquiry**

Early contractor involvement

A partnership requires early contractor involvement. This is seen as crucial for building mutual trust enhancing the likelihood innovations will succeed (Ozorhon, Abbott, & Aouad, 2014).

2. **Selection**

Resource needs

For firms innovation is costly and time consuming. The success of an innovation process is uncertain for firms. Partnerships help to improve the likelihood of success (Haeussler, Patzelt, & Zahra, 2012).

3. Research and Development

Cooperation

Lack of co-operation between client and contractor is seen as a major cause for the low innovation in the sector. Partnerships tighten this relationship and foster the innovative behaviour throughout the sector (Dubois & Gadde, 2002)

Multiple projects

Partnerships stimulates parties working together on more than one project. Fostering the likelihood successful innovation will be the result (Holmen, Pedersen, & Torvatn, 2005). Innovation is more likely to succeed when it is developed by parties working closely together with stakeholders as co-producers of knowledge (Kadefors, Björlingson, & Karlsson, 2007).

4. Follow-up projects

Champions

Champions within contractors are necessary to foster the change needed to be supportive for innovation and partnering. These champions are able to change culture and establish mutual trust and teamwork. Both essential for successful diffusion of innovations (Ozorhon, Abbott, & Aouad, 2014).

4.2.4 Concluding remarks

Partnering is commonly used in the construction sector. However the effect on innovation is less intensively researched. From literature it can be stated that partnering is a great opportunity to establish innovation within construction. Especially when contractors are early involved in the construction process. This enhances trust between contractor and client resulting in mutual investments. Also support is increased from both parties to develop innovation cooperatively. For public agencies it a challenge to create such relationship in a **procurement procedure**. The organization of this procurement procedure is crucial for innovation.

4.3 Provoking innovation

The aim of this section is to answer the last theoretical research question: *What factors can be influenced by a public agency to provoke innovations for market parties?*

In order to answer this question, first the factors are relevant to provoke innovation are described. Secondly the role of public agencies regarding the subject is elaborated and lastly concluding remarks are given.

4.3.1 Factors to provoke innovation by a public agency

By answering the previous research questions some factors whom provoke innovation already are revealed. This section elaborates further on the specific factors public agencies can influence to provoke innovation. Literature on this subject is limited. Therefore this section gives insight in what a public agency must establish within their PP to provoke a sufficient level of innovation. The factors found in literature are described and referred to the innovation partnership procedure.

1. **Market inquiry**

Choosing an appropriate contract format

As shown in the previous sections are contract formats an important tool to foster innovation in construction. DBB contracts are the most detrimental contracts for innovation. In 2012 procurement law changed, public agencies are able to use more innovative ways of procurement. Those innovative ways, like the BOOT contracts opens more room for innovative behaviour of market parties. These act more innovative when they have the freedom to make the design. Clients have the role of determining functional requirements. (Kulatunga, Kulatunga, Amaratunga, & Haigh, 2011).

2. **Selection**

Enhance specific requirements

Clients can stimulate market parties to be innovative by enhancing specific requirements regarding innovations. Especially when products are not available at the market, clients can formulate functional requirements. Together with choosing the appropriate procurement form, innovation will be stimulated according to these requirements (Blayse & Manley, 2004).

Exert pressure on project participants

Especially in the conservative construction industry, contractors are not likely to innovate from their own interest. To foster innovation clients can exert pressure on project participants to improve performance of the project (Blayse & Manley, 2004).

Demand higher standards of work

In the construction industry standards are set for a long period. Contractors do not have the drive to innovate. Clients can influence this by simply demanding higher standards of work within their construction contracts. When these higher standards are not available at the market yet, clients foster contractors to be innovative. Hereby clients must be aware of what already is available at the market. Lastly clients must also be able to transfer these higher standards into clear requirements in procurement documents (Blayse & Manley, 2004; Barlow, 2000)

Enhance a good combination of firms

Developing innovations individually is hard in construction. Larger firms have the resources to innovate, however often not the organizational capacity. SMEs have the organizational capacity but often not the resources for innovation. A combination of SMEs and larger firms is seen as critical success factor to establish innovation (Saastamoinen, Reijonen, & Tammi, 2018).

3. **Research and Development**

Absorbing risks

Traditionally public agencies in the construction industry act risk averse (Zelenbabic, 2015). However applying innovation brings risks, those risks have to be partly absorbed public agencies. Especially when socially/ecologically innovative products are demanded by public, agencies must be willing to absorb a certain amount of risks. Furthermore, innovations typically come with higher costs at the beginning of an innovation procedure. Innovative products are simply more expensive in the beginning since EoS are hard to create. Public agencies must bear these costs at this stage of the innovation cycle (Edler & Georghiou, 2007).

Enhance a co-operative relationship

With a co-operative relationship between public agency and market party innovations are more likely to become successful. In this relationship both parties have to invest in the development of

innovations (Appelt & Galindo-Rueda, 2016). Public agencies have to enhance that market parties work together in the innovation process. This collaboration results to a wide range of skills and specialisms on project basis. Effective collaboration relies on effective diffusion of information throughout the project. Parties are co-producers of knowledge helping to champion innovations throughout the sector (Harty, 2005; Loosemore, 2015). The lack of co-operation between contractor and client is even seen as one of the sources for the low level of innovation in the industry. And therefore a prerequisite for establishing successful innovations (Holmen, Pedersen, & Torvatn, 2005; Ozohorn, 2013; Aouad, Ozorhon, & Abbott, 2010).

Resource investment

Different resources are needed for the development of innovations. In a co-operative relationship public agencies must be willing to invest resources in the innovation. This investment is not limited to financial resources, also human resources must be invested by the public agency. Lastly should available knowledge of the public agency be shared (Ozorhon, Abbott, & Aouad, 2014).

4. Follow-up projects

Maintain long-term relationships

The construction industry consists of various short-term, project-to-project relationships. Due to construction procurement law, clients are obliged to search a new contractor for each single project (Dubois & Gadde, 2002). Those short term relationships do not offer an innovative environment. Long term relationships are a precondition to enhance innovation in the sector. Especially clients can influence this long term relationship by, for example, bundling projects or contract larger volumes (Nam & Tatum, 1997).

4.3.2 Role of Public agencies

The previous section describes the factors public agencies can use to facilitate innovation during the procurement procedure. However, public agencies must also take a certain role in the procurement contract to establish innovation. Tendering for lowest price is a large drawback for fostering innovation. During these processes a contract is awarded to the party who offered the lowest price for the contract. In this process clients took the 'design' role, determined what work had to be done and quantified how much materials were needed. Contractors priced these items resulting in a procurement price. The contractor with the lowest price was awarded with the contract. The role of the client during this process was relatively large, whilst the contractor had a minor role (Dorée A. , 2004). Subsequently a major collusion in the Dutch construction industry was reason to change the way clients procure their civil engineering projects. Nowadays clients prescribe functional requirements rather than specific requirements to contractors. A contractor has to determine a solution satisfactory to the functional requirements of the client. However it is the task of the client to prescribe functionally sound requirements in a way that in the end the desired result is obtained. This changes the way clients have to deal with their civil engineering projects (Dorée, & Holmen, 2004, Dorée, 2004).

Procurement methods as described above resulted in a world whereby contractors did not have to think about design or innovation. They just had to make what the client prescribed. These procurement procedures are not beneficial for establishing innovation (Vennström & Eriksson, 2010). Furthermore does more competition together with tendering for lowest price result in a large amount of parties putting in their bid during a tender procedure. However research in the

past decade showed that this phenomenon doesn't hold for public goods such as roads, railways, bridges, lighthouses etc. Those facilities are necessary for a smooth society, whereas nobody in the society feels responsible for the goods. Especially in the public goods' sector more competition leads to a 'race to the bottom'. Hereby the price is lowered by contractors only to win a tender, resulting in such low bids that quality, safety and regulatory issues arise. Collaboration is essential in the public goods' industry to enhance innovation. Contractor and client have to work together in order to retrieve a successful innovation process (Dorée, Holmen, & Caeterling, 2003)

Another important role a public agency has to take is already briefly mentioned previously: government championing. The public agency is an important financial, technical and political player with power in the construction system (Caeterling, Di Benedetto, Dorée, & Halman, 2011). A public agency should therefore take the role to regulate and foster innovation throughout the industry. Within this role Caeterling et al. (2011) explains the aspects that governments have to take into account regarding fostering innovation:

- Establish long term objectives to help firms innovate;
- Gain support of policy makers, especially on top level;
- Help to break down counteracting regulatory barriers towards innovation;
- Incorporate officials who decide on procurement of new technologies;
- Promote innovation throughout the governmental organization.

It can thus be stated that the government should take a role of promoting an innovation throughout the organization. One of the most important things to do so is to arrange the regulatory framework in a way that it promotes and enables innovation.

4.3.3 Concluding thoughts

This section presents several factors how a public agency should provoke innovation through public procurement. Hereby is the **organization** of the public procurement procedure important. Public agencies can organize the public procurement procedure in a way that innovation is fostered. Public agencies have to be fully aware of the current availability of products at the market before starting a PP for innovation. During a PP public agency and market party have to enter in a co-operative relationship, maintaining long relationships and absorbing a certain amount of risks. The last important factor is the championing of the innovative procurement procedure and innovative behaviour throughout the organization.

4.4 Recent innovations

In this section the following research question is answered: *What are recent innovations in the construction of quay walls and due to what process were these developed?*

This is done by first describing the standard quay wall construction type used in Amsterdam. Secondly, the most common renewal method is given. Thirdly. New innovations regarding quay wall structures are presented. Which are invented internally by the municipality and externally.

4.4.1 Quay wall structures in Amsterdam

Quay wall structures in Amsterdam are as old as the construction of the first canals in the city. Back in the 16th century most of the canal belt in Amsterdam was constructed and so were the quay walls. In the past centuries these structures were improved. Currently the most common structure in Amsterdam is the weight wall (Dutch: gewichtsmuur), as can be seen in Figure 7. This type of quay wall is mainly constructed between 1830 and 1910. It is estimated that a major part of the quay walls in Amsterdam are weight walls, and are thus far over their expected technical lifetime of 100 years. However it is not clear what type of quay walls is constructed throughout the city and what the status of these walls is (Ingenieursbureau gemeente Amsterdam, 2018).

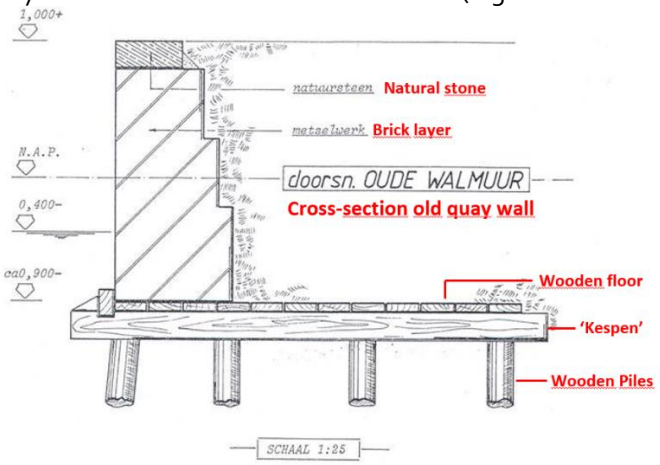

Figure 7: cross section of standard quay wall structure in Amsterdam (Gemeente Amsterdam, 2018)

One of the main problems with the standard quay wall structure is rotting of the wooden piles. Dry periods and dewatering of locations in the city (for example during construction works) give an extra impulse to this process. Another problem is the likelihood of soil washout because no screen for seepage is integrated into the structure. The first symptom noticeable when a quay wall is damaged are cracks in the structure (Figure 8). When this is noticed the quay wall is put under sharp supervision by the municipality. When further degradation is noticed emergency measures are needed to prevent the quay wall from collapsing. In front of the wall, a sand bucket is created locked up with sheet piles (Figure 9). Subsequently all trees are cut on the quay, and the road is closed for heavy traffic.

Figure 8: Example of damaged quay wall

Figure 9: measure to prevent collapsing

4.4.2 Standard procedure to renew quay walls

As a major part of the quay walls in Amsterdam consists of a 'standard' structure, so does current renewal method. Currently around 500m[1] of quays is renewed yearly. Renewal is a costly and time

consuming process. Furthermore causes renewal extreme hindrance for the surrounding and is in the end, on the first sight, not a lot changed (Gemeente Amsterdam, 2018).

The process for standard quay wall renewal (Figure 10) is as follows: firstly two strings of sheet piles (Dutch: damwanden) are constructed. Hereby a construction pit is created in which the old structure is demolished and new piles for foundation can be installed. These (concrete) piles are mostly screwed or constructed in the ground because of hindrance reduction. Thereafter the new quay wall is made, consisting of a concrete L-structure (Dutch: betonnen L-wand). On this structure brickwork is constructed (Figure 11). In the last stage the sheet pile in the canal is removed. The sheet pile on 'the road side' is mostly integrated into the new structure and used as seepage screen (Ingenieursbureau gemeente Amsterdam, 2018).

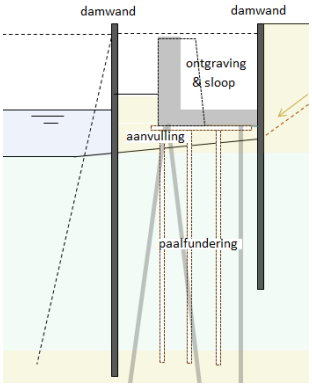

Figure 10: Current renewal process

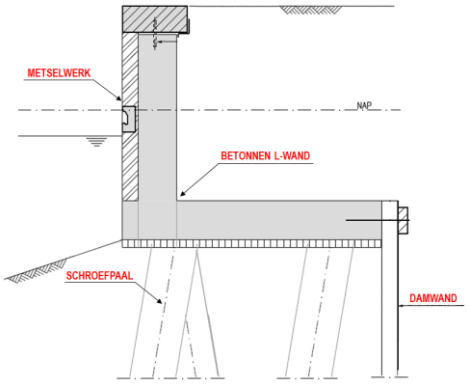

Figure 11: Renewed quay wall

4.4.3 Innovations related to quay walls

Previous sections explain how the quay walls are constructed technically. This method is broadly used in Amsterdam. In the Amsterdam case the municipality described for decades how contractors should execute projects. For contract preparations engineering firms were hired. The first part of this section presents a solution developed internally by the municipality. Secondly, solutions developed by external parties are presented.

Internal developed innovation

One of the innovations is developed by engineers of the municipality. Not a special process can be dedicated to the development of this innovation. It was asked to the engineers whether they had good ideas for innovations in quay wall renovation, where they came up with this idea.

