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Exploring the acceptance of innovation based on standardization in a construction programme

The role of uniqueness bias in the acceptance of innovation

Master Thesis Report - Construction Management and Engineering

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Exploring the acceptance of innovation based on standardization in a construction programme:

The role of uniqueness bias in the acceptance of innovation

by

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"*It does not matter how slowly you go as long as you do not stop*." – Confucius

This quote has resonated with me throughout my journey to study abroad—a dream deeply rooted in my heart. Pursuing this dream has been about more than personal growth; it's been about my commitment to making a positive impact on the world. I've learned that true progress comes from embracing mistakes.

Over the past eight months, my thesis adventure has been challenging, but every hurdle faced has demanded determination and underscored the importance of continual progress. Each step, no matter how small and slow, has been significant in achieving my goal. The essence of this journey was never about the speed of my progress but about the consistency of my pursuit of knowledge, understanding, and growth. In line with what Confucius advised, stopping was never an option; but to keep moving forward, regardless of the pace.

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Executive summary

In the realm of construction management, programmes are increasingly recognized for their numerous advantages, including fostering both horizontal and vertical collaboration, facilitating improved knowledge transfer, and promoting more efficient and appropriate resource utilization. A key aspect of these programmes is their potential to adopt innovation based on standardization, rooted in shared project characteristics, thereby streamlining the achievement of programme objectives. This approach to innovation focuses on delivering customized products while maintaining the efficiency, cost, and quality standards of mass production.

However, translating these theoretical benefits into practice presents several challenges. A fundamental issue is the 'uniqueness bias' prevalent among project managers in the construction industry. This bias stems from the perception of each project as a unique endeavour, leading to a reluctance to learn from other projects and an underestimation of risks. This tendency significantly impedes the acceptance of innovation based on standardization.

This research aims to delve into the phenomenon of uniqueness bias and its impact on innovation acceptance within construction programmes. Specifically, it investigates how this bias manifest in the construction programme, taking *Programma Bruggen en Kademuren* (PBK) as a case study. The goal is to increase awareness of uniqueness bias within the programme, thereby facilitating the acceptance of innovation. From an academic perspective, this study seeks to bridge the gap in research regarding uniqueness bias in the construction industry and the acceptance of innovation in construction programmes. The insights gained are expected to contribute significantly to both practical and theoretical understanding in these areas. In order to achieve the objective, this research utilized the following research question.

"To what extent does uniqueness bias exist within the acceptance of innovation based on standardization in a construction programme?"

In the first phase of the research, a literature review was conducted to establish a sufficient theoretical foundation. Three concepts were investigated in the literature review: uniqueness bias, innovation acceptance, and construction programme. Uniqueness bias, which is defined as a tendency of planners or project managers to view their projects as singular and unique, is a concept that has a lack of study within the project management research. There has not been any research that connects the concept of uniqueness bias to the acceptance of innovation, and also to a construction programme, proving the gap in the literature. In the acceptance of innovation, two theories are retrieved from literature, which are the Innovation Diffusion Theory, and the Innovation Decision Process. Lastly, programme definitions and its characteristics are also retrieved from literature. Based on the literature review, the research develops two hypotheses. First is on whether uniqueness bias is recognized by those involved in the construction programme (H1), and secondly, whether this bias negatively impacts the acceptance of innovation based on standardization (H2).

To understand the extent of uniqueness bias within the acceptance of innovation based on standardization, it is important to first understand the process of innovation acceptance within a programme. This is done by reviewing the PBK's official documents and performing exploratory

interviews with the individuals working in the department of innovation within the programme. Based on that, the research identified the process of innovation development and the stakeholders that are involved in it. The development of innovation within the case study programme generally has four phases, which are the initiative phase, testing ground phase, transition phase, and implementation phase. The research also identified that, within the case study programme, innovation is developed in two ways, one is internally through a living lab, within the department of innovation in the programme, and the other is through innovation partnership (IPK). The innovation that is developed internally within the living lab will take place in an ongoing traditional project, while innovation from the IPK will have its own designated place. In the development of innovation, a variety of internal and external stakeholders are involved, from the workers in the innovation department, workers in the traditional projects, market parties, and knowledge institutes. The acceptance of each stakeholder is crucial in order for innovation to be developed. With this data, information about individuals involved in innovation development was collected. At the same time, the data is also utilized to optimally build semi-structured interview questions. The questions were designed to find the influence of uniqueness bias in innovation acceptance and to know the factors that influence the bias, which were then performed with a total of 19 individuals, working both internally and externally (i.e., market parties) in the programme. The results of the interviews were transcribed, which were then analysed by using thematic analysis.

Findings

This research identifies variety of factors that influence the acceptance of innovation based on standardization within a programme. The factors are categorized into preconditions, barriers, and enablers to innovate. Such categorization is derived based on the result of the semi-structured interviews. Three preconditions were identified that are essential for fostering innovation: availability of suitable place for development, mindset to innovate, and availability of financial resources to support innovation activities. Eight barriers were identified, which include: less amount of work volume, shifting innovation objectives and constant changes in project scope, difficulties in finding location for innovation, resistance from established practice, lack of coordination, lack of direction, large number of stakeholders, and operational constraint. Furthermore, this research identified two enablers that facilitate innovation, which are a positive business case that supports innovation, and contractual agreements that supports innovation.

The findings of this research do not indicate a significant impact of uniqueness bias on the acceptance of innovation based on standardization. Uniqueness bias, understood as the tendency to perceive projects as distinct and thereby impeding knowledge transfer and risk assessment, does not prominently feature in the challenges associated with innovation acceptance. Instead, the reluctance to adopt standardized innovation appears to be influenced more by practical considerations such as organizational culture, operational constraints, and challenges related to program dynamics.

In conclusion, the finding suggests that the acceptance and implementation of innovation are more directly affected by practical organizational factors. These factors include the dynamics of the program, work culture, governance issues, and operational constraints, as well as the presence of conducive business and contractual environments.

Framework

Utilizing factors that influence the acceptance of innovation, which was identified in the result, this research builds a framework that is aimed at facilitating a conducive environment for the development and implementation of innovation within a programme. The framework is evaluated

by one expert and adjusted based on their feedback afterwards. The framework is intended to be utilized by the public client, and for an ongoing programme. It consists of three intervention plans, which are: establishing a clear baseline and direction of a programme, creation of innovation section within the programme forum, and a contractual flexibility for innovation integration. The first intervention helps on providing clear direction to every worker within the programme, which would help on creating synergy in the effort of pursuing innovation. The second intervention helps on providing information revolving around innovation within the programme, keeping all the workers informed, and motivated, and see opportunities that they might be able join in. Lastly, the third intervention helps on reducing the risk of innovation development posing negative impact on the project objective, which would provide more room for workers in projects to take innovation initiatives. The final framework can be seen on the next page.