This method only uses one sheet pile. Demolishing takes place under water, where after a pre-fabricated construction element is installed. The explanation of this method is presented in Figures 12 - 15. The main advantage of this method is that only one line of sheet piles is needed. Construction time and hindrance for the surrounding are therefore reduced. However demolishing and demounting becomes harder because this stage takes place under water. Moreover remains the old wooden structure inside the new structure (Gemeente Amsterdam, 2014).

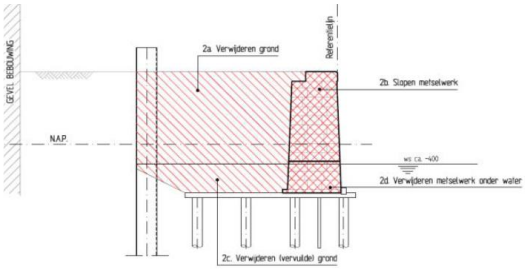

Figure 12: Phase 1: installation of sheet pile and demolishing of the old quay wall

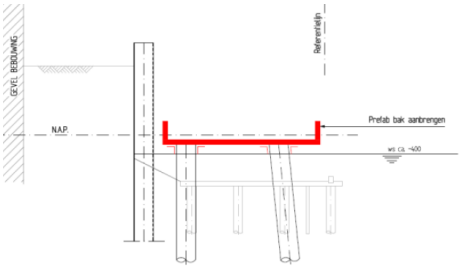

Figure 13: Phase 2: installation of piles and prefab structure

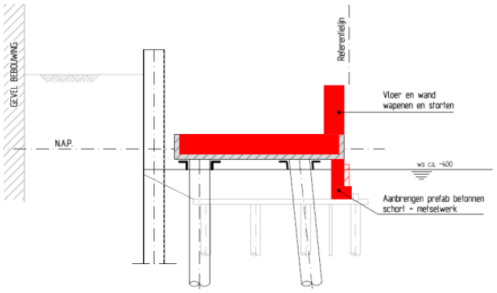

Figure 14: Phase 3: installation of floor and wall

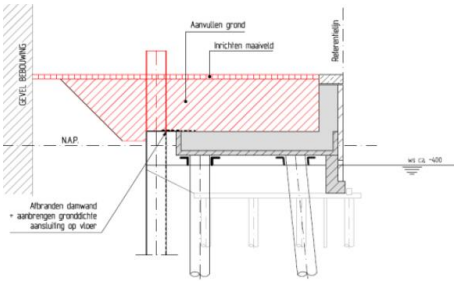

Figure 15: phase 1: integrate sheet pile and decorating ground level

External developed innovations

Several innovations are developed by external parties. However a distinction can be made related to these developments. Many quay wall innovations are related to constructions used in ports. The main the function of this structure is to moor large ships. Those quay walls are mostly thick structures, heavy enough to transfer the forces of moored ships towards the ground. Secondly quay wall innovations are related to inner city quays. These quays have the main function to secure the ground behind the quay. Innovations related to heavy quays are widespread throughout the world. In cities as Gdansk, Bremerhafen, Hamburg & Nagoya innovative quay wall solutions are installed (Hoshiyama, 2009; De Gijt, 2010). As the scope of this research specifically deals with inner-city quays, only innovations related to these are documented. The most important innovations are presented below.

Non-invasive method for quay wall reconstruction

Dutch engineering company Witteveen & Bos (W&B) was specifically asked by the municipality to develop an innovation for the renewal of quay walls in Amsterdam. Hereby the engineering company received a contract of the municipality to develop a new renewal method. W&B came up with a non-invasive method for quay wall renewal (Figure 16). The process of the method is as follows: Firstly tubular piles are screwed close to each other behind the old quay wall, hereby a sheet pile structure is created. This structure is supported by rake piles screwed at a 30 to 40 degree angle at a particular interval. Secondly the old quay wall structure is demolished whereby a part is left in the ground, only the masonry can be demolished. Thirdly prefabricated masonry is attached to the sheet piles. Hereby the originally look of the quays is restored

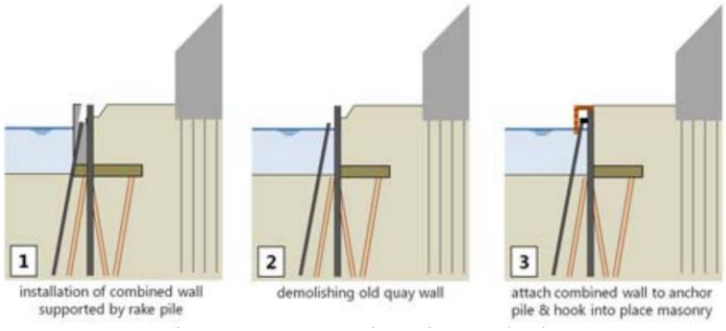

Figure 16: Non-invasive quay wall reconstruction, withdrawn from Dorst & Vervoorn (2017)

This method was tested on two locations in Amsterdam. Main advantages of the method are the absence of excavation, dewatering and vibration during the construction works. This reduces hindrance for the surrounding and construction time. However as can be seen in Figure 16, the old structure is not entirely removed, the ground thus remains polluted with the old structure. The old structure also displaces extremely during installation. For this reason the method cannot be used on a 'too large' plot but must be installed meter after meter (Dorst & Vervoorn, 2017).

Steenwijk Wall (Steenwijk wand)

Dutch contractor H. van Steenwijk proposed a new, innovative, way to renew quay walls in Amsterdam on their website. This method was developed by the company internally. The main incentive for developing this method was the experience of the company regarding quay wall renewal projects. Hereby they faced several disadvantages while using the 'normal method' of the municipality of Amsterdam. Therefore they decided to develop a new method able to solve the execution problems. They came up with the idea to first drill a sheet pile construction in the canal. Hereby the construction site can be drained and the old structure removed. Secondly piles are drilled into the ground for sustentation of the wall. In between the piles concrete is poured to create a concrete curtain. Thirdly a concrete layer is constructed on top of the line with piles. This layer is extra sustained by drilling piles under a certain angle. Lastly a prefabricated brick wall is installed on top of the concrete layer.

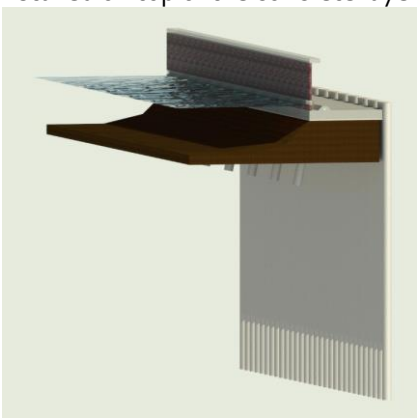

Figure 17: Example of Steenwijk wall (Withdrawn from Cobouw, 2018)

The main benefit of this method is the absence of installing a second line of sheet piles on the street side. According to the contractor this line of sheet piles often remain in the ground after construction, without use. Moreover room is created between the line of piles and the actual quay wall. This room can be used for extra functionalities like underground garbage bins. Disadvantages of this method are the time intensive drilling of the line of poles. This process is more labour intensive than drilling a sheet pile (Tissink, 2018). Moreover, it is doubted whether ground water

can flow freely to the canal, free ground water flow is one of the main requirements of the IPQ (Amsterdam, 2018).

Concluding thoughts
The sections above describe the current quay wall construction in Amsterdam, current renewal process and new innovations whom can be applied on inner city quay wall constructions. Important to notice is that more innovations may be present throughout the industry. Lots of small examples were found on websites of companies. However explicit information about these practices was not found and therefore not used in this research. The innovations described above present three different developments in inner-city quay wall renewal. It must be noticed that more innovations are developed on larger quay wall constructions in ports. However because of the specific characteristics in Amsterdam, these are hard to apply in this case.

4.5 Theoretical framework/Conclusion

The theoretical framework can be presented as final product of this literature review. When answering theoretical research questions one to three the following important aspects came up when provoking innovation through public procurement:

1. **Procurement procedure:** Referring to what specific aspects must be concluded into the procurement procedure according to literature.
2. **Partnering:** Determining what characteristics should be taken into the procurement process to increase the level of partnering between market and public agency.
3. **Organization:** What specific elements should be organized during the whole contract phase to stimulate an innovative environment.

During the literature review characteristics were found which can be referred to these three specific aspects. The theoretical framework presents those aspects with a small explanation. Using this framework more guidance and understanding is used during the empirical phase of the research. This framework presents the factors provoking innovation according to literature as well. Therefore the results will be used in further determination of the design of the research.

Important conclusions from this chapter are the following:

- Different barriers and opportunities exist to establish a procurement procedure where public agencies can foster innovation. The most important factors to translate into a PP are: establishing several testing ground, and stimulation of non-technical capabilities;
- A Partnering relationship helps to organize an environment in which parties are challenged to innovate. Most important factors related to partnering are: long term relations and co-operative relationships;
- A public agency demanding for innovation has to organize this extensively. Whereby the most important factors related the public agency are: political carrier towards innovations, and risk absorbing;

Table 2: Theoretical framework

Theme	Aspects	Description	Source
Procurement procedure	Functional requirements	Innovative procurement procedures must consist of requirements whom are functionally specified. Market parties get in that case the freedom to bring in their own expertise.	(Dorée, & Holmen, 2004); (Blayse & Manley, 2004)
	Stimulating non-technical capabilities	Managerial capabilities are necessary in innovation procedures. These capabilities are more important than rather technical.	(Georski, 1990)
	Prototyping and testing ground	Important is that the procurement procedure contains a prototype or testing phase. This improves the likelihood that ideas are developed until TRL 9.	(Rothwell, 1984); (Barlow, 2000)
	Early engagement	Early engagement is necessary to increase understanding and support for the choices made in the procurement procedure by the public agency.	(Zelenbabic, 2015); (Ozorhon *et al.*, 2014)
Partnering	Long-term relation with several projects	A long-term, multiple project procedure is a prerequisite for innovation in innovation procurement procedures.	(Nam & Tatum, 1997); (Dubois & Gadde, 2002)
	Cooperative relation	Cooperative relationships between a public agency and market parties are needed in innovation procurement contracts.	(Appelt & Galindo-Rueda, 2016);
	Exchanging knowledge	Absorptive capacity of knowledge is a prerequisite to the parties working together in an innovation procurement procedure.	(Barlow, 2000); (Kadefors *et al.*, 2007)
	Objectives on same line	When entering a partnering agreement, it is important that objectives of the parties are in the same line.	(Barlow, 2000) (Bygballe *et al.*, 2010)
	Mutual investments	An important factor in the partnering agreement is that both parties invest (financial and physical resources) into the development of innovations.	(Chan, *et al.*, 2014)
Organization	Amount of companies	Different parties have to participate in the procurement procedure. Competition in this procedure leads to more effective innovation developments.	(Tammi *et al.*, 2017)
	Absorbing risks	Clients must be aware of the fact that innovation causes risks. Especially for market parties it is important that clients absorb risks which cannot be carried or influenced by those parties.	(Zelenbabic, 2015); (Lember *et al.*, 2011);
	Promotion of learning	During the innovation procurement procedure it is important that a learning environment is created.	(Lember *et al.*, 2011)
	Stimulation of communication and interaction	Within a partnership it is crucial that parties interact and communicate clearly to enable innovation success.	(Uyarra, *et al.*, 2014)
	Political carrier to stakeholders/ innovation champions	The role of public clients in innovation procurement procedures is to increase acceptance under the public stakeholders. Furthermore the role of public agencies is to promote technical innovations	(Harty, 2005); (Loosemore, 2015)

5 Empirical results

This chapter presents the empirical results of the research, each section answers an empirical research question. Firstly is described what the outline of the current IPQ procedure of the municipality of Amsterdam is. Secondly the empirical results from the interviews are described. Two sets of interviews are executed: one round with representatives of the municipality. Hereby is focused on the choices in the IPQ. In a second round interviews are executed with market parties interested in the IPQ.

5.1 Current innovation partnership procedure

In section 2.1 is shortly the IPQ of the municipality of Amsterdam mentioned, this section explains the PP in more detail. The innovation partnership is a relatively new method to European public procurement law, aiming to stimulate innovation. Important for an IPS is the unavailability of a certain product at the market or the absence of the desired performance/quality level. The IPS procurement technique is the only procedure integrating the development of innovations with the actual purchase of the innovation (Pianoo, 2019). In this section is described how the municipality of Amsterdam arranged their IPS.

5.1.1 Project scope

During the IPQ market parties are challenged to find innovations for quay wall renewal. As the scope of an innovative procurement process might be hard to determine, the municipality has set a clear scope for the project. Hereby parties 'must' develop an innovative solution for quay wall renewal regarding the quay itself. Parties 'should not' develop a solution affecting other facilities like bridges or foundations of houses. Parties 'may' use the 'grey area' between 'must' and 'should not' for the development of their innovations. If parties do so, they have to make clear what the extra benefits are for the municipality of Amsterdam.

5.1.2 Current procurement procedure

As stated in the problem statement the main reason for the municipality to start the innovation partnership procedure is the unavailability of sufficient solutions for quay wall renewal. In Figure 1 the process overview of the different steps in the innovation partnership are given. This section elaborates further on the process overview of IPQ. The municipality elaborated three phases for the IPQ: 1) procurement phase, consisting of a selection and an awarding phase.2) Research & development phase. 3) Commercial phase. Important information about these phases is presented in Table 3 and the next paragraph.

1.1. **Selection:** During this first phase all interested parties for the IPQ are asked to apply for the selection phase. These parties are selected on application criteria (minimum

requirements) and, when more than six parties apply, on their vision towards innovation. Six appropriate consortia are invited to the next stage.

1.2. **Awarding:** During the awarding phase parties are asked to develop their idea from scratch (TRL-1) to a business case level (TRL-3). Hereby parties deliver the business case and a quotation for the innovation based on a fictive project. During this phase several negotiation rounds take place after which parties can optimize their innovations. After the awarding phase three consortia are selected based on awarding criteria. Three parties are invited to join the R&D phase, the apostatized parties are invited to the waiting room.

2.1. **Prototype:** During this phase development of the idea takes place towards TRL-5. At the end of the stage is assayed whether the prototype satisfies with the assay criteria: maximum price and minimum quality. These are determined before the R&D phase starts. When a consortium does not meet with the assay criteria after this phase they will exit the procedure. Another party, excluded in the previous phase and put in the waiting room can re-join the procedure.

2.2. **Validation prototype:** During this phase a validated prototype is developed. When necessary these prototypes need to be certified before the pilot phase may start. At the end an assay takes place on minimum quality and maximum price, when the prototype meets these assay requirements the consortium may proceed to the next phase.

2.3. **Pilot:** During this phase a real-life pilot project is executed by the consortium. Hereby the innovations are applied on this project. After the project an assay takes place on the results of the pilot, evaluation and progress of improvements. Using these assay criteria is judged whether the pilot meets with requirements, ground conditions and special appointments made between the municipality and the consortium.

3. **Commercial:** After successful completion of the pilot phase each consortium will be awarded with a framework contract (4 years). Within this contract are projects awarded to the consortia. During the contract performance evaluation place based on PDCA. When projects are completed satisfactory the framework agreement can be extended with two periods of two years.

Table 3: Important characteristics of phases in IPQ

Phase	Description	Type of awarding	criteria
1. Procurement phase			
1.1 Selection	Selection of 6 appropriate consortia based on application and selection criteria	Application	- Experience in designing quays - Experience in constructing quays - Working in metropolitan context
		Selection	- Vision on innovation development
1.2 Awarding	Funnel towards 3 consortia based on MEAT criteria	application	- Maximum price - Minimum quality
		Award	- Scalability - Impact on surrounding - Futuristic value - Team - Price
2. R&D phase			
2.1 Prototype	Assay on TRL-5 on minimum requirements and maximum price	Assay	- Minimum quality - Maximum price
2.2 Validation prototype	Assay on TRL-7 on minimum requirements and maximum price	Assay	- Certification - Minimum quality - Maximum price
2.3 Pilot	Assay on TRL-8 on minimum requirements and maximum price	Assay	- PDCA - Requirements - Ground conditions - Appointments
3. Commercial phase (framework contract)			

5.1.3 Goals IPQ

The IPQ has several goals and ambitions. The main goal formulated by the municipality is: *bringing the quay walls in the centre area quickly as possible up to date.* Four ambitions are formulated to achieve this main goal:

1. **50% hindrance reduction:** Hindrance for people around quay wall renewal projects is high. Hindrance includes for instance: road/canal blockages, blocked parking places, replacement of houseboats. Furthermore has hindrance in the form of, for instance, road blockages effect on the amount of projects which can be executed simultaneously. It is aimed that more projects can be executed when the hindrance is cut by half.
2. **50% execution time reduction:** Currently both, preparation time of quay wall renewal projects by the municipality and the execution time of quay wall renewal projects by market parties is high. This has influence on the amount of projects whom can be executed simultaneously and sequentially. By the municipality is claimed that more projects can be executed when market parties cut the execution time by half.
3. **Applicability of solution in central area:** It is claimed by the municipality that a solution applicable, without 'too many adaptions', on different locations throughout the city. Has a positive effect on the scalability of the solution. It is claimed that a new innovation must be applicable within the Amsterdam city centre area.
4. **50% cost reduction:** Investment costs for quay wall renewal in Amsterdam are significantly higher than in other (large) cities in the Netherlands. It is claimed that more projects can be executed when the execution costs are cut by half.

The ambitions presented above are the four main ambitions of the municipality with the IPQ. Furthermore they formulated three secondary goals: durability, multi functionality and stimulation of innovation within the sector. These goals are kept out of the scope of the research since the main focus of the IPQ is to stimulate the ambitions presented above.

5.1.4 Usage of Technological Readiness Levels (TRLs)

During the IPQ TRLs are used to judge upon the readiness of innovations. This section presents a global overview on the background of TRLs as well insight in how the municipality is planning to apply TRLs.

Background
TRLs are used as a tool for decision making on Research & Development projects. The tool was firstly introduced by NASA in during the 1970's. At NASA a new innovation often consisted of several single technologies. The original aim of the tool was to communicate regarding the maturity of new technologies. By setting different levels the maturity of technology could be communicated understandably between departments.

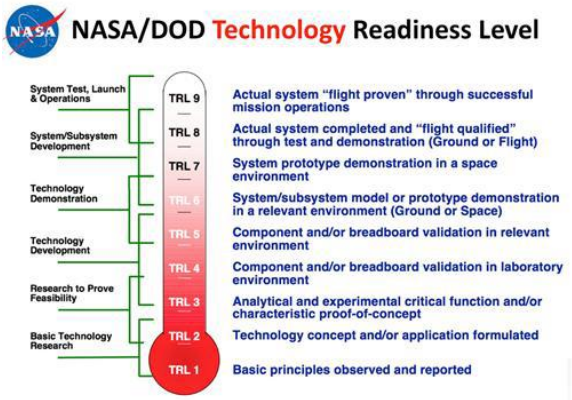

Figure 18: Technological Readiness Levels at NASA (Source: NASA)
When applying TRLs towards a specific case it is important that different levels in the tool are tailor made towards the case and the organization. Applicability of TRLs offers great solution for communicating on new technology development however the following drawbacks exist (EARTO, 2014):

1. *Lack of attention to setbacks:* Product development is more an iterative process whereby products can be set back from TRL-8 to TRL-3 during the development stage. The TRL tool is not designed to this.
2. *Single technology approach:* Originally is the tool created to communicate the maturity of single technologies. When the tool is used to the development of systems this should be investigated and elaborated.
3. *Context specificity of TRL scales:* Before the TRL tool can be used on a project it must be specified to the context of the project. It thus cannot be used directly, the project team working with the tool must adapt it to specific requirement.
4. *TRL scales have a focus on product development:* The original TRL scale is adapted towards product oriented technologies. However when developing innovations non-technological aspects like, readiness to go to market, and readiness of the organization are also important.

TRLs in IPQ
During the IPQ TRLs are used to judge upon the scale of innovations throughout the procedure. As can be read above should a TRL tool be tailor made for the project. The municipality of Amsterdam applies the following TRLs in their project:

- **TRL3:** Developed proof of concept; finished idea-phase
- **TRL5:** Validated prototype in laboratory environment
- **TRL7:** Demonstrated prototype in operational environment
- **TRL8:** Complete and operational product
- **TRL9:** Market introduction and implementation

As can be seen are the TRLs tailor made for the project in Amsterdam. Some of the 'official' TRLs are combined to one level. During the development of the innovation the municipality guides parties to achieve the desired TRLs.

5.1.5 Conclusion

This section answers the following research question: *What is the current innovation partnership process of the municipality of Amsterdam.*

During the IPQ the municipality currently aims to apply three different phases: Tender, R&D and Commercial. In these different phases sub phases exist on which parties are challenged to develop their innovation to a certain TRL. Whom are predefined for each phase. For the phases awarding, assay and application criteria exist to judge upon the quality the innovations or the market parties itself.

5.2 Interviews municipality

This section answers the first two empirical research questions. During this phase three interviews were executed with five representatives of the municipality. Table 4 presents a summary of the interviewees.

Table 4: summary of responsibilities interviewees

Interview #	Function	Task	External
1	Risk manager, procurement advisor	Risk file, selection guideline, sparring partner	yes
2	Legal council	Tenderboard	No
3	Contract manager(1), project manager (2), contract writer (3)		No

Two aspects are important to notice regarding the interviewees:

1. The first interview was executed with an advisor from an external consultant company. It was noticed that the perspective of this interviewee differed from the others'. In the presentation of the results is made clear when this is the case;
2. The third interview was executed with three interviewees whom form 'the heart of the project team'. Tasks within this team are not clearly divided.

5.2.1 Sufficient innovations

According to interviews with the municipality, the main reason to start the IPQ was the unavailability of sufficient solutions for quay wall renewal. With the procedure is aimed to develop a partnership between municipality and three consortia of market parties. In section 5.1 an overview is given of the current IPQ procedure, the specific aims and process overview. This section determines what, according to the municipality, are sufficient innovations.

During the interviews was noticed that the reason to search for a new method was mainly because current method is not able to maintain a stable quality level of quay walls in the city. During the interviews was investigated whether the aims of the IPQ, according to interviewees, differ from the aims presented in the tender documents. From the interviews the following main aims of the IPQ are withdrawn:

1. **Bringing asset quay walls up to date**

The most important goal of the innovation partnership is to bring the quality of the quay walls in the city back to an appropriate level. Currently safety issues occur around quay walls. Therefore safety cannot always be guaranteed for the inhabitants and visitors of Amsterdam. In the past quay walls spontaneously collapsed around the city. The most important task of the IPQ is to deliver a renewal method able to bring the quality of the quay walls back to an appropriate level, guaranteeing safety for the people in Amsterdam.

2. **Scalability**

Currently a large part of the quay walls in Amsterdam suffer from quality issues. Deteriorated quays need renewal and improvement. Since a large part of the quays is deteriorated badly, fast improvement is needed. With the IPQ is aimed to develop a solution which is able to bring a large part of the quays to an appropriate level. Therefore the representatives of the interviews claimed anonymously that scalability is an important aim of the IPQ. The sub-goals: reduction of lead time, costs and hindrance are, according to the interviewees, needed to fulfil the aims above.

By the interviewees of the municipality is claimed that execution costs are least important. While these are in Amsterdam currently higher in comparison to other cities in the Netherlands (for example: Utrecht, Haarlem). It is claimed that the risk leading to a delay in the execution process is the main reason for this difference. Moreover have internal costs of the municipality influence on the total costs of a quay wall renewal project. The influence of market parties on this total investment is relative.

Conclusion

In this conclusion the central research question in this section is answered: *What are, according to the municipality, sufficient innovations in the innovation partnership for quay walls?*

Two aims are according to the municipality important for the innovation partnership for quay walls. Firstly must the asset quay walls brought up to date by the program. Secondly must the solution be scalable to a large part of the quay walls in the city centre. The aim of the IPQ according to the interviewees is slightly different than those communicated in the tender documents. According to the interviews is the cost aspect seen as least important.

5.2.2 Factors to provoke innovation

This section focusses on the different factors, integrated in the IPQ, provoking innovation. These are withdrawn from the interviews with representatives of the municipality. From the interviews the following four important factors could be derived:

1. **Business case for market parties**

When preparing the procurement process the municipality opted to set up a significant business case for market parties. According to the interviewees a significant business case is needed to foster parties towards innovation. However it is hard for the municipality to estimate the size of the business case in relation to the innovation demand. In the IPQ the business case resulted in a project scope of 300m[1] quay wall renewal per year, per party in the commercial phase. From the interview with the external consultant became clear that uncertainty around the business case might form an enormous risk in the willingness of parties to innovate. In this interview is claimed that the business case should be known before the tender starts.

2. **Market consultations/Transparency**

Transparency is claimed to be one of the most important factors provoking innovation. Interviewees claim that the municipality tries to be as transparent about the PP as possible. Using this attitude the project team hopes that collaboration during the innovation route is maximized. Also the procedure can be adapted according to the desire of market parties. This factor is important to create a procedure whereby market parties are fully capable of innovating.

One example how the municipality tries to increase transparency is by organizing three market consultations in the year previous to the start of the tender procedure. The consultations were used as a platform to retrieve feedback on the progress of the municipality. While developing tender documents the municipality tried to incorporate the feedback into new products.

3. **Freedom for market parties**

By the representatives of the municipality is claimed that freedom for market parties is an important factor in the IPQ. In this case freedom is created by giving market parties the possibility to develop their own ideas without too much restrictions from the client. In this project the municipality tried to do this by, for instance, determining functional requirements in the contract. When developing the requirements for this contract the municipality tried to specify them in a functional manner. When using traditional ways of working, requirements are withdrawn from objects of the project. Using functional specification, requirements have to be withdrawn from a function (Figure 19). The municipality struggles with the development of functional requirements in this project. Because currently a common used and optimized method for quay wall renewal exists. Stakeholders are familiar with this way of working and the potential risks. In the IPQ this way of working should be put aside. Meaning that stakeholders have to accept uncertainties about the eventual solution in this project, and also with the risks whom might occur.

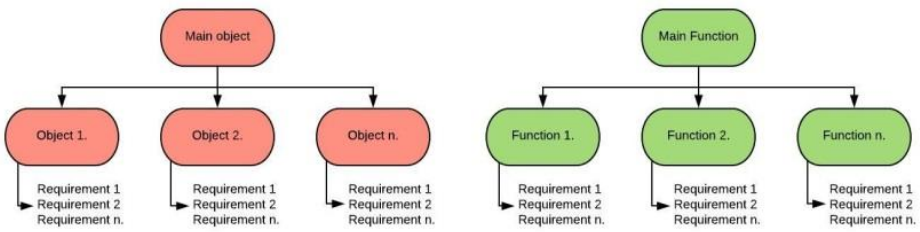

Figure 19: Functional specification of requirements. Red illustrates specification in objects, green in functions

Subsequent to the limits of creating freedom caused by the current way of working, this is also limited by law and local regulations. These put boundaries for the municipality to accept any solution delivered by market parties, since these solutions must meet with law and local regulations. Therefore these set boundaries for the eventual freedom of innovation development.

4. **Cooperation**

According to the interviews is the cooperation an important factor to foster innovation in the IPQ. It is claimed that cooperation is necessary in two forms. Firstly the municipality should cooperate with market parties. It is argued that innovations can be developed faster when municipality and market work together. Furthermore is the likeliness that these innovations are developed according to the needs of the municipality higher. In the IPQ market and municipality should cooperate in the R&D phase. However there is disagreement under the interviewees whether cooperation should take place after the R&D phase. By the municipality is claimed that market and municipality should also work together in the commercial phase. Whilst the external consultant claims that cooperation is only important during the R&D phase, and in the framework contract the relationship between market and municipality is 'business as usual'.

Secondly different types of market parties should cooperate. It is claimed by the interviewees that innovations can seldom be developed individual by one party. Construction companies usually have limited human resources. While innovators and engineering firms have limited financial resources. It is argued that the likeliness of a successful innovation process is increased when different types of market parties cooperate.

Above is described what the four most important factors to provoke innovations are according to the municipality, these are integrated in the IPQ. However more factors are, according to the interview, considered to be important to foster innovation. These were however eventually not integrated in the PP, the next sections present these two most important factors.

1. **Selection on cooperation**

Especially by the external consultant is claimed that an extra assessment step should be added in the PP. This step should consist of collaboration criteria where is assessed whether the teams of market and municipality are able to work together. According to the interview is selection on collaboration a crucial item in innovation development projects. Using this assessment criterion it can be judged whether there is a fertile environment to develop innovations. However from the interviews with the municipality is become clear that they tried to integrate cooperation in the 'team' assessment criteria. Furthermore is it for a public agency hard to judge upon cooperation since it is hard to make clear judgements about these criteria.

2. **Multi functionality solutions**

Currently the aim of the IPQ is to find solutions for quay wall renewal. However as market parties develop new concepts for this, it might also open challenges for development of other functionalities in the structure. The project team has discussed a lot about if multi functionality should be awarded in the project. However until now it is unclear if and how this is going to be addressed into the IPQ. It is claimed that it might be beneficial for innovation to judge positively upon multi functionality. As is argued that market parties are then challenged to think beyond the borders of the PP and search for entirely new functionalities in quay walls.