Discussion

A critical examination reveals that the concept of uniqueness bias, initially hypothesized as a barrier to innovation acceptance in construction programmes, did not manifest as expected. Contrary to the initial assumption, the research found no significant evidence linking uniqueness bias to resistance against innovation based on standardization. This deviation from the hypothesis underscores a complex landscape where organizational culture, economic factors, and a preference for operational freedom significantly influence innovation adoption. The findings challenge the traditional notion of uniqueness bias in project management, suggesting that its impact on innovation acceptance is more nuanced and less direct than previously thought.

The research also delves into the acceptance process of innovation within a construction programme, revealing complexities beyond what is outlined in Rogers' Innovation-Decision Process theory. It identifies a unique development phase, highlighting the intricate process required for innovation to align with specific project needs. This phase adds a layer of complexity, involving factors like resource allocation, risk management, and the balancing act between ongoing traditional projects and innovation development. The research findings suggest that the acceptance and implementation of innovation are influenced by stakeholders' risk tolerance, responsibilities, and the potential impact on project objectives.

Lastly, the research acknowledges its limitations, including the interdisciplinary challenges, the scope of the master program, and the exploratory nature of the study. These limitations highlight areas for future research, particularly in developing more refined methods to capture the subtleties of behavioural biases and their impact on innovation acceptance in construction programme settings. This acknowledgment of limitations not only adds credibility to the study but also opens opportunities for further exploration and understanding of the complex dynamics in construction programme management.

Recommendations

This research provides recommendations for public clients and external parties in construction programmes. Public clients are advised to regularly update stakeholders on the programme's direction, particularly regarding innovation, and to establish clear channels for sharing innovation progress. They should also integrate contractual flexibility to encourage innovation and prioritise long-term partnerships with external partners for successful innovation development. For external parties, the emphasis is on maintaining proactive communication with public clients and stakeholders and actively sharing knowledge and expertise about innovation to foster collaborative innovation efforts within the programme.

Regarding future research, the research highlights the need to involve behavioural science experts to further understand uniqueness bias and its impact on innovation acceptance. It also suggests

examining the role of contractual agreements in innovation acceptance and exploring how organisational work culture affects standardisation processes. The research lastly advocates for the improvement and re-evaluation of the proposed framework with broader expert input and for conducting multiple case studies to enhance the generalisability of the findings across the construction industry.

Figure 0.1: Proposed framework

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Chapter 1

Introduction

1.1. General

The civil engineering and construction industries are among the largest and most essential sectors of the global economy (McKinsey & Company, 2020). Together, they contribute approximately 13% to global GDP, and many other industries rely heavily on the infrastructure they create to deliver economic and societal value. However, these industries are also the largest global consumers of raw materials and are responsible for 25-40% of the world's carbon emissions (World Economic Forum, 2016). In pursuit of the Sustainable Development Goals, the adoption of innovative ideas and productivity enhancements is critical within these sectors (United Nations, 2022) Even minor improvements can significantly impact sustainability efforts, underscoring the need to increase resource efficiency and promote circularity. By integrating new technologies and practices, the civil engineering and construction industries can mitigate their environmental impacts while simultaneously boosting economic competitiveness. Thus, it is crucial for these industries to place a high priority on innovation and sustainability in their operations.

1.2. Research background

Challenges of innovation in the Dutch construction industry

The Dutch construction industry is hindered by the limited opportunities for large-scale deployment of innovations. This is due to the nature of the industry, where a multitude of unique construction projects limit scalability and financing options for innovation (Arnoldussen et al., 2016). Traditionally, the construction industry is a project-based industry that is delivered through a project-based organization (Adriaanse, 2014; McKinsey & Company, 2020; Vosman et al., 2020). These fundamental characteristics of the construction industry have resulted in a fragmented landscape, where according to (Adriaanse, 2014), the Dutch construction industry suffers fragmentation in three forms: horizontal fragmentation, vertical fragmentation, and longitudinal fragmentation. Horizontal fragmentation occurs when each project has its unique organization and structure. Vertical fragmentation refers to the separation of construction phases. Finally, longitudinal fragmentation occurs when projects are managed separately without a unified approach, resulting in different project teams from one project to another (Vosman et al., 2020). The lack of continuity in the project team also forces a new learning curve which negatively affects the project's efficiency levels (Riazi et al., 2020).

Furthermore, the fragmented nature of the industry poses significant barriers to innovation. Compared to manufacturing products in large quantities, the project-based nature that concentrates on one-off products makes it more challenging to earn back investment from product innovation(Lenderink et al., 2022a). Additionally, fragmented procurement processes hinder integration, coordination, and communication, further limiting innovation opportunities (Love et al., 1998). The short lifespan of the collaboration coupled with the complexity of the system also resulted in more challenges for innovation to prosper in this industry (Lenderink et al., 2022a).

Historically, there has been a consensus that the fragmented nature of the construction industry obstructs the capture and reuse of valuable knowledge. Expertise garnered during construction projects is often lost as teams disband upon project completion (Dave & Koskela, 2009). In general, the fundamental rules and characteristics of the industry lead to delayed industry

performance (McKinsey & Company, 2020). Given these inherent challenges rooted in the nature of the construction industry, it becomes evident that traditional project-based models may not be the sole answer. A paradigm shift is necessary, one that addresses fragmentation and encourages more streamlined approaches for better knowledge retention and innovation deployment.

Programmatic approach: a solution to the challenges?

This leads to the consideration of the programmatic approach, which has emerged as a promising solution to the aforementioned fragmentation (Buuren et al., 2010). Programme management is an integrated, organized framework that coordinates, aligns, and distributes resources, as well as plans, executes, and manages multiple related construction projects to gain maximum benefits that cannot be achieved if the projects are handled independently (Shehu & Akintoye, 2009). When comparing it to a project, a program tends to have longer-term, more abstract, and strategic aims that can also be changed as needed over time (Pellegrinelli, 2011). This long-term perspective characteristic makes a programme better at addressing strategic policy goals such as climate change and carrying out circular economy into concrete projects (Pellegrinelli, 2011), while also implementing innovative and sustainable ambitions (Rijkswaterstaat, 2022). Moreover, bundling projects can create the necessary scale for innovation development (Hart et al., 2019) and stimulate cross-project learning and knowledge sharing (Arnoldussen et al., 2016). Hence, with the increasing complexity and the amount of work that the Dutch construction sector will encounter, it can be expected that the usage of programmes will become increasingly prominent to tackle societal challenges.