Conclusion

In this section the second empirical research question was answered: *What are choices made by the municipality, within the innovation partnership for quay walls, to provoke innovation?*

The municipality integrated four factors to provoke innovation in the innovation partnership procedure:

1. Formulate a business case for market parties;
2. Act transparent and hold market consultations;
3. Freedom for market parties;
4. Cooperation.

Those are the most important four factors whom were integrated by the municipality in the procurement contract to provoke innovation. Other factors as selection on cooperation and multi functionality of solutions are still considered to be important for the stimulation of innovation. However those are not integrated in the innovation procedure until this moment.

5.3 Interviews market parties

In the second phase of the empirical research interviews were executed among ten market parties interested in the IPQ. Table 5 presents a description of the interviewed market parties.

Table 5: Characteristics of the companies involved in the interviews

No	Type of company	Employees Netherlands (fte)	Type of business
1	Engineering firm	5	Design and verification
2	Engineering firm	66	Design, structural analysis, quality management, risk management
3	Engineering firm	2500	Design, Consultancy
4	Engineering firm	2300	Design, Consultancy
5	Contractor/supplier	300	Foundations, piling, construction pits
6	Contractor	1200	Dredging, infrastructure, construction of harbours, land reclamation
7	Contractor	70	Infrastructure
8	Contractor	50	Quay wall renewal, industrial construction
9	Contractor	200	Hydraulic construction, steel construction
10	Innovator	3	Generating solutions

As can be seen in the table above 10 interviews are executed among interested parties of the innovation partnership procedure. The following aspects are important to notice:

- The interviewee of interview one worked at the engineering firm but was also shareholder of a middle size (150-200 fte) construction company in the Netherlands. The view of this interview might be two folded and is interpreted with care;
- Company number five operates mainly as subcontractor or supplier in infrastructure contracts. However in this case they operate as main contractor in a consortium;
- Company number seven is a relatively small Dutch subdivision of a large German-based contractor (6500 fte worldwide). When processing the interview it is tried to gain understanding whether the results are assigned to the subdivision or the parent company.
- Only one innovator was interviewed during the interviews, conclusions in this research regarding innovators are based on this interview. Because the narrow data, results must be interpreted with care;

- As extra data source official questions from market parties to the municipality are used (Dutch: Nota van Inlichtingen or NvI).

5.3.1 Innovation process

This section describes the innovation processes of the different companies. For each type of company is elaborated what the general innovation process is of the company. During the interviews was noticed that the innovation processes of different types of companies differ. Based on this the innovation processes are described for each company separately.

Contractor
From the interviews can in general be concluded that the main reasons for contractors to innovate is because of opportunities in the market. Parties are trying to increase their competitive advantage over other parties by using innovations. Using integrated contract types (like Design & Construct) do offer the opportunity to innovate. However this is not dedicated to contract form only. Innovation is possible because of freedom in the contracts. When for example the client of a D&C contract still prescribes solutions for the tenderers, innovation potential of contractors is highly reduced. Contractors need the freedom to put in their own knowledge and skills into the project. From this basis they are able to develop new innovations.

Especially the larger companies (company number 6 and the German parent company) innovate by developing innovations totally new to the market (architectural innovations). Those companies have a significantly large R&D department responsible for the innovations. Market shifts are the main ground for the innovations. From these market shifts the R&D department determines in what direction innovations are developed, hereafter the actual innovation procedure starts. During this process testing is extremely important, the companies build large testing grounds to test the innovations in a real life environment. The innovations they develop differ from manufacturing equipment to new techniques and processes.

Especially SMEs innovate mainly on project basis. Their organizations are erected as project organizations, constructing several projects in a certain business line for different clients. The companies claim that their innovations are mostly incremental innovations. Innovation is for them 'updating or adapting an existing technology'. These are always adapted in a way that the current project can be executed. For these companies it is most important to execute the project according to plan, adaptions of technologies are necessary. Furthermore it should be noticed that these companies do not have a prescribed innovation process. Innovations are mainly developed by a small, experienced team and then executed on a trial –and– error basis. For SMEs it is important to be involved early with the client. Then they have more time to think about their innovations and to develop these in cooperation with the client. Patents are not important for SMEs. It is claimed that their innovations are minor and the process of patenting costs too much time.

Engineering firms
Engineering firms differ on some aspects in the development of innovations from contractors. However no clear distinction in the results from the interviews can be made related to the size of the companies. For engineering firms the main reason to start innovating are developments in civil engineering. Furthermore they try to stay ahead on competitors by innovating. To lesser extent engineering firms are innovating very specifically in response to market changes.

The innovation process whereby new innovations are developed can be classified as the innovation funnel. The innovation funnel is described in Schilling (2013).

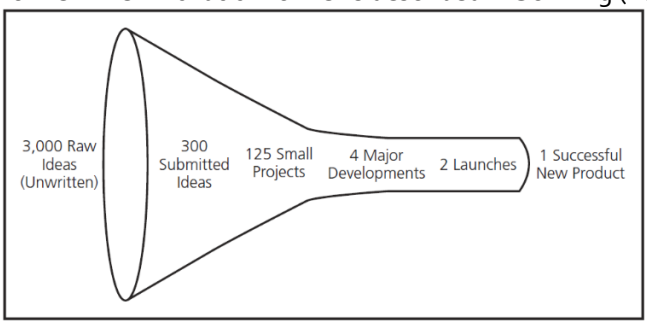

Figure 20: Innovation funnel from Schilling (2013)

Focusing especially at the new innovations developed by engineering firms the process can be seen as the innovation funnel. Within engineering firms these ideas are generated by employees working at the firm. Each department has a certain innovation budget and manager who is responsible for the innovations. When the idea is accepted by the manager, company resources are used to develop the idea to an actual innovation. For engineering firms the idea generation is highly important for the eventual development of new ideas. Therefore people are stimulated to pitch new idea. For the innovation capacity of these firms the idea generation of employees is extremely important. Only when employees are well known with the innovation process and where to pitch their idea, innovation might become a success.

For engineering firms it is important to be involved early in the contract. In that case the firms can bring in their knowledge to develop innovations. However engineering firms are always involved early with the client and therefore the amount of innovation capacity is not so dependent on contract type or freedom within the contract. This can be explained by the following. In traditional contracts (for example: RAW) engineering firms are hired by public agencies to develop the specifications and conditions for the contract. In that case they can bring in their knowledge and expertise on this side of the table. Whereby they have the possibility to integrate incremental innovations. Using integrated contracts engineering firms are mainly hired by a consortium or a main contractor. In that case the engineers can bring in their knowledge and expertise on that side of the table. For likeliness of innovations it does not matter whether they are hired by public agencies or contractors. In both cases they are involved early and workout he eventual plan.

Innovator

The innovation process of innovators is different than that of contractors and engineering firms. Innovators are mainly small companies (up to 5 fte) owned by someone who has produced certain innovations in the past. For the innovation process, innovators start by having a good idea in which they trust. After doing market research and deciding whether there is market perspective for the innovation, they develop the idea. Resources are needed when companies want to innovate. Innovators mainly do not have those resources so partnering is important for them. The most important resources for innovations are: capital and workforce. Capital is mainly obtained by governmental grants. Workforce is most of the time hired externally or by partnering with other companies. When innovators decide to partner, it is for them important to preserve the say about the company or the idea. The business case of innovators is to generate innovations. After innovations are developed, innovators try to sell the idea and move on to other projects.

Conclusion
This section answers the following theoretical research question: *What is the current innovation process market parties follow internally to develop innovations?*

One innovation procedure for all types of market parties does not exist. Grounds for innovation, important factors, innovation processes and the results for innovation vary between the market parties. This is summarized in Table 6. As can be seen does the process, ground for innovation and important factors differ for the different companies. A conclusion regarding the IPQ is that these parties might react differently on several provoking aspects in the PP. Additionally these parties might be provoked in another way on several aspects.

Table 6: Innovation processes of the different parties

	Large contractor	SME contractor	Engineering firm	Innovator
Ground for innovation	Market changes	Projects	Stay ahead of competition, keep track of developments	Idea
Important factors	Patents	Early contractor involvement	Rewarding employees, early contract involvement	Need for resources
Innovation process	Prescribed innovation process by R&D department	Trial – and – error	Innovation funnel	Not defined
Result	Mainly architectural innovations	Mainly incremental innovations	Incremental, architectural and radical innovations	Incremental and architectural innovations

5.3.2 Organization of procurement procedure

In this section tis investigated what the different possibilities are to organize a PP which, according to market parties, stimulates innovation. During the interviews the following themes were categorized as important: involving market, time span, characteristics client, risks, and way of procuring and business case. For each of these aspects is described firstly how a public agency should organize itself in such a contract. Secondly is described more detailed what the municipality of Amsterdam should do in the IPQ. Results in this section are mostly unanimous given by the different types of market parties. If a certain party has its own view on the subject this is explicitly framed.

Involving market
For market parties it is important that they understand what choices a public agency has to make in the procurement process. Nowadays parties are often frustrated when agencies make, in their eyes, fully incomprehensible choices. Understanding and trust of market parties in the public agency rises when they are informed about the choices made in the procurement process. Sharing of information can for instance be done in the form of market consultations. Subsequently public parties have to share unambiguous information with market parties. Especially when several information moments take place during tender phase. In that case the public agency must be

aware to share the same in all sessions. When aspects in the procedure change, this must be communicated clearly and as soon as possible to market parties.

Innovation partnership procedure
The choice of the municipality to hold three market consultations in the year prior to innovation partnership procedure was wise according to the market. Especially the information shared during these sessions was highly rated under market parties. Moreover the fact that the municipality asked for extra input during these sessions was an advantage for the level of trust market parties.

However involving the market in a very early stage has also its reverse side. Market parties have the feeling to be lured to the first consultation for the job of renewing a large part of the 200 kilometres quays in Amsterdam. The fact that the framework contract now only offers the possibility to renew around 300m[1] per party per year disappoints parties. Their claim is that the municipality should be very clear at the first consultation what the exact amount of the awarded work should be. Furthermore is claimed that the municipality has to reflect to market parties. Answers on comments and questions in question rounds should be sustained so market parties know why thing are as they are. In that case the understanding of market parties towards the choices of the municipality during IPQ rises.

Time span
When developing innovative solutions it is important that parties are able to translate their idea quickly into an actual development process. Parties with new ideas are often enthusiastic about their solution and want to start transferring their idea into actual innovations as fast as possible. Time from initiating the idea to developing should be as quick as possible. However the time span needed for developing the actual innovations is highly dependent on what type of innovation is going to be developed. Another factor influencing this is the type of company. Larger companies might for example have better and faster access to specific resources while smaller companies have to search for specific partners during this process. Critical for public agencies is that they do not impose a specific time span for developing innovations. Market parties themselves must be able to determine their own time span, which can be controlled by the public agency.

Innovation partnership procedure
According to market parties it took too long from the first market consultation to publishing the tender documents. In this case market parties have the feeling that the urgency to renew quays quickly is not real. In November 2017 market parties were asked to join a market consultation about the IPQ, talk to possible partners and generate possible solutions for the problem. While a year later the procurement procedure started, parties claim that this process is too lengthy for their innovation process. However most of the parties understand that such a process can cost time in municipal organizations. Especially since a new board had to be formed in the spring of 2018. This board explicitly had to address the urgency to renew quay walls.

Subsequently it is in the R&D phase important to let parties determine their own time span. Some interviewed parties claim that the current time suggestion of the municipality for the R&D phase was too short. But some claim this was too long. This all depends on the type of innovation what companies develop and the characteristics of the companies whom are developing the innovations.

Characteristics client

In an IPP the client must meet with the following characteristics:

1. The internal public organization should backup the innovation process and eventual innovation. This backup must originate from the whole organization and not only from the team working on the procurement procedure;
2. Public agencies should be aware of the fact that when an innovation process starts, it is not clear what exactly is going to be developed. The scope of the project should therefore not be set tight at the start of the project. Market parties must be able to develop, during the project, ideas outside the scope but beneficial for the client.
3. Especially contractors claim that it is important to test innovations in the civil engineering sector in real life. It tends that public agencies have the tendency to stay in the 'plan writing phase'. Whereas for contractors it is important to test their innovations in real-life in which they can manage problems and possible solutions for innovation improvements.

Innovation partnership procedure

Regarding the characteristics of the municipality in the IPQ the following can be stated:

1. The task of the municipality is to propagate the IPQ throughout the municipal organization. The project needs backup from several departments involved in quay wall renewal. Typically in Amsterdam a lot of departments are involved;
2. The municipality must give parties a sort of basis scope for the development of the innovation. However when parties have ideas how to solve relevant problems for the city, they have to act proactive in searching possibilities to integrate these into the project.
3. The municipality has to offer parties different testing grounds to test their innovations. Hereby it is important that the complexity on those sites differs. In that case parties are able to test their innovations several times before executing them in a real project in the middle of Amsterdam.

Risks

In a process whereby innovation is developed, it is important that public agencies accept a certain amount of risk. Working with new, innovative solutions, cause other risks than working with a solution already known for many years. Furthermore should public agencies be aware that the risk for market parties to apply in a public tender is quite high. Market parties must invest a part of their resources (mainly financial and workforce) for the actual application. It is estimated that market parties have to invest up to 3% of the contract volume to put in a bid. Adding an extra innovative component to a tender, results mostly in even higher transaction costs for market parties. Especially since the chance to win a tender for market parties is around 30%. Transaction costs invested in lost tenders is gone. Public agencies must realise that the market has to earn back their initial investment.

Innovation partnership procedure

In the IPQ the municipality must be aware that applying innovative solutions takes risks. In the beginning the application of those solutions might take more risk than regular methods. In the IPQ the municipality has to take this risk in order to support the innovation procedure. When defining and dividing risks it is important that risks are taken by the party capable of carrying the risk. Especially in quay wall projects this forms a potential problem. A lot of quay wall renewal projects are nowadays executed under traditional contracts (Dutch: RAW bestek). Resulting in less liability for market parties, whereby these contracts are in favour for SME contractors.

Way of procuring
In innovation tender procedures it is important that public agencies enable low entrance criteria. Hereby a variety of different companies is able to participate in the tender, increasing innovation likeliness. Furthermore it is important that the public agency has an instrument able to assess the different innovations, market parties must be aware of the criteria used in this instrument.