Programma Bruggen en Kademuren

One of the ongoing construction programs in the Netherlands is the Amsterdam Bridge and Quay Walls Programme, otherwise known as *Programma Bruggen en Kademuren* (PBK). The programme was created to repair, renovate, or renew around 800 bridges and 200 kilometres of quay walls in Amsterdam (Gemeente Amsterdam, 2023). The programme was also set up to speed up the task and make less use of the city's financial resources through the use of innovation by utilizing pilot projects and living labs that collaborate with knowledge institutes and market parties. This is a large and complex task, not only because of its size but also due to intertwinement with the environment, trade-offs between socio-economic values, the desire to maintain original bridges and quay walls useful and impacts on the utilization and preservation of cultural heritage (AT Osborne, 2021).

One of the challenges that the programme is currently facing is the acceptance and implementation of innovative solutions. Although there are potential benefits to selecting standardized solutions, progress in this direction has been slow. It is assumed that the root cause of this issue is a tendency known as uniqueness bias. Uniqueness bias refers to the tendency for individuals to perceive themselves as more singular than they actually are (Suls et al., 1988). From a project management perspective, uniqueness bias is defined as the tendency for planners and managers to view their projects as unique (Flyvbjerg, 2021). In the PBK, the bias can be observed in people's resistance towards selecting innovation based on standardization over a customized approach. This phenomenon is impending the programme's ability to achieve its innovation goals, reduce costs, and speed up progress.

1.3. Problem definition

In the realm of construction management, programmes offer numerous advantages. It promotes horizontal and vertical collaboration (Project Management Institute, 2017b; Shehu & Akintoye, 2009), improved knowledge transfer (Lycett et al., 2004), and more efficient and appropriate resource utilization (Lycett et al., 2004; Pellegrinelli, 1997; Shehu & Akintoye, 2009). Since a programme comprises multiple projects that share similar size and complexity, there exists an

inherent potential for the adoption of standardized solutions. These solutions, derived from innovation rooted in shared project characteristics, promise the streamlined achievement of programme objectives.

The idea of innovation based on standardization is to deliver products that have some degree of customization while striving to meet the standards of efficiency, cost, and quality of mass production (Viana et al., 2017). Literature suggests that the adoption of this type of innovation brings various benefits such as simplification of the design process, increased customization achieved by rearranging optional modules, and many others (Viana et al., 2017).

While in theory a programme would improve knowledge transfer, more efficient resource utilization, and stimulate innovation, in practice there are still many challenges to do so. One fundamental aspect to consider is that a project, by definition, is a temporary endeavour to create a unique product, or process (Project Management Institute, 2017a). Given that the construction industry typically delivers its work through projects, professionals in the field are conditioned to perceive what they are doing as unique (Flyvbjerg, 2021). This leads to the emergence of 'uniqueness bias', where project managers perceive their projects as being singularly distinct (Flyvbjerg, 2021). This tendency impedes managers' learning as they think that they have little to learn from other projects as their own project is unique. At the same time, it also feeds the inside view and optimism, which in turn feeds the underestimation of risk, causing the project team to wager on the risk they would not have likely accepted if they had known the true odds (Flyvbjerg, 2021). With that in mind, research about how uniqueness bias influences innovation acceptance in a construction programme has never been done in any academic literature before. As such, this research attempts to fill those academic gaps.

At the same time, this bias has been observed to create resistance to selecting innovation based on standardization in the Programma Bruggen en Kademuren (PBK), hindering the program's ability to achieve its goals efficiently. Therefore, this research aims to address the literature gap in understanding uniqueness bias in the construction industry while also exploring how it manifests in the PBK in a practical context, with the aim of identifying potential solutions to promote the adoption of innovation based on standardization.

1.4. Research objective

This research aims to investigate and understand the phenomenon of uniqueness bias and its impact on innovation acceptance, particularly on innovation based on standardization, within the construction programme. The result of the investigation is expected to increase the awareness of the uniqueness bias in the programme, and thus help in the acceptance of innovation. From the academic perspective, the study aims to contribute to the gap in research on uniqueness bias in the construction industry, and also the gap of research in innovation acceptance in construction programmes.

1.5. Research questions

In order to achieve the previously mentioned objective, the following main research question is developed:

"To what extent does uniqueness bias exist within the acceptance of innovation based on standardization in a construction programme?"

Additionally, four Sub Research-Questions (SRQ) were composed to acquire all necessary input for answering the main research question:

1. What is the process of innovation acceptance in a construction programme?
2. What are the factors that influence the acceptance of innovation based on standardization?

3. How do the factors that influence the acceptance of innovation based on standardization relate to uniqueness bias?
4. How can the model or framework assist in fostering a better space for innovation acceptance in a construction programme?

1.6. Research scope

The research focuses on the Programme Bridge and Quay Walls (PBK) in Amsterdam, with a specific focus on the "quay wall" context. The PBK programme is set up to investigate around 200km of quay walls and 800 bridges, and if necessary, to renovate or renew them. The selection of this programme as the research context is justified by its ongoing nature, providing a current depiction of industry practices within a programme setting. Examining a contemporary event would present the most recent situation of how the industry works on a programme, and also the researcher speculates that it would show and emphasize the uniqueness bias clearer since they are currently experiencing it compared to a historical event when people have a chance to retrospect.

The decision to focus on the PBK programme also aligns with the interest of the thesis sponsor, the Municipality of Amsterdam. This ensures the practical relevance and applicability of the research findings to the sponsoring organization. It also fosters a collaborative partnership, enabling access to necessary resources, people, and information to effectively perform the research.

A specific focus on quay walls was chosen for two main reasons. First, given a relatively short timeframe, focusing on one specific context would reduce the complexity of the research. Secondly, quay walls arguably have a relatively lower complexity compared to bridges, and the research performed on quay walls about this topic, to some degree, might also be applied to the bridge context.

1.7. Research design

To achieve the research objective, this research is divided into four phases. The research starts with the first phase, the theoretical phase, where the methodology of the research is established, and a literature review is conducted to build a theoretical foundation. The second phase, the empirical phase, deals with the single-case study where analysis of case-study documents, exploratory interviews, and semi-structured interviews are performed. The findings from the second phase are then utilized as input for developing the framework before it is validated by the expert in the third phase. Lastly, the fourth phase deals with finalization, where discussion, conclusions, and recommendations are presented.

Phase 1: Theoretical Phase

The first phase of the research deals with creating the research proposal, methodology, and a preliminary literature study. The research has an exploratory and qualitative nature. This is because research on the concept of uniqueness bias in the construction industry is relatively new. Additionally, research on the acceptance of innovation in a construction programme is also an emerging topic. This means that there is limited literature available related to this research. With limited related research, an exploratory interview is performed within this research, which will be done in Phase 2.

Following the research preparation, the topics investigated in the literature review are based on the concepts brought into the research. Three concepts are brought up in the research: uniqueness bias, innovation acceptance, and construction programme. Information regarding these three concepts is searched in academic literature to create a theoretical foundation. To

perform the literature review optimally, a literature search plan is established. For more information about the search plan, see Chapter 3 and Appendix A.

To cast a wider net and encapsulate related themes, the search plan subdivides the three primary concepts into broader categories: uniqueness bias, decision-making, acceptance, innovation, construction, and programme. The addition of 'decision-making' emerged during the review process, recognizing its potential overlap with the acceptance of innovation. Moreover, 'construction' and 'programme' are treated separately to potentially gather insights from programmes across diverse industries. Further explanation of the search plan can be found in Chapter 2 and Appendix A.

It's worth noting that the uniqueness bias as a concept has roots in behavioural science. Consequently, the literature review extends beyond the confines of the construction industry, incorporating insights from various academic fields.

Phase 2: Empirical Phase – Single case study, result, and analysis

The second phase, the empirical phase, is performed to gain an understanding of the influence of uniqueness bias in innovation acceptance within a construction programme. The main data source for this research is a single case study on one of the ongoing construction programmes in the Netherlands. The construction programme that is selected as the case study is the one this research is collaborating with. For the empirical phase, a single-case study is utilized. This method helps to provide an in-depth explanation of certain circumstances (Yin, 2018), and the researcher utilized this to help gain an understanding of the uniqueness bias phenomena that are specifically happening and influence the object being studied. The single case study helps in answering SRQ-2 and SRQ-3.

Document review

This step is to gather information regarding the programme being selected as the case study. The information revolves around how the programme operates, its organizational structure, and its current progress. Retrieving and reviewing this information is important in building the case study, which would help in answering SRQ-1, SRQ-2, and SRQ-3.

Exploratory interview

To understand the influence of uniqueness bias in the innovation acceptance in a construction programme, it is important to first understand the process of how innovation came, was selected, developed, and implemented in the construction programme. Acquiring insights into the process of innovation acceptance is one of the objectives of this part. Additionally, it also intends to understand which stakeholders are involved and critical during the innovation acceptance and development process. This will help the researcher to create selection criteria and questions for the subsequent semi-structured interview. More information regarding exploratory interviews can be found in the Appendix B.

The experts who were interviewed were selected based on their experience in innovation development in a construction programme. The following are the steps of the exploratory interview:

1. Gathering information about the innovation acceptance process in PBK through official documents review.
2. Selection and invitation of the expert to participate in the exploratory interview. Experts were selected based on their experience and knowledge in the innovation acceptance process in the construction industry.

3. Formulation of questions for the interview based on the literature review and official documents review.
4. Performing the interview. The interview is also recorded in order to have traceability.

Semi-structured interview

Semi-structured interviews were performed after document review and exploratory interviews. This is because the insights gathered from these preliminary steps will help in creating more tailored questions that would help in understanding the influence of uniqueness bias within the innovation acceptance in the construction programme. Information about the structure of this phase and the questions being asked can be found in Appendix C.

After the interview is performed, analysis of the data is done by using thematic analysis. With the help of computer software "Atlas.ti", data from the semi-structured interview will be classified into themes that represent significant patterns or concepts.

Phase 3: Framework Development

Utilizing findings from the single-case study analysis, a set of recommendations was proposed and a preliminary framework that help on increasing awareness of uniqueness bias, and how it influences the acceptance of innovation in a construction programme is established. To maintain the quality of the research, the preliminary framework was validated by experts from public clients working in a construction programme to ensure its relevance, credibility, and applicability to practice. A discussion during the experts' session allowed the identification of aspects that have not been observed in the case study. From the output of expert evaluation, the framework was refined and finalized before finally being presented as a final framework, and an answer for SRQ-4 was provided.

Phase 4: Finalizing

The final phase provides discussion, limitation, and the conclusion of the research. This discussion highlighted a comparison between the empirical data and the theoretical foundation. The limitations of the study were also identified in this stage. By the end of Phase 4, the primary research question, along with all sub-research questions, were addressed. The study concluded with a set of recommendations, marking the completion of the research.

1.8. Research outline illustration

The thesis is structured around the four distinct phases of research design as outlined in the subsection – Research design. The research begins with a theoretical phase, which encompasses the introduction in Chapter 1, a detailed methodology in Chapter 2, and a literature review in Chapter 3. This segment provides a deep dive into the theoretical foundations of the study, with a particular focus on the uniqueness bias, innovation, and construction programme. Chapter 4 provides insights from a document review and an exploratory interview pertaining to the case study. Within this chapter, the innovation development phase is elucidated, along with the criteria for individual selection for the semi-structured interview, the design of the interview questions, and their underlying rationale. Chapter 5 showcases the findings and analyses derived from the semi-structured interviews. Based on these findings, Chapter 6 outlines recommendations and leads to the formulation of a preliminary framework. This framework is subsequently evaluated by experts to establish the final blueprint. In Chapter 7, a discussion about the research is provided while also highlighting its limitations. Chapter 8 concludes the study by drawing conclusion, offering recommendations, answering the main research question, presenting the definitive framework, and pointing towards potential areas for future research.