Innovation partnership procedure
In the IPQ the restrictions to participate in the tender are strong. Engineering firms and innovators claim that the requirement which states that they should work together with a partner who has renewed a certain amount of quay wall is oppressive. Especially since in first phase the idea for innovation is not important. The firms claim to be pushed to work together with a contractor without knowing exactly who 'the best contractor' for the job is. For them it is unsure who is best capable of cooperating in developing their innovation. This factor is blocking innovative capacity of, especially, engineering firms. An alternative is to let parties tender individually in the beginning. Hereby the municipality selects parties on their innovative power or idea they have for quay wall renewal. After this phase the municipality can be involved in the process of bringing parties together since they have the knowledge about all parties in the poule.

Business case
For market parties one of the most important aspects is to earn back their innovations. Public agencies must determine with what business case market parties are earning back their innovation expenses. To do so the public client have to develop a business case on which private parties are able to earn back their investments. Characteristic hereby is that multiple similar projects are often needed for market parties to split the investment costs. Furthermore innovations should be improved over different projects in the business case. The innovation process does typically not stop after a development phase. Hereafter innovations can be updated and upgraded.

Lastly both parties should invest in the development of the innovation. In advance should be known what amount of resources parties have to invest to develop innovations. It is important that the investments originate from both types of parties. Only in that case the innovation can be useful for as well the market party as the public agency involved in the contract.

Innovation partnership procedure
Especially for contractors the volume of work promised by the municipality in the framework contract, is low. Parties claim that it is hard to develop ground-breaking innovations with the small framework contract. Contractors need at least 1000 meters per party per year to invest significantly on innovations in the tender phase. For engineering firms the amount of meters in the framework contract is not very important. However they claim that different projects are needed to earn back their investment costs. For innovators the innovative capacity is not dependent on the amount of meters or projects.

These different angles of approach might origin from the different business cases upon the different companies are built. Contractors earn money by executing projects within their budget. The more projects they can make or the larger the projects are, the more revenue they make. In the business case of engineering firms revenue is made by renting out engineers to different projects. In the case of earning back an innovation it is necessary to divide the costs over different projects, however this is not strongly dependent on the amount of work within the projects. Lastly innovators earn their revenue by producing ideas. Their business model focusses on the very beginning of the innovation partnership. When the framework contract starts the work for

innovators is done. These different business cases of the three different companies might be the reason for the previously described arguments. Moreover, parties claim that there is a correlation between business case, tender compensation and innovative capacity. Meaning that parties will only develop innovations when there is or a significant business case or a significant tender compensation.

Lastly parties claim that the investment into the innovation must come from both the consortium and the municipality. Main reason for this is that co-ownership is being created by the mutual investment. This co-ownership is necessary to propagate the solution through the organizations and to carry out successful projects. The percentage each party invests up front must be known at the start of the procurement procedure.

Conclusion

This section answers the following research question: *How should, according to market parties, public agencies organize a public procurement procedure whereby innovation is one of its targets?* Table 7 presents the conclusion of this sub question. In the table for each of the six aspects is given how a public agency should arrange it procurement process, in general and specific for the innovation partnership procedure.

Table 7: Conclusion of sub question eight

	General	Innovation partnership procedure
Involving market	• Inform about important choices/proceedings in developing the contract; • Share unambiguous information; • Do not change without explicit substantiation.	• Share information during market consultations; • Ask for input during market consultations; • Do not change important characteristics as business case; • Reflect to the market.
Time span	• Quick translation from start process to developing innovations; • Do not impose a specific time path for the innovation process.	• Shorten the period from first market consultation to start of tender; • Let market parties determine their own time span in the R&D phase.
Characteristics client	• Fix backup of internal organization; • Be open to scope changes; • Start testing in real-life rapidly.	• Propagate intention for IPQ through organization; • Give basic scope and be open to changes; • Different testing grounds varying in complexity.
Risks	• Accept risks; • Be aware of high tender investments by market.	• Accept that working with new methods enlarges risk; • Derive risks to a party capable of carrying the risk.
Way of procuring	• Low entrance barriers; • Value innovation capacity of companies.	• Select parties individually in advance; • Enable an environment whereby consortia are formed.
Business case	• Deliver a profitable business case; • Accept that new methods initially can take more time/investment. • Mutual investments during innovation process.	• Increase business case to 1000m[1] per party per year; • Invest a predefined percentage in R&D phase.

5.3.3 Partnership in the procurement procedure

This section focuses on the partnering characteristics which, according to market parties, are necessary in a PP to provoke innovation. Hereby the specific characteristics necessary to enable a partnering relationship in a public procurement process are described. These are firstly given in general and secondly in relation to the IPQ.

Partnership characteristics
The partnering relation must have certain characteristics to enable an environment where parties can innovate. Below the five important characteristics according to interviews are given:

1. *Early involvement:* Market parties should be involved as early as possible in the procurement contract. In that case parties are able to bring in their fully expertise and increase the project value. Especially for contractors it is important to collaborate with public clients as early as possible. For them it is important that they can join the contract during the contract preparation phase.
2. *Maintain collaboration:* During the whole procurement procedure it is important that parties join forces. Since developing innovations is a never ending process. Collaboration is also needed when applying new technologies in reality.
3. *Trust:* Trust is one of the most important factors for a good partnering relationship. During innovation processes the exact outcome remains unsure until the end. As stated above challenges along the way must be solved together. Trust of market parties rises when their feedback is taken seriously. Furthermore should parties act on an equal basis.
4. *Contradictory interests:* Partnering between public and private agencies is difficult because of contradictory interests. Especially on the field of risk deviation and financial aspects, public and private parties have different interests. Market parties suggest that collaboration on this aspect is possible, but good arrangements must be made in advance.
5. *Selection on collaboration:* According to market parties is collaboration between public and private party essential in developing innovations. During a long-term innovation process it is important that people working on both sides are able to join forces. Selection on collaboration gives certainty in advance on the likelihood of successful innovations.

Implications for the innovation procedure for quay walls

1. *Early involvement:* Especially for contractors it is important to be involved in the project as early as possible. During the IPQ parties must gain the possibility to reflect on tender documents. This ensures the possibility to collaborate in the PP.
2. *Maintain collaboration:* Partnering is necessary during the R&D- and commercial phase. Presumably developed innovations suffer from different problems short after development. The municipality has the task to the consortia in solving problems and improving the effectiveness of innovations during the commercial phase.
3. *Trust:* Trust must be increased during the IPQ. It is important that the municipality shares information directly and with logic sustentation. Furthermore feedback of market parties must be taken into account whilst developing the procurement procedure.
4. *Contradictory interests:* From the interviews is derived that the interests of parties during the IPQ contradicts risk and financial aspects. As the main interest of the municipality is to gain as much value during the project for their investment. On these aspects is collaboration difficult, therefore clear agreements must be made in advance.

5. *Selection on collaboration:* People working on an innovation process are essential for the development of the innovation. Therefore parties should be selected using collaboration criteria.

Conclusion

In this section the following research question is answered: *How should market parties and public agency form a partnership to stimulate innovation during the procurement process?*

Table 8 presents a summarization of the results gained during this research phase.

Table 8: Important factors provoking a partnering relationship during an IPS

	General	Innovation partnership
Early involvement	• Involve market parties as early as possible in the project; • Let market parties participate in procedure development;	• Involve especially contractors as soon as possible; • Ask parties to reflect on tender documents;
Maintain collaboration	• Collaboration during whole procedure	• Extensive collaboration during commercial phase; • Help parties in solving problems and improving innovations; • Help parties during changing environmental aspects.
Trust	• Asking for feedback; • Act on equal basis.	• Share information directly; • Take feedback of parties into account and reflect.
Contradictory interests	• Make good arrangements when collaborating with contradictory interests.	• Make clear agreements in advance when working when collaborating in financial and risk aspects.
Selection on collaboration	• Select market on collaboration criteria	• Use a collaboration assessment to judge upon collaboration.

5.3.4 Innovation possibilities innovation partnership procedure

This section focuses on the advantages and disadvantages against the current IPQ procedure according to market parties. Different views exist among the different types of market parties. Therefore this section describes separately for each type of whether the procedure opens enough possibilities for the market parties to innovate.

Contractors

Advantages

1. Contractors appreciate the way the municipality approached the market in the IPQ. They state that the municipality recognizes the problem and is willing to invest in innovation. Furthermore is it important for them to get the chance to innovate in this contract. Also the fact that contractors get the chance to help finding solutions is important for them.
2. The length of the framework contract is beneficial for the collaboration relationship between contractor and municipality. The current duration of minimum 4 years and possibility to upgrade with another four years is beneficial for contractors. It is claimed that this duration is necessary and needed to develop adequate innovations.

Disadvantages

1. The forecasted amount of work in the framework contract is too little for contractors. Thereby creates the fact that the amount of quay wall renewal in the framework contract is still unknown uncertainty for them. Contractors need guarantees upon the business case prior to the start of a tender. Only then they are sure how much investments can be made during the R&D phase. Roughly estimated do contractors need around 1000 m^1 quay wall renewal yearly to start developing innovations.
2. The fact that in the first phase selection takes place on the view of innovation is marked as critical for contractors. They claim that parties might have good ideas for quay wall renewal. However they are now unable to show them in the first phase of the tender. Hereby they are facing the chance of being excluded from the tender phase when their 'view on innovation' is not appropriate. According to them this is negative for the possible outcomes of the IPQ.

Innovators

Advantages

1. Innovators claim that the preparation of the IPQ by the municipality is really good. According to them it is really clear what can be expected from the procurement procedure and what parties have to do during the tender process. This clarification is important for innovators for establishing innovations.
2. As was claimed in the previous sections is it important that consortium and public agency are able to work together. According to innovators, the team involved in the IPQ of the municipality is very innovative. Innovators claim that there is trust in innovating together with the team of the municipality, which marked as prerequisite for innovators at this stage.

Disadvantages

1. Innovators claim that it is hard to form consortia up front with construction companies and engineering firms. Mainly caused by the total different vision towards innovations. Innovators are only involved in the development process of innovations and interested in upgrading this process. However for other parties it is hard to take them in their consortium because they claim to be unsure about the added value for innovators.
2. The municipality has chosen to use TRLs during the R&D process. Innovators claim that the usage of TRLs is hard in the civil engineering business. It is stated that TRLs origin from other industries where progression is easy to measure and indicate. However in the civil engineering industry environmental aspects change in every project. Making it hard to indicate the progression based on very detailed, predefined levels.

Engineering firms

Advantages

1. Engineering firms claim that the approach of the market by the municipality was positive. An important aspect is that the municipality improved the procurement procedure according to comments of market parties.
2. According to engineering firms is it very wise to select on the 'view of innovation'. The possibility to generate solutions is the most important factor in this type of contract. It is important that the ideas can be generated in cooperation with the municipality.

Disadvantages

1. Engineering firms claim that the entrance criteria for the tender are too extensive. Parties must for instance deliver a reference project whereby they show to have experience in quay wall engineering or construction. Hereby are many parties with good ideas excluded from participating into the contract. Especially since is claimed that radical innovation often comes from parties outside the business. For the innovation partnership it is therefore beneficial to enable participation from these parties.
2. According to engineering firms consortia must be formed during the IPQ. For them it is impossible to know with who to work with, without knowing the idea which is going to be developed. Firms are now forced to choose a contractor to work with, without exactly knowing the best party for executing the innovation. The proposition is to first select parties individually on the view of innovation, let parties develop their first idea and then force them to form consortia.

Conclusion

This section answers the final sub question of this research: *What are, according to market parties, advantages and disadvantages of market parties to innovate in the innovation partnership for quay walls?*

Table 9 presents the conclusion of this research question. In this section is also elaborated on the usage of TRLs in the project. The TRL tool is designed to communicate upon the status of single technologies within an organization. However they give structure to communicate about technological readiness in a project, the following drawbacks arise: lack of attention in setbacks, single technology approach, context specificity of TRLs and strong focus on product development.

Table 9: Advantages and disadvantages of contractors, innovators and engineering firms to the IPQ.

	Advantages	Disadvantages
Contractors	1. Trust due to positive approach of municipality; 2. Length of framework contract.	1. Business case too small in relation to requested innovation power; 2. Selection on 'view of innovation' in the first phase.
Innovators	1. Clear preparation of IPQ procedure; 2. Trust in innovativeness of IPQ team.	1. Formation of consortia in advance; 2. Choice of TRLs during R&D phase.
Engineering firms	1. Invitation to participate in the project; 2. Selection on 'view of innovation' in the first phase.	1. Criteria to references in the selection phase; 2. Directly selecting consortia instead of parties individually.

5.4 Conclusion

In this chapter the theoretical empirical research questions of the research are answered. This conclusion presents the most remarkable findings during the empirical findings.

- The ground for innovation, innovation process and important provoking factors of the different types of companies in the IPQ differs. Therefore the municipality has to stimulate these parties differently in an innovation procurement procedure. Especially since the different types of companies form consortia. For the municipality it is important to determine what specific factors are integrated in the PP.
- For the municipality the most important reasons to start the IPQ are to bring the asset "quay walls" up to date and the scalability of the eventual solution. Within the IPQ the municipality aimed to provoke market parties by three aspects:
    - determining a 'significant' business case (eventually 300m^1 per party per year) in the commercial phase;
    - Giving full transparency to the market parties, this is for instance done by organizing market consultations prior to the start of the PP;
    - Giving freedom to market parties to determine their own solutions, for instance done by setting functional requirements;
    - Cooperating with market parties during the IPQ.
- From the interviews with market parties different factors are withdrawn which provoke innovation these can be found in Table 7 and Table 8.
- Difference in the view of market parties and municipality exists on the following aspects:
    - The proposed business case by the municipality is claimed to be too marginal by the market parties. They claim that a correlation exists between direct innovation compensation, business case in the commercial phase and willingness to innovate. In case of the IPQ should the business case be around 1km^1 per party per year.
    - The municipality embedded firmness by setting reference criteria in the selection phase of the IPQ. However by market parties is claimed that these criteria block innovative companies from entering the contract.

6 Redesign

The previous chapters elaborate on the theoretical and empirical results. This chapter presents the 'redesign' of the research. Hereby are the results from previous chapters translated to a redesign for the IPQ.

6.1 Important factors

This section presents the important factors gained from theoretical and empirical research whom are translated into the redesign. These factors can be seen in Table 10.