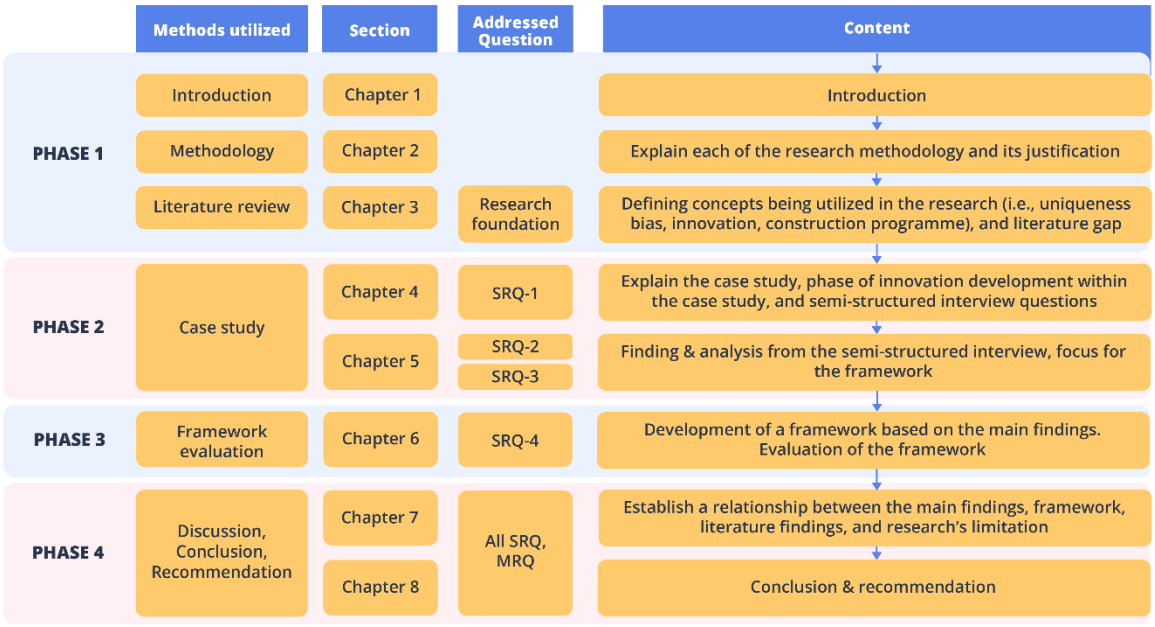

Figure 1-1. Research outline

Chapter 2

Methodology

This chapter introduces the research methodology, provides justification, and sets suitable parameters that fit the purpose of this research. The chapter provides three important pieces of information, which are the research methodology, the justification of why a particular method is chosen, and the mechanisms of applying the methodology to achieve the research objective.

The most important decision a researcher must take when designing research is the kind of approach or strategy that will be taken (Verschuren et al., 2010). Research strategy describes the way the researcher will conduct the study, starting with the collection of relevant information, processing it, and concluding with the answer to the research questions. Verschuren et al (2010) state three key decisions that researchers make when making a research approach.

First, the researcher must determine if he or she seeks a broad overview of a field or a comprehensive analysis of all facets of a phenomenon that spans time and space (Verschuren et al., 2010). This in other words is a choice between breath or depth. Studies about the influence of uniqueness bias on innovation acceptance in a construction programme have yet to be done by anyone. Uniqueness bias itself is a psychological concept with relatively few academic literatures that studied it. Additionally, innovation acceptance in a construction programme is also a phenomenon that is rarely talked about in the academic literature. Since there are limited studies that directly address uniqueness bias in the context of innovation acceptance, a thorough investigation of its influence seems to be necessary. As such, depth is the preferred choice for this research.

Secondly, the researcher must determine whether the research will follow a qualitative or a quantitative approach(Verschuren et al., 2010). As uniqueness bias in the context of construction programmes is relatively understudied, a qualitative approach would be more valuable in exploring the phenomenon in depth. The qualitative approach captures the subjective experiences, and interpretation of the phenomena (e.g., exploring individual perspectives, motivation, and perceptions of uniqueness through semi-structured interviews). Another reason is that the qualitative approach offers flexibility and adaptability during data collection and analysis, enabling researchers to uncover unexpected insights that may not have been anticipated from the study.

The third key decision entails choosing between performing fieldwork and collecting primary data or relying on existing literature and secondary data to achieve the research objective (Verschuren et al., 2010). Although every academic research necessitates a certain level of desk research involving a thorough review of prior literature, the existing body of literature does not address the specific objective of this research, creating a need for empirical research. Hence, this research has elements of both an empirical and a desk study.

Decisions mentioned above will then determine the choice of source of data being selected and also the method utilized to process the data to achieve the research objective.

2.1. Literature review

The purpose of the literature review in this study is to gather relevant information to shape the theoretical framework of the research. This involves defining key concepts used in the research and spotting areas that haven't been extensively covered in previous studies. The information is sourced from both online platforms and library books. Several academic search tools, such as

Google Scholar, Scopus, ScienceDirect, and the TU Delft Repository, have been used. The main goal is to understand insights from past research related to the topic and highlight the research gap in the area.

To find the most relevant theories about this research, several keywords are used when performing a literature review. The main research question "*How does uniqueness bias influence the acceptance of innovation in a construction programme?*" contains three main concepts. Those concepts are uniqueness bias, innovation, and construction programme.

For the concept of innovation, several keywords are utilized when performing a literature review which are acceptance, adoption, resistance, diffusion, barrier, innovation, novelty, advancement, transformation, and technology. For the second concept, which is construction programme, keywords that are being used are: "programme", "portfolio", "programmatic approach", "civil engineering", "civil construction", and "construction industry". The two concepts are also combined when performing a literature review by utilizing Boolean operators. For the concept of uniqueness bias, the keywords that are being used are: "uniqueness", "uniqueness bias", "perceived uniqueness", and "bias". More information about the steps performed and keywords utilized for the literature review can be found in the Appendix A.

The steps of the literature review are as follows. First, keywords from the same concepts are applied together by using the Boolean operator "OR" to the academic search engine. The search engine will show the number of relevant literature available, which initially will start with a huge number. Afterwards, keywords from other concepts will be added to the search prompt by using the Boolean operator "AND". In this phase, synonyms of the other concepts are also utilized. Naturally after adding the second concept to the search prompt, the number of results will gradually get smaller. This iteration is performed until the search engines show less than a hundred results. If the search engines show a small number of results, some keywords are removed. Following that, the abstract of every literature shown from the search engines is read and in this step the researcher carefully selects literatures relevant to this study.

2.2. Single case study

A case study is a method that helps to provide an in-depth explanation of certain contemporary circumstances (Yin, 2018). This method of research is purposedly utilized for a technically distinctive situation that relies on multiple sources of evidence such as observation, official documents, interviews, questionnaires, and participants' comments.

For this research, a single-case study is utilized. This means that the research will focus specifically on in-depth analysis of a single individual, event, or situation. Single-case study is performed as the researcher wants to gain a deeper understanding of the phenomenon that is specifically happening and influences the object being studied. Additionally, the single-case study is also used as a construction programme is already a relatively large-scale organization consisting of a variety of interrelated parties, divisions, and members, making it complex.

The data collection for this research is performed in three ways in order: document review, exploratory interview, and semi-structured interview. In a case study, incorporating multiple input sources leads to a broader understanding (Yin, 2018). Moreover, leveraging diverse sources can enhance one another and yield more precise outcomes (Yin, 2018).

2.2.1. Data collection: document review

Documents related to the case study are reviewed in order to gather information related to the case study programme, how it operates, its organizational structure, and its current progress. That particular information would help in building the case study, which would help in answering

SRQ-1, SRQ-2, and SRQ-3. For this research, the documents being reviewed were retrieved from both publicly available documents on the internet and private documents. Table 2-1 provides the lists of documents being reviewed in this research and its code.

Table 2-1. Document review

Document code	Document date	Document descriptions
DR1AP	2022	Present the programme action plan for the period of 2023-2026
DR2HM	2022	Presents manual for the chain of work within the programme
DR3MS	2020	Present the market strategy of the programme
DR4PP	2020	Present plan of the programme
DR5PS	2020	Presents standards and rules of work within the programme
DR6PR	2023	Present the progress report of the programme until 2023
DR7OG	2020	Presents the hierarchy of organization within the municipality of Amsterdam
DR8OP	2023	Presents the hierarchy of organization within the programme

The results of the document review can be found in Chapter 4, along with the result of the exploratory interview.

2.2.2. Data collection: exploratory interview

The exploratory interview, along with the previous document review is performed in order to answer "SRQ-1: What is the process of innovation acceptance in a construction programme?". There are two objectives that the exploratory interview intends to realize. The first is to understand the process of how innovation came, was selected, and implemented in the case study programme. And secondly to identify which individuals or groups are involved during the development of innovation, along with their authority on accepting innovation. Knowing this information would help create justified selection criteria for the next semi-structured interview and help in developing questions for the semi-structured interview.

In general, questions for the exploratory interview are divided into three sections. The first section explores the process of innovation development and acceptance within the programme. The second section deals with understanding stakeholders involved within the innovation development, and the decision-making process for innovation acceptance within the programme. Lastly, the third section tries to gather information about the importance of stakeholder support within the acceptance of innovation in the programme. More information about the exploratory interview steps and questions can be found in Appendix B. With the "exploratory" nature of the interview, the author may ask questions that come up during the interview process.

To be considered for the interview, the prospective interviewees should: (1) possess authority and have been actively involved in the general process of innovation development within the programme, and (2) have ample experience and expertise pertaining to innovation development in the programme. Table 2-2 delineates the individuals interviewed, their respective codes, and their team or department where they work.

Table 2-2. Individual interviews

Code	Team or Department
EI01	Strategy and Innovation team
EI02	Living Lab Life Extension
EI03	Living Lab Renewal

2.2.3. Data collection: semi-structured interview

Semi-structured interviews were conducted with practitioners involved in the case study. In this type of interview, the interviewer has a predetermined set of questions to ask while also having room for open-ended questions, allowing participants to elaborate on their answers (Brinkmann & Kvale, 2018). This creates flexibility that the author thinks will help in exploring unexpected responses and digging deeper into specific topics that might arise during the interview. According to Adams (2015), a variety of situations where SSI is suitable are:

1. If the study intends to cover the respondents' individual ideas.
2. If the research intends to cover issues or problems that the respondents may find difficult to convey freely on official documents or in the presence of other peers in a focus group setting.
3. If the research is covering an undiscovered topic the interviewer needs the flexibility to explore and discover unknown problems.

Based on the three situations mentioned above, it seems relevant to utilize semi-structured interviews for this research. Firstly, the study intends to explore diverse individual ideas to gain insights into how uniqueness bias influences innovation acceptance. Secondly, the research addresses issues that respondents may find difficult to express freely in written documents. Lastly, as uniqueness bias in the context of construction programmes is an understudied area, performing semi-structured interviews allows the flexibility to explore and discover unknown problems and factors that influence innovation acceptance. To find more about the semi-structured interview, see Appendix C.

As previously noted, the criteria for selecting interviewees and the questions for the semi-structured interview will be formulated after conducting both the document review and the exploratory interview. The insights garnered from these preliminary steps will aid in crafting more tailored questions, specifically targeting the role of uniqueness bias in the acceptance of innovation within the programme. Consequently, details regarding the interviewee selection criteria and the semi-structured interview questions can be accessed in Chapter 4.

2.2.4. Data analysis: Thematic analysis

To analyse the data gathered from the semi-structured interview, this study utilized Thematic Content Analysis (TCA). In qualitative research, TCA is a method for identifying, analysing, and reporting patterns (themes) within data (Braun & Clarke, 2006). TCA entails systematically analysing and classifying data into themes that represent significant patterns or concepts within the data. With the help of computer software, Atlas.ti., codes will be assigned to help find similar themes from the interview transcripts.

TCA was chosen due to several reasons. First, since the research is exploratory in nature, TCA allows for an in-depth exploration and understanding of the data. This allows the researcher to identify and analyse emerging themes and patterns from the interview transcripts. Secondly, TCA provides flexibility in analysing qualitative data. As the research problem has limited existing literature, TCA allows the researcher to open unexpected findings and adjust the analysis approach accordingly. Lastly, it is relatively easy to conduct a good TCA on qualitative data hence aligned with the researcher's limited experience in qualitative research (Braun & Clarke, 2006).

Inductive Thematic Analysis

Deductive Thematic Analysis is a top-down, theory-driven approach. It begins with a specific theory or research question in mind. Rather than deriving themes directly from the data, they are established based on pre-existing knowledge or frameworks (Braun & Clarke, 2006). In this method, the researcher often approaches the data with predetermined codes, expectations, or ideas, which are informed by previous literature or theoretical considerations.

Conversely, Inductive Thematic Analysis is data driven. Instead of applying a preconceived theory or framework, the researcher allows the data to guide the emergence of themes. In this approach, themes are not established in advance but naturally surface during the coding process. It offers a more open-ended and exploratory methodology.

Given the exploratory nature of this research and considering that the concept of "uniqueness bias" has rarely been discussed within the construction industry—let alone within a construction programme, a more fitting approach for this study would be the Inductive Thematic Analysis. This ensures an organic and uninhibited exploration of the data, allowing novel insights to emerge without being constrained by pre-existing theoretical structures.

Phases of performing TCA

This subchapter provides an explanation for the phase of performing TCA for this research, based on the guidelines provided by Braun and Clarke (2006).

1. Data familiarization: This involves transcribing the interview recording in a written format, and immersion of the data by re-reading it to become familiar with it. In this phase, the researcher should be active in looking for meaning and taking notes that can be used to identify initial ideas and patterns.
2. Developments of initial codes: This involves identifying and coding meaningful pieces of data that relate to the research questions. As mentioned previously, Atlas.ti is utilized to perform the coding process.
3. Establishing themes: This involves categorizing codes into potential themes and gathering all data relevant to each potential theme.
4. Examining themes: This involves checking if the themes work in relation to the coded extract (level 1) and the entire data set (level 2), generating a thematic 'map' of the analysis. In this phase, certain themes might be removed if for instance there is not enough data that supports them. Certain themes might also be merged or broken down into separate themes.
5. Defining and naming themes: This involves refining and defining the themes and giving them clear and concise names.
6. Creating a report: Writing up the analysis, including quotes and examples to support the themes identified.