Table 10: Aspects withdrawn from theoretical and empirical research taken into account in the redesign

	Theory	Empiricism
Market inquiry	- Large amount of companies	- Involve market when procedure is clear
	- Fix internal backup and communicate with important stakeholders	
Selection	- Stimulation of non-technical capabilities	- Selection on view of innovation
	- Functional requirements	- Individual selection
	- Large amount of companies entering the project with 'low' entrance criteria	
Competition	- Stimulate communication and interaction	- Collaboration assessment criteria
R&D	- Exchange knowledge	- Let market parties determine time span
		- Assessment on progression instead of TRLs
	- Mutual investments with a predefined compensation	
	- Different testing facilities varying in complexity	
Commercial	- Cooperative relationship	- Large business case
	- Long term, multiple projects	
	- Acceptation that working with innovative methods take more risks	

As can be seen several aspects are taken into account when redesigning the IPQ. Some of these aspects were found in the theoretical research, others in the empirical research. Also some points were found in both studies. The next sections elaborate further on the improved procedure and the overview of the different phases.

6.2 Improved procedure

The aspects from the previous section are translated into the redesign of the IPQ. Figure 21 presents the process scheme with the most important aspects of the redesigned IPQ. Whilst Table 11 presents a summarization of the improved innovation partnership procedure. In this table the different steps, selection procedures and role of the public agency are presented. The next sections elaborate in more detail on each phase individually.

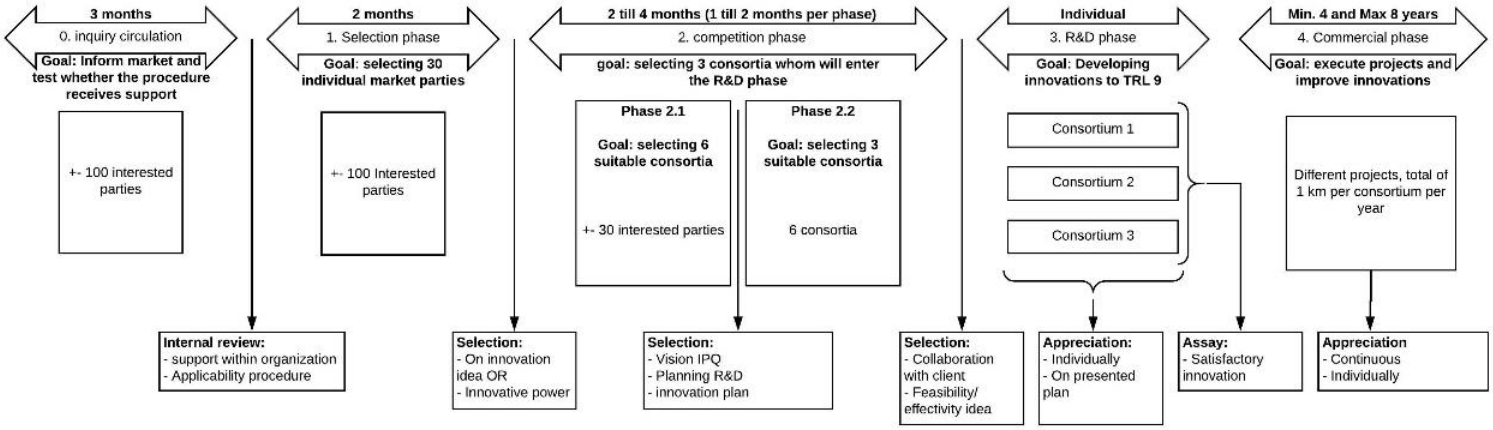

Figure 21[7]: improved innovation partnership procedure

Table 11: Summarization of improved innovation partnership procedure

	Goal	Important aspects	Role public agency
Market inquiry	Inform market and test whether the procedure receives support.	• Increase amount of interested companies; • Short timespan; • Ask for feedback.	• Organize internal backup; • Organize market consultations
Selection	Select 30 individual market parties.	• Stimulate non-technical capabilities; • Take feedback into account and reflect; • Set functional requirements; • Individual selection;	• Organize start meeting; • Be open to scope changes
Competition	Selecting three consortia for the R&D phase.	• Form consortia; • Setting of cooperative relation; • Make financial and risk related agreements;	• Asses on collaboration; • Stimulate in forming consortia
R&D	Developing innovations to TRL 9.	• Mutual investments • No pre-set timespan; • Exchange knowledge; • Different testing grounds;	• Support in developing innovations; • Assessing progress
Commercial	Execute projects and improve innovations	• Long-term relation; • Different projects; • Accept that working with new methods may take longer and is more expensive; • Exchange knowledge; • Profitable business case.	• Assisting in solving problems and improving innovations

6.3 Inquiry circulation

The first phase of the IPQ consists of the inquiry circulation. This phase aims to gain internal support and inform the market about the procedure. For this step it is important that the speed of the procedure does not influence the innovation capacity of market parties. Therefore must this phase be as short as possible. The municipality has to organize two aspects during this phase:

[7] Public procurement procedures are highly dependent on politics. Whether a PP can start and how much budget is available is dependent on budgets. These are set every 4 years in budgets and strategic plans, furthermore are they likely to change every 4 years when a new board is elected.

Internal review
Before can be started with inquiring the market and the eventual procurement procedure an internal review should take place. Hereby it must be reviewed internally whether the IPS is the correct procurement instrument for this project. Additionally an internal review helps to gain support to the procedure of all relevant departments to the procedure. Only after support is gained the actual procurement procedure can start.

Market consultation
After an internal 'go' is given, consultations with the market can start. During these market consultations market parties are informed about the procedure. It is important that during these consultations the municipality can clarify on the following aspects: the exact assignment of the IPQ, reward during the procurement procedure and commercial phase and the goals of the IPQ. These market consultations are important to build trust between market parties and the public client. Hereby is transparency of the municipality towards the market parties key element. During the consultations feedback has to be asked on the procedure. After the consultation the municipality has to translate this feedback into the PP, and has to let the parties know what is done with their feedback. It is important that information is shared during the consultation however, only information which is not likely to change. Changing elements like reward or project scope later on decreases the trust of market parties in process and client.

6.4 Selection phase

The main aim of the selection phase is to select applicable parties for the further tender process. Important during the selection of parties is usage of 'low' entrance requirements, since innovation potential is increased when many different parties are selected. Secondly is important to select parties individual in this stage. Since parties are not sure what exact innovations are being developed, this is initiated in the next phase. Within this phase the following aspects must be organized by the municipality:

Start convention
At the start of the selection phase the municipality must organize a start convention. This convention is needed to align all objectives, targets and challenges during the process. Thereby it becomes clear how the whole procurement procedure looks like, what is expected of parties and on what selection criteria parties are judged in the several phases. Lastly it is important to refer to the previous market consultation and specifically how feedback is translated.

Selection process
As stated in the introduction of this section it is important that the selection criteria of this contract in the selection phase are as 'low' as possible. This results in a situation whereby a wide range of parties with different backgrounds is able to enter the contract. Parties inquiring in this step must be asked to deliver a plan in which they clarify their innovative power, or the idea for specific innovation. It is important that both options remain possible. Main reason for this is that parties whom already have an idea, have a dedicated view on innovative power. However they are mostly not able to translate it onto paper. On the other hand parties whom have not a specific idea for the innovation might have the innovative power to generate innovations.

6.5 Competition phase

During the competition phase the goal is to select three appropriate consortia whom enter the R&D phase. To do so the phase is split up into two parts where after selection takes place. These are explained in more detail in the next sections.

Phase 2.1: formation of combinations
The goal of this phase is to select six combinations. During this phase the market parties are stimulated to form consortia. The municipality has to offer a platform helping parties to form consortia. Since parties have to interact with each other it is important that some time is given to them, therefore is the idealistic time for this stage around 2 months. After the stage the applicants must be judged upon a plan for the R&D phase, this plan must be assessed on the following criteria:

- The feasibility of the plan for the R&D phase;
- Assessment criteria on which the consortium is being judged in the R&D phase.

Phase 2.2: Formation idea
The second stage of this phase consists of developing the idea for the innovation. Hereby each selected consortium should work on developing a feasible and applicable innovation. At the end of this phase a concept shall be presented to the public client. Collaboration between client and market is extremely important during the R&D phase, therefore one of the assessment criteria is dedicated to this point. Secondly the consortium should be assessed upon how feasible and applicable the idea is in relation to the presented development plan in the previous stage. From interviews is concluded that usage of TRLs is challenging in construction projects. Moreover is claimed in literature that TRLs are developed to communicate about innovation maturity of single products, not innovation maturity of systems. As the innovation in this case might be a process innovation and is more likely to be an innovation system, TRLs are not used in the redesigned IPQ. As alternative each consortium has to deliver a plan how they are ensuring their innovation during the R&D phase. The municipality should judge upon the feasibility of that plan.

6.6 R&D phase

During the R&D phase consortia develop the actual innovation from scratch to practice. All departments of the municipality should be on the same line and support the innovation project. During the R&D phase municipality and consortia are investing mutually into innovation development. According to literature it is important that parties are investing with, roughly, the same proportion in the development, in this phase this will be done on a 50/50 basis. Moreover several testing facilities are offered by the municipality. These testing facilities, varying in complexity, are used by market parties to test their innovations. During the testing and pilot projects a public agency has to accept that working with new, innovative, solutions takes risks. Market parties cannot bear risks which they cannot influence or carry as organization. For the development of the innovations it is important that the municipality bears this types of risks, and is not dividing them to the market. Lastly, the municipality has to accept that problems are very likely to occur during the R&D phase. These problems might interfere with the planning and the innovation plan as presented by consortia on forehand. For the likelihood to successful innovations it is important that the municipality does not stick to the letter of this plan. On the other hand it is important that consortia are able to update their development plans with realistic measures.

When these measures have no likelihood to succeed in the development process, parties must be excluded from the project.

Assessment in this stage takes place during the whole phase. Whereby the municipality judges upon the progress of the consortia, and when necessary about how the measures to solve problems are executed. In the end it must be judged whether the developed innovations match with the ambitions of the municipality.

6.7 Commercial phase

The final stage of the procurement process consists of the commercial phase. During this phase quay wall renewal projects are awarded to consortia whom successfully finalized the R&D phase. Under this framework contract individual projects are awarded. Within the commercial phase it is important that municipality and consortia join their forces and keep on collaborating. Especially because innovations always can be further developed and optimized. Furthermore (site-related) characteristics occur, possible affecting the successfulness or applicability of innovations. It is important that to present a large, long-term, business case to parties during this phase. According to procurement law the longest possible period for this is 8 years. The amount of projects within this business case are around 1 km per party per year.

6.8 Conclusion

This section present the redesign of the IPQ. This redesigned procedure is aimed to provoke innovation for market parties in the PP. In the redesigned procedure concessions were made, innovation processes of different parties are different and so are the factors whom are provoking innovation. These factors are in some cases adverse. Table 12 presents for each phase in the redesigned IPQ the specific factors integrated to provoke innovation.

Table 12: Factors provoking innovation integrated in the redesign

Factors provoking innovation	
Market inquiry	- Internal review - Process certainty - Market consultations
Selection	- Low entrance requirements - Individual selection
Competition	- Assessment on collaboration
R&D	- Individual determination of planning - Mutual (50/50) investment - Several, with different complexity, testing locations
Commercial	- Large business case - Collaboration between consortia and municipality

7 Validation

This chapter presents the validation of the research, hereby is aimed to validate the redesign to several interviewees. Four interviews were executed with different parties, all had knowledge about the IPQ of the municipality of Amsterdam. The first section of this chapter describes the validation plan, in which is described how and with whom validation takes place. Secondly are the results of the validation interviews presented. Hereby is presented what adaptions should be done to the redesign, according to the interviewees. Furthermore the general remarks of the interviewees regarding the redesign are presented. Lastly is concluded upon the important aspects in a public procurement procedure which provoke innovation.

7.1 Validation plan

The main goal of the validation research is to determine whether the proposed redesign is logically sound. Hereby the redesign is presented to the interviewees whereby is withdrawn whether aspects could be removed or added to the procedure. This is done by interviewing four interviewees whom have knowledge about public procurement for innovation and the IPQ. The interviewees in this stage were not involved during the interviews of the empirical phase. Table 13 presents a summarization of the people interviewed during this stage of the research.

Table 13: Summarization of interviewees during validation

Validation #	Type of interviewee	Function interviewee	Goal of validation
1	Municipality	Senior strategic advisor	Check the practicality of the design & whether the design is complete
2	Municipality	Transition manager	Check the practicality of the design & whether the design is complete
3	Contractor	Director	Check the implications of the design on a contractor
4	Road agency	Program manager innovation partnership	Check the soundness of the design with another public agency.

7.2 Validation results

This section elaborates on the results derived from the validation interviews. These are presented in the next sections. Firstly an overview is given of the necessary adaptions to the design according to the interviewees. Secondly further results and remarks, given by the interviewees, are presented. During the interviews, specific attention was paid to the factors integrated in the redesign to provoke innovation (Table 12).

7.2.1 Necessary adaptions

Usage of TRLs
According to the municipality and road agency is the usage of TRLs necessary for judging upon the innovations during the process. TRLs give guidance during an innovation project and it is possible to judge upon the progress of innovations in a transparent way. According to the contractor TRLs can be used however they have to be optimized and adapted to the specific case of the IPQ. This argument is sustained by the other interviewees. According to the validation interviews TRLs will be introduced to the redesign of the IPQ. However, the tooling must be customized for the specific case, hereby input from market parties is necessary.

Mutual investments
According to the municipality and the road agency collaboration on financial aspects is hard. Due to administrative reasons, a certain budget has to be set for the R&D phase before the procurement procedure starts. However, mutual (50/50 based) investment is highly demanded by market parties, this is again sustained in the validation interview with the contractor. The willingness of market parties to innovate depends on mutual investments in the R&D phase. The interests regarding this topic are thus adverse according to the validation interviews. For the redesign is decided to change the aspect of mutual investments: the municipality sets a predefined compensation. However, the municipality must be aware of the fact that willingness of parties to innovate is now totally dependent on the size of the business case.

Usage of reference criteria
The redesign of the IPQ does not use any reference criteria in the selection phase. However according to the municipality it is demanded to know whether parties are eventually able to construct the innovations. Therefore reference criteria are critical in the IPQ. This aspect is important according to all interviewees however, it is argued that usage of TRLs fits best in the competition phase. Mainly because in this phase parties know what idea they are going to develop and have the possibility to search the right partner. Due to the validation interviews the redesign therefore will be adapted and an assessment on relevant references takes place in the competition phase.

7.3 Remarks on redesign

This section presents the remarks on the redesign according to the interviewees. Hereby is aimed to underpin what aspects are extra important to foster innovation. The next sections present for each phase in the IPQ the remarks according to interviewees on the factors integrated to provoke innovation.

7.3.1 Market Inquiry

Internal review
The road agency and municipality claim that internal backup is an important necessity for the IPS. Before an inquiry with the market can start, the project team of the municipality must inquire their own organization. People and departments involved have to backup and support the project. It is likely that this process takes time and dedication of the project team.

Process certainty
According to the contractor it is extremely important that the following three aspects are known during the market consultation: process steps, compensation during the project and goal of the procedure. The process certainty is thus an important factor provoking them to innovate.

7.3.2 Selection

Individual selection
The arguments about individual selection are two folded. The municipality and road agency claim that it is wise to select parties firstly individual. In that case the most innovative power from various market parties is withdrawn. However also a drawback arises: when parties are selected individually it is not likely that one party is capable of constructing and engineering the eventual innovations. Therefore is adaption on the redesign necessary, on which consortia are tested among reference criteria. From the validation interviewees can be concluded that individual selection is an important factor to provoke innovation. However, reference criteria are needed later on in the process to determine whether parties are able to develop the innovations.

Low entrance requirements
According to all interviewees innovation is fostered when parties are selected working outside the construction industry. Low entrance barriers enabling a wide range of companies are therefore necessary.

7.3.3 Competition

Assessment on collaboration
According to all parties collaboration is necessary when selecting parties in an IPS. Successfulness of an IPS is dependent whether parties are able to work together. Selection on collaboration in this stage helps to determine potential successful collaborative relationships. However an assessment on collaboration is difficult, adequate tools are not available an therefore good engagements are necessary. Moreover is collaboration also dependent on rotations of human resources during the project.

7.3.4 Research & Development

Individual determination of planning
The interviewees claim unanimously that individual determination of planning is important in the R&D phase. The innovation process of different market parties differs extremely and must therefore be adapted to their desire.

Pilots & testing
As claimed by the municipality are pilots extremely important during the R&D phase. Hereby is emphasized the importance of firstly testing innovations on non-critical sites before applying these onto realistic cases. The municipality has to facilitate different testing locations and pilots.

7.3.5 Commercial

Business case
All interviewees claim that a profitable business case is necessary in an IPS. However by the municipality is claimed that it is hard to increase the business case for the IPQ. Mainly because of the budgetary system of the municipality which assigns yearly a certain budget for the renewal of quays. Furthermore because support for the process is not on the same line within the whole organization. Resulting in distrust in the IPQ among several departments. A possibility to solve this issue is by fixing the internal backup in the market inquiry phase. This aspect is extremely important to increase backup from the organization during the whole process and increase support.

Collaboration during whole project
Collaboration during the whole project is highly demanded by market parties. It even can be seen as a prerequisite for successful implementation and improvements for innovations. However by the municipality is claimed that this requires an enormous effort from both organizations.

7.3.6 Conclusion

This chapter presents the validation of the redesign. In the IPQ several important aspects, provoking innovation, are integrated in the contract. Extra aspects that should be added according to the validation research are: usage of TRLs and reference criteria in the competition phase. These factors are not specifically provoking innovations but are necessary for a fluent execution of the IPQ. Table 14 presents the different factors that are integrated into the contract to provoke innovation. In the last column is presented how important these characteristics are. Hereby three categories are possible:

- crucial: factor is crucial for provoking innovation
- Highly: Factor is moderate important for provoking innovation
- Normal: Factor is normal important for provoking innovation

As final conclusion gives this section the overview of the adapted IPQ redesign according to the validation results. To gain the overall overview, the original procedure as well the proposed redesign are added.

Table 14: Categorized factors to provoke innovation in redesign

Factors provoking innovation		Category
Market inquiry	- Internal review - Process certainty - Market consultations	crucial Normal Normal
Selection	- Low entrance requirements - Individual selection	Normal Highly
Competition	- Assessment on collaboration	Highly
R&D	- Individual determination of planning - Mutual (50/50) investment - Several, with different complexity, testing locations	Highly crucial Highly
Commercial	- Large business case - Collaboration between consortia and municipality	crucial crucial

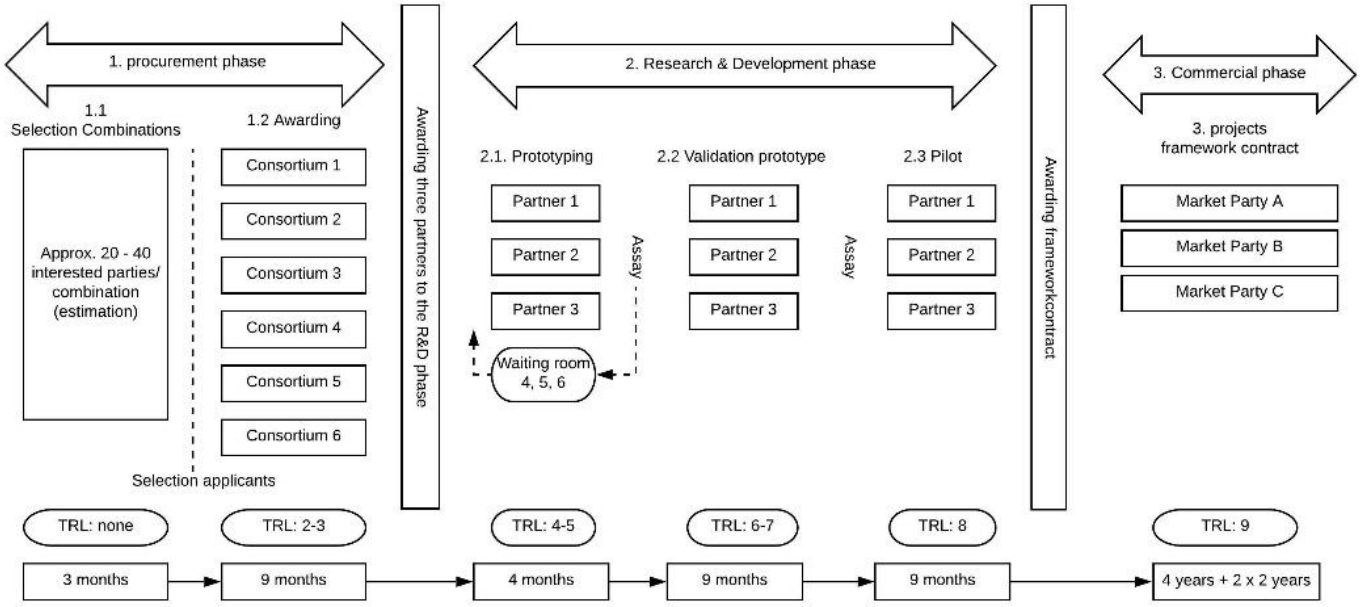

Figure 22: Original procedure of the municipality of Amsterdam

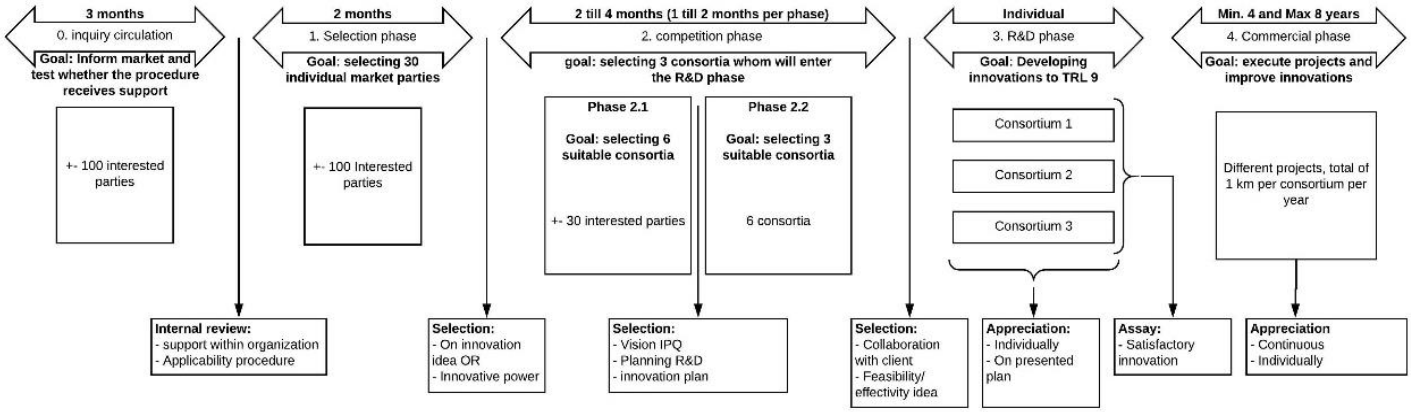

Figure 23: Redisgned procedure

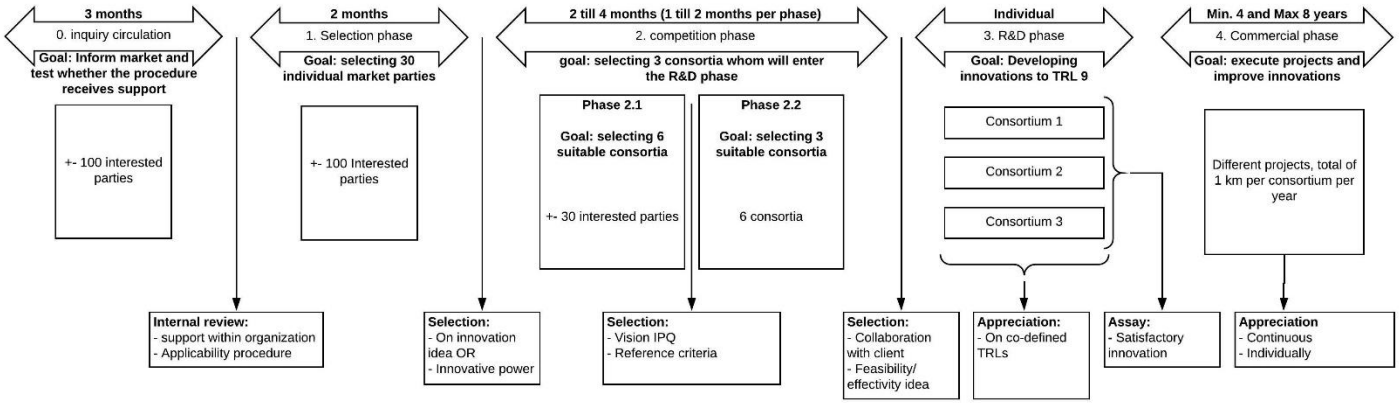

Figure 24: Validated procedure

8 Conclusion & Recommendations

8.1 Conclusions

This research investigates how the innovation partnership for quay walls procedure of the municipality of Amsterdam should be organized in order to provoke innovation for market parties. This specific procurement process focusses on finding new solutions for the renewal of quay walls in the ancient city of Amsterdam. To do so a theoretical framework was constructed from relevant scientific literature. Subsequently interviews were executed among ten different market parties (contractors, engineering firms & innovators) interested in the IPQ[8]. The theoretical framework, together with the empirical results, were translated into a redesign for the IPQ. In the final stage of this research this redesign was validated among four different interviewees. This concluding section answers the central research question:

- *How should the municipality organize its innovation partnership procedure to provoke effective innovation by market parties?*

An important discovery in this research are the variations in innovation processes of different types of market parties. Grounds for innovation, innovation process and important factors provoking innovation of SME contractors, large contractors, engineering firms and innovators differ. Because of this variation, parties react different on aspects in procurement procedures. This conclusion is especially important when a public agency aims to provoke innovation in consortia of different types of market parties. This is also the case in the IPQ, whereby aspects integrated in the procurement procedure might have an adverse influence on the different parties in the consortium. This research aims to optimize the IPQ procedure to provoke innovation for the different market parties involved in the procurement procedure. The following three aspects are seen as most important when provoking innovation in an IPS[9].

Internal backup: Before the actual procurement procedure starts, a public agency has to arrange internal backup and support for the IPS. This aspect is not directly provoking innovation for market parties, but is important as facilitating factor for the whole procedure. When a public agency executes civil engineering projects, many different parties are involved. Departments and managers might be sceptic about innovation projects. Working with innovative solutions changes the old, reliable, way of working leading to possible resistance of departments. However the backup of these departments is necessary to determine the following important factors: process overview, tender compensation and business case. These factors are seen as crucial for market parties to know on forehand. When these factors remain unchanged during the procedure trust of market parties in the public organization rises, as does the willingness of parties to innovate.

Financial incentive: Market parties are commercial organizations, their willingness to innovate highly depends whether the IPQ offers enough possibility to earn back their innovation related investments. The willingness to innovate is correlated with (and depended on) the direct tender compensation and the business case. In the redesign of the IPQ the business case is used as financial reward, consisting of 1km[1] per party per year.

[8] Innovation Partnership for Quay walls
[9] Innovation Partnership

Collaboration during commercial phase: An IPS is new to European procurement law. The procedure specifically stimulates the development of innovation and offers the possibility to purchase the innovation thereafter. In the IPS innovation are developed in a R&D phase where public- and private party partner to develop the innovation. In this R&D phase the innovations are developed towards TRL 9. However, it is inconvincible that developed innovations are completely finished after the R&D phase. Optimization and improvement of innovations has to take place during the execution of several projects in the commercial phase. During this process collaboration between public agency and market party is necessary. Moreover do site related characteristics differ in each civil engineering project. Adaptions to the developed innovations are therefore necessary on each project.

The factors presented above are crucial when provoking innovation for market parties while using an IPS. However the factors presented below are categorized as 'highly important' for provoking innovation in an IPS.

- *Individual selection*: To enable the full individual innovation capacity of market parties, parties have to be selected individually on forehand. Consortia of market parties can be formed later on in the procurement procedure;
- *Assessment on collaboration:* Collaboration between market and municipality is extremely important in innovation development. Assessing collaboration during the procurement procedure helps to increase the likelihood of forming a successful partnership;
- *Planning R&D phase:* Innovation processes and the time innovation development takes differs for each type of organization. It is important to let market parties determine their own planning for innovation development (R&D phase).

Lastly three factors are categorized as 'normal important' regarding the organization of an IPS. These factors should not be neglected when developing an IPS, however these can be integrated after the factors above are integrated.

- *Market consultation:* During the market inquiry market consultations need to be executed to involve the market to the IPS. Only after receiving internal support market involvement can start;
- *Low entrance requirements:* Low entrance requirements are necessary to receive a broad selection of different types parties to the IPQ, is beneficial for innovation.
-

These factors resulted in an improved IPQ procedure. In this procedure all relevant aspects to provoke innovation are integrated. The procedure can be seen in Figure 25.