The result of the thematic analysis can be found in Chapter 5.

Chapter 3

Literature review

In this chapter, the literature relevant to the key concepts of the research is reviewed. It serves to pinpoint the gap in the current literature and to establish a solid foundation for the theoretical constructs used in this study. Through an examination of the three concepts related to the research: uniqueness bias, innovation, and construction programme, clear definitions and understandings are set forth for the research. This chapter assesses existing literature, justifying the research's necessity, and laying the groundwork for the analysis that follows. This literature review is essential not only for framing the research question but also for demonstrating how this study contributes to the existing body of knowledge.

3.1. Uniqueness bias

This section will explain findings about uniqueness bias from the scientific literature. Aside from innovation and construction programmes, uniqueness bias is one of the concepts that this research focuses on. The findings about uniqueness bias will be firstly explained from a behavioural science perspective, as the bias itself first originated in it. Later, findings about uniqueness bias from the project management studies will be explained.

3.3.1. Uniqueness bias: Behavioural science perspectives

Uniqueness bias is a behavioural bias that has gathered significant interest within the field of behavioural science. Despite its relevance, it is worth noting that the existing research on uniqueness bias in this field remains relatively limited. This section aims to provide an overview of uniqueness bias from existing behavioural sciences literature, incorporating relevant definitions and exploring its impact.

Definition of uniqueness bias

The term uniqueness bias was first introduced by Goethals et al (1991) to describe a phenomenon where individuals perceive themselves as more unique and special than others. According to their findings, individuals who perceive themselves as unique or exceptional tend to engage in upward social comparisons, driven by a desire to maintain a positive self-image or enhance their social status. Goethals et al (1991) also stated that the effect of uniqueness bias may depend on a variety of factors, such as the context of the social comparison, and the individual's goals and motivations.

Furnham and Dowsett (1993) contributed by defining uniqueness bias as the tendency to underestimate the extent to which others possess socially desirable attributes compared to oneself. In other words, individuals with the uniqueness bias tend to believe that they possess more positive attributes or behaviours than others. The study supports the idea of the existence of uniqueness bias by performing a social comparison, utilizing a questionnaire to measure the degree and trend of uniqueness bias between genders. The study found that people with high self-esteem are especially likely to demonstrate uniqueness bias (Furnham & Dowsett, 1993)

Delving deeper, Lange et al (1999) perceived the uniqueness bias as an overestimation of one's own uniqueness, exaggerating the superiority of one's own reactions and behaviours. They also drew parallels between this bias and the idea of perceived superiority, especially concerning relationship dynamics.

In a more contemporary exploration, Monin and Norton (2003) conducted a study involving the behavioural responses of participants during a shower ban. Employing the definition of uniqueness bias developed by Goethals et al (1991), they examined the disparity between

participants' assumption about showering prevalence and the actual reported figures. Their results showed that participants consistently underestimated the commonalities of desired behaviours. This confirmed the presence of uniqueness bias, as those practising desired behaviours assumed fewer others did the same, while the opposite was true for those involved in less-desired behaviours.

Previously, uniqueness bias was termed "false uniqueness", which refers to the tendency of individuals to underestimate the number of others who can or will perform desirable actions, calculated by subtracting the mean estimate of the prevalence of a desirable behaviour from its actual reported prevalence (Suls et al., 1988). In other words, this means that people tend to believe that their own behaviours are less common than they actually are among the general population. Suls et al (1988) hypothesize that motivational processes, such as the desire to feel unique or different in a positive way might be one of the factors that contribute to the development of uniqueness bias.

Relation to other bias

Uniqueness bias does not exist in isolation and exhibits a significant relationship with other social perception biases, such as false consensus, false polarization, and pluralistic ignorance(Monin & Norton, 2003; Suls et al., 1988).

- False consensus refers to the tendency for a person to estimate more support for one's own position or behaviour than do people holding the opposite position or behaviour (Ross et al., 1977).
- False polarization refers to the tendency for people to perceive greater differences between groups than actually exist (Monin & Norton, 2003).
- Pluralistic ignorance refers to the phenomenon where people privately reject a norm but believe that others accept it, leading to a false consensus (Monin & Norton, 2003).

In conclusion, from the behavioural science perspective, uniqueness bias is generally defined as the tendency of individuals to perceive themselves or their actions as more unique and special than others (Goethals et al., 1991). This perception could stem from an inherent motivation to see oneself as positively different or unique (Suls et al., 1988). Those who perceive themselves as unique tend to compare themselves to others in a way that enhances their self-image or social status. Furthermore, there is a tendency for these individuals to either underestimate or overestimate the prevalence of certain behaviours in the general population compared to their own actions (Monin & Norton, 2003).

3.3.2. Uniqueness bias: Project management perspectives

Uniqueness bias definition

In project management, the term uniqueness bias was only mentioned by Bent Flyvbjerg. Uniqueness bias is defined as the tendency for planners or project managers to see their projects as singular (Flyvbjerg, 2014). This notion is further reinforced by the frequent use of nonstandard technologies and designs.

As both project planners and managers are systematically predisposed to view their projects as unique, uniqueness bias is regarded as a particularly widespread and rewarding area of study in project management (Flyvbjerg, 2021). This is because even the standard definition of a project, according to the Project Management Institute (2017) is "a temporary endeavour undertaken to create a unique product, service, or result", emphasizing uniqueness as one of the defining features of a project.

Perceived Uniqueness

Before the term uniqueness bias was popularized, “perceived uniqueness” was used to describe similar phenomena in the realm of project management (Budzier, 2014; Newell et al., 2006). Projects perceived as unique often exhibited the following characteristics:

- Limited Learning: Such projects often took limited learning from other projects, preferring to develop a project from a bottom-up approach without benchmarking or comparing against similar endeavours (Budzier, 2014).
- Political Intent: They had more political intentions influencing their plans.
- Unrealistic Schedules: These projects faced less realistic and reliable schedules.
- Requirements Volatility: They encountered higher fluctuations in requirements.
- Design Ambiguity: There were more unknowns in their design approach.
- Resource Mix: They often had a less sustainable combination of internal and external resources and a poorer performance from suppliers.
- Experience Shortfall: There was often a noticeable lack of experience among key project team members.
- Inward Looking: The perceived uniqueness of projects meant that there was a common view that learning in the project was too specific to be relevant to the rest of the organization (Newell et al., 2006). Based on interviews conducted by Newell et al (2006), even though many acknowledged that the alleged uniqueness of projects was likely overstated, there remained little effort to capture and apply lessons, especially regarding processes that might be of value elsewhere.