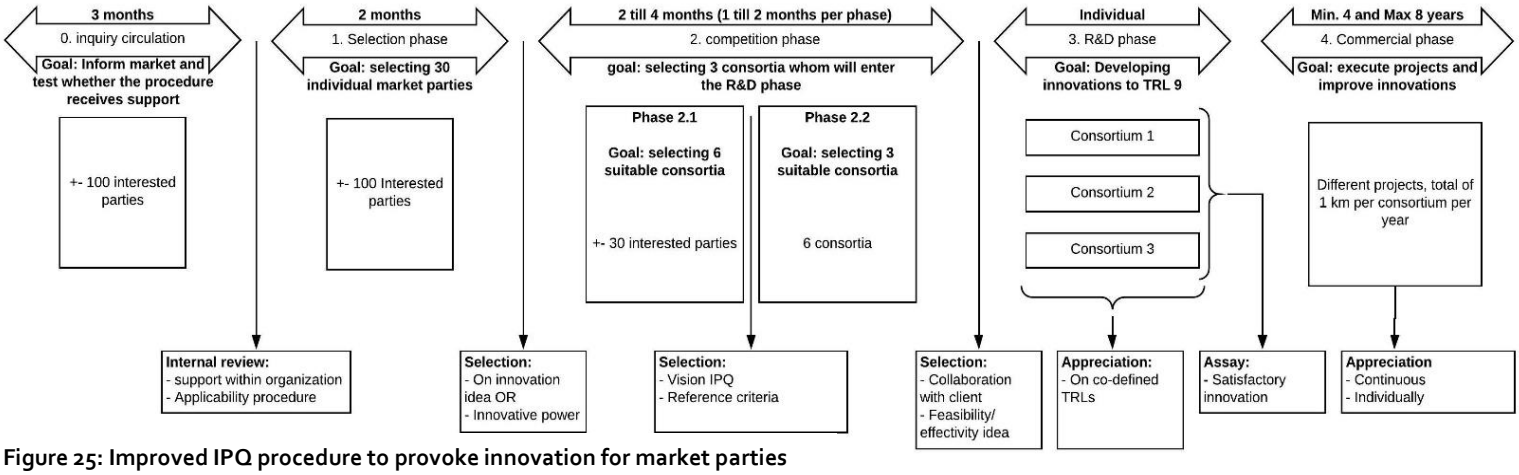

Figure 25: Improved IPQ procedure to provoke innovation for market parties

8.2 Recommendations

This section presents the recommendations following out of the research. This section is derived into two parts. In the first section recommendations for further research are given. These give an overview into undiscovered areas in the world of science related to this research. The second section consists of practical recommendations for the municipality of Amsterdam. As the IPQ started last December, some of these can still be implemented and others are for future innovation partnerships.

8.2.1 Recommendations for future research

1. As the innovation partnership is a relatively new innovative procurement tool, it is hard to find best practices. Furthermore does the amount of different innovative procurement instruments rise. For public agencies it is hard to judge upfront what procedure fits best to a specific case. In future research it could be interesting to develop a roadmap giving insight into the different innovative procurement processes and how these different tools can fit to a specific case.
2. From this research is concluded that support within the internal organization is critical for the successfulness of an innovation partnership. However a lack of research exists about how support can be improved within a public organization. In future research it would be interesting to research the different factors enabling support for a specific way of working within a (public) organization.
3. A limitation of this research is the narrow case study: only one case study was used during the research. Furthermore is the case study related to a civil engineering project, taking into account engineering firms, contractors and innovators. For future research it might be first interesting to research whether the conclusions of this research hold under more IPS case studies in construction. Second is the usage of innovation partnerships not limited to the construction sector. Therefore it can be researched whether the outcomes of this research hold when applying innovation partnerships in other businesses.
4. As stated in this research is collaboration between private and public parties important in a project lasting over 8 years. Furthermore is the relationship between these parties extremely important for the likelihood that applicable innovations are developed. During this research was noticed that a collaboration assessment is beneficial for gaining insight into the fertileness of a relationship between public and private party. Some best practices are known within the civil engineering sector. However there is a lack of scientific knowledge on assessment criteria in procurement projects. For future research it is recommended to research how public parties can assess on collaboration during procurement stages.
5. An important issue which came up several times during this research is risk mitigation during an IPS. Mitigation of risks is important in civil engineering projects. Especially in new procurement processes this mitigation is difficult. For the IPQ the municipality is not sure about how and what specific risks must be mitigated in what way. For future research it might be interesting to focus at the mitigation of risks in innovation partnerships. Hereby a specific protocol can be made how risks in an IPS should be investigated and mitigated.

8.2.2 Recommendations for the municipality of Amsterdam

1. Currently quay walls, one of the most critical assets In Amsterdam, are being procured using traditional contract forms. Very recently (Kruyswijk, 2019) the critical status of the quay walls is extra emphasized. Speed is necessary to bring quay walls up to date. During the research it was noticed that several market parties (in specific contractors) had good ideas for new quay wall renewal methods, however these ideas might not always be innovations or the contractors will not be selected in the IPQ. For Amsterdam it could be a possibility to put several integrated (for instance Design & Construct) contracts on the market for quay wall renewal. These contracts can be used to give these parties design freedom to develop and roll-out their own idea into practice.
2. In innovation procurement practices it is often seen that public agencies rely heavily on innovation capacity of the market. 'The market must deliver solutions for problem X' is an often claimed statement in innovation procurement processes. It can be interesting to make the allegation that innovations are initiated by people working within these companies. However within the municipality people work with the same (educational) background as employees of market parties. Therefore it is recommended to challenge employees of the municipality itself for the development of innovations. It might be an underestimation that the market is able to solve anything, and public agencies are only in the lead of procuring these parties.
3. At the start of the innovation partnership procedure the municipality determined a certain scope. With this scope the most important goals for the municipality of the innovation partnership are being solved. However it was noticed that market parties often have good ideas outside the scope of this project. It is, as municipality, important to filter these ideas out of the project, and investigate whether there is support for these ideas within the internal organization. It is possible that other departments have the possibility for developing these ideas. Whom might be beneficial for the livability in Amsterdam.

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Appendix A: Definitions

Table 15 presents the explanation of some definitions commonly used in the research. Hereby are two different kind of sources distinguished. A definition can either refer to a definition extracted from a certain (scholar) source. However the definition can also be defined by the researcher. The perspective of such a definition differs over the sector, the researcher defines how the definition must be read in this particular research.

Table 15: List of common used definitions within the research

Definition	Source	Explanation
Technological Readiness Level (TRL)	(Héder, 2017)	Presents a method for estimating the technological readiness during a development track. Nine different TRL levels can be distinguished: 0. Idea: unproven concept, no testing has been performed; 1. Basic Research: needs are described, however not sustained; 2. Technology Formulation: concept and application are formulated; 3. Needs Validation: There is an initial offer, stakeholders like the idea; 4. Small Scale Prototype: Prototype in laboratory environment; 5. Large Scale Prototype: Tested in intended environment; 6. Prototype System: Tested in intended environment and close to expected performance; 7. Demonstration System: operating in operational environment at pre-commercial scale; 8. First of Kind Commercial System: All technical processes and systems to support commercial activity in ready state; 9. Full commercial application: Technology available for all costumers.
Market Parties	own	Within the innovation partnership market parties develop innovations. These parties can be individual companies or consortia. Several companies showed to have interest in the procedure: Innovators, Contractors and Engineering firms. The term market parties can be related to each of these different companies or combinations.
Innovation Process	own	In this research proposal is often referred to an innovation process. With the innovation process is meant the several points in the innovation partnership procedure where the municipality claims to provoke innovation within market parties.

Appendix B: Research activities

In Figure 3 the research framework of this research is presented. The goal of this framework is to accomplish the objective within this research. Research activities are determined in order to specify how this is achieved. Table 16 presents the different research activities in the several phases throughout the research.

Table 16: Research activities in different phases

Phase	Products	Description
a.	Literature review – Theoretical Background	Phase a. forms the basis for the research. In this phase all important literature regarding the subject will be studied. The goal of this phase is to answer the theoretical research questions 1 to 3.
b.	Substantiation of current innovation process by municipality & List of barriers and improvements according to market parties	Phase b. forms the basis for the empirical part of the research. In this part all interviews are executed. The goal of this phase is two folded:` 1. Gaining insight into the underlying reasoning for current innovation process as prepared by the municipality. 2. Inquiring barriers and possibilities to improve current innovation process.
c.	Design of improved innovation partnership procedure & validation	In Phase c. the innovation partnership procedure is improved according to the empirical and theoretical results. Thereafter is this improved process validated with external and municipal representatives.
d.	Conclusion and recommendations	For the final phase the main research question is answered. Lastly recommendations are presented. These give insight in how the research contributes to a more effective innovation process.

During the different phases products are created by the researcher. The table above presents which products in what phase are made. More detailed information is needed to specify what data is needed in each research phase. The next paragraph specifies how data is being collected and translated into concrete products.

9.1.1 Data collection

During different phases within the research data is being collected. This data is collected throughout academic journals or participants in the interviews. The next sections describe in detail how this data is going to be collected. Also is explained what essential information is needed for each step.

Literature Review

Phase a. consists of a literature review among different (international) academic journals. The goal of this literature review is two folded: firstly is examined what already has been researched regarding this topic by previous researchers. Secondly the theoretical research questions are answered during this phase. This literature review plan guides the review in a more structured way.

Table 4 presents what database sources are used in this research. In the literature research is focused on the following subjects:

a. Stimulating innovation through public procurement;
b. Stimulating innovation in partnerships;
c. The current innovation process in the innovation partnership for quay walls.

Keywords help to guide the search for specific articles. The keywords used in this research are:

a. Innovation AND Public Procurement;
b. Innovation AND Construction;
c. Partnership AND Innovation;
d. Innovation Partnership;
e. Innovation-driven Procurement;
f. European Innovation Partnership;
g. Demand-driven Procurement AND Innovation;
h. Fostering Innovation AND Public Procurement;
i. Drivers for Innovation AND construction.

The risk occurs that previous presented key words result in a large list of articles. Specific criteria are used to challenge the articles found. All literature is exposed to following criteria:

a. Presence of Keywords in abstract;
b. Amount of references;
c. Reputation of Author(s) and Organization(s);
d. Reputation of the Journal;
e. Year of Article;
f. Relevance of results to Dutch construction sector.

Table 17: Sources for finding literature

Database Source	Description
Google Scholar	Database from Google. Used to find literature among different scholarly sources throughout the World Wide Web.
FindUT	Library database containing articles held by the University of Twente.
ASCE Library	Library with articles of several engineering journals.
Blackboard	Relevant literature from courses followed during the Master course CME at the University of Twente.
Scopus	Database of peer-reviewed literature consisting of scientific journals, books and conference proceedings.
Municipality of Amsterdam	Database of non-scholarly products held by the municipality of Amsterdam. This source is more practical and related to the quay wall renewal project

Interviews

During phase b. empirical data is gathered from both municipal representatives and market parties. Interviews are hold among these parties aiming to gather qualitative data. The researcher uses a semi-structured interview structure. In this structure a set of basic questions is prepared by the researcher. During the interview the researcher asks follow-up questions. These questions are asked to the points important for the research. Below is explained what the content and goal of the two sets of interviews is.

Interviews with municipality
Firstly interviews will be held with representatives of the municipality. The goal of these interviews is to get more understanding of the current innovation procedure in the innovation partnership. Especially to what choices are related in facilitating innovation within the partnership procedure. In total three interviews will be executed among representatives of the municipality. Those were involved in the development of the innovation partnership procedure. The functions of the representatives of the interviews are:

- Systems Engineer (responsible for the functional specification);
- Team leader;
- Procurement Advisor;
- Legal Counsel;
- Consultant Risk Management.

The aim during these interviews is to answer the first two empirical research questions. Therefore the interview will be divided into two parts. In the first part it is aimed to gain understanding about the idealistic result of the innovation partnership for quay walls. In the second part the choices made by the municipality to foster innovation in the procedure are withdrawn. Using this approach is also the theoretical framework tested among representatives of the municipality. After these interviews the researcher has full understanding of the procurement procedure and the different choices made by the municipality.

Interviews with market
Secondly market parties are interviewed. The goal of these interviews is to gather their view towards the innovation procedure. Furthermore the interviews will be focused on the subject how public agencies should provoke innovation in their tender procedures. Different companies are in charge with the innovation partnership. In the year prior to the selection procedure of the innovation partnership three market consultations were held. Five groups of market parties can be extracted from the parties available:

- Engineering firm;
- Contractor;
- Innovator;
- Supplier;
- Knowledge institution

The municipality of Amsterdam aims that consortia are formed among engineering firms, contractors and innovators. Therefore will only these parties be involved in the execution of interviews. Table 18 presents the amount of companies available and how much interviews are executed among the different firms.

Table 18: Amount of parties interested in the innovation partnership and deviation for interviews

Type market party	Amount	Interviewees
Contractor	62	5
Engineering firm	41	4
Innovator	13	1
Supplier	4	0
Knowledge institution	3	0
Total	**123**	**10**

Validation

Phase c. of the research consists of a validation step. Results from phase b. are validated during this step. Validation takes place with representatives of the municipality and market parties. Possible improvements are made to the innovation procedure of the municipality of Amsterdam. Validated is whether the improvements match with the view of the developers of the innovation partnership procedure and market parties. Especial attention is paid to whether the improvements match with the strategy and view of the municipality.

9.1.2 Data processing

During the research data is gathered during the literature review and empirical part of the research. This section describes how the data is processed.

Theoretical framework
Firstly a theoretical framework will be constructed from the literature review. The goal of the theoretical framework is two folded. Firstly the literature review is conducted in a structured way. Secondly the interviews can be conducted in a structured way.

The literature study is aimed to find possibilities gaining theoretical knowledge on three aspects:
- Stimulating innovation through public procurement;
- Stimulating innovation through partnerships;
- Facilitating innovation through public procurement.

Finally resulting in a list of factors how innovation can be stimulated related to those three aspects. These aspects are divided into three themes:
1. **Organization:** In which the organizational aspects about the procurement procedure are treated;
2. **Partnering:** In which the aspects, related to collaboration between public and private party are treated;
3. **Procurement procedure:** In this last theme the important aspects related to the procurement procedure are discussed.

The framework presented in Table 5 presents the preview of the theoretical framework. This can be seen as starting point for the empirical research. During this second stage the researcher tries to find similarities between literature and empirical results.

Table 19: example of theoretical framework

Theme	Aspects	Description
Partnering	Aspect 1	
	Aspect n	
Procurement procedure	Aspect 1	
	Aspect n	
Organization	Aspect 1	
	Aspect n	

Empirical research part

From the empirical part of the research, data is gathered in the form of interviews. During execution the interviews will be recorded by a recorder. After the interviews the researcher transcribes the tape. The combination of transcriptions is used to withdraw conclusions from the different interviews. The goal of this research is to construct a framework which public agencies can use to provoke innovation using a public procurement procedure. The theoretical framework will therefore be used to sustain such a framework.