The overarching implication of these findings is that perceived uniqueness can lead to a series of project inefficiencies and misjudgements, inadvertently hampering the project's potential success.

Impact of Uniqueness Bias

According to Flyvbjerg (2021), uniqueness bias has a detrimental effect on managerial learning as it leads managers to believe that their projects are unique, preventing them from drawing lessons from other projects. In line with this, Newell et al (2006) suggest that there is a tendency for planners to reinvent the wheel rather than learn from the experiences of previous projects, inhibiting knowledge transfer and learning. This bias also reinforces what Kahneman (2011) refers to as the "inside view" and optimism, resulting in the underestimation of risks. Consequently, project teams may unknowingly accept risks they would have otherwise avoided if they had a more accurate understanding of the actual odds.

The inside view, from a project perspective, entails planners and project managers focusing on the specific circumstances and components of their own project, relying heavily on their personal experiences. Consequently, activities such as budget estimation and scheduling are developed "from the inside and out." In contrast, the outside view involves considering the planned project from the vantage point of similar completed projects, utilizing the actual outcomes of these projects as the basis for estimation.

Flyvbjerg (2021) argues that uniqueness bias prompts planners to instinctively adopt the inside view, disregarding the outside view during the planning phase. However, it is the outside view that effectively incorporates all risks, including the elusive "unknown unknowns." By succumbing to uniqueness bias, planners become oblivious to these risks.

In conclusion, uniqueness bias in project management refers to the tendency of planners and project managers to view their projects as singular and unique, often neglecting to learn from previous projects or compare their plans to existing knowledge. This bias can lead to detrimental

effects, such as inhibiting knowledge transfer, underestimating risks, and reinventing the wheel instead of leveraging lessons from past experiences. By adopting the "inside view" and disregarding the "outside view," project teams may overlook potential risks and fail to incorporate valuable insights from similar completed projects.

3.2. Innovation

This subchapter provides theoretical background for innovation. It starts by providing definition of innovation, followed up by common categorization of innovation, and lastly innovation based on standardization.

3.3.1. Defining innovation

In order to innovate, one must choose to accept something novel (Stroh et al., 2023). This research utilized the definition of innovation by The Organization for Economic Co-operation and Development (OECD): "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD, 2005). The definition stresses three important points in conceptualizing innovation (OECD, 2005). First, the 'innovation process is not only made up of technological development but also implies the market introduction of the invention, embracing organizational and marketing innovations alongside technological innovations. Secondly, the responsibility for innovation is not solely placed on one company as collaboration and connections with other firms or institutions play a big role in the innovation process. Lastly, the definition also acknowledges the importance of innovation in industries that may not heavily rely on research and development, such as services and low-technology manufacturing.

Several disciplines such as engineering, marketing, and management, have attempted to define innovations. For example, in the field of civil engineering, Lenderink et al (2020) define innovation as the development and successful implementation of new ideas, products, or processes in the design and realization of new civil engineering objects.

3.3.2. Types of innovation

The literature on innovation contains many categorizations of innovation with many different dimensions. There is little consensus on which terminology is correct, with many terms having overlapping meanings while the same term is often used in different ways (Gaziulusoy & Twomey, 2014). In this research, several common types of innovation which are incremental and radical innovation, and process and product innovation will be explained.

Incremental innovation and radical innovation

Radical innovation can be seen as an innovation that is very new and different from previous solutions (Schilling, 2020), realized using totally new technology that is completely new to the world market (Lenderink, 2022). From the novelty of the knowledge base that underlies the innovation, radical innovation involves a considerable discontinuity in the knowledge base that underlies the technical system, while also posing greater impacts and more disruptive as opposed to incremental innovations (Gaziulusoy & Twomey, 2014). Sometimes, the radicalness of an innovation is also described in terms of risk (Schilling, 2020). Since it frequently incorporates new knowledge, producers, and buyers will differ in their experience with the invention and their evaluation of its usefulness.

Incremental innovation can be described as a continuous process that does not solely emerge from deliberate research and development (R&D) efforts but rather stems from the suggestions and improvements put forth by production personnel or user proposals (Gaziulusoy & Twomey, 2014). It involves making relatively minor changes or adjustments to existing practices, without

necessarily introducing groundbreaking or exceptional elements (Schilling, 2020). In fact, such incremental innovations may already be familiar to the firm or industry, as they typically involve only modest modifications or adjustments to prevailing practices (Schilling, 2020). This type of innovation is characterized by its incremental nature, emphasizing gradual improvements rather than radical transformations.

Process innovation and product innovation

According to OECD (2005), product innovation is defined as the introduction of a new or significantly improved product in terms of its characteristics or intended uses. It involves the implementation of new features, functionalities, or qualities that differentiate the product from existing alternatives in the market. It is embodied in the outputs of an organization, such as its goods or services even if those products are services (Schilling, 2020).

On the other hand, process innovation is defined as the implementation of a new or significantly improved production or delivery method(OECD, 2005). Process innovations typically aim to enhance the effectiveness or efficiency of production. This can be achieved by reducing defects or increasing the quantity of output within a specific timeframe (Schilling, 2020).

3.3.3. Innovation based on standardization.

As the construction industry strives for continuous improvement, one approach that has gained attention is innovation based on standardization. This subchapter discusses findings about innovation based on standardization from academic literature. This chapter has relevance to the research since what was assumed to happen in the case study is that there is resistance from stakeholders in the case study (PBK) to accept innovation based on standardization.

Two concepts are being merged in the innovation based on standardization, that is innovation and standardization. Standardization is concerned with the extensive and repetitive use of a solution that deals with recurring problems, being applicable to both product and process modularity (Viana et al., 2017). In other words, it is the degree to which activities in a form can be performed in a regular manner (Schilling, 2020). It is also the process of developing and implementing established frameworks and guidelines for products, services, or processes that involves creating a common language and framework for testing, validating, and communicating new ideas (Okrepilov, 2015). Standards play a crucial role in facilitating innovation by establishing a shared framework and defining the rules of the game. They provide common vocabularies, set essential product/service characteristics, and identify best practices within ecosystems, leading to fruitful outcomes (Shin et al., 2015).

Combining both concepts, this research defines innovation based on standardization as:

> *"A creative and strategic implementation of novel or significantly improved products, processes, marketing methods, or organizational practices with a structured framework of established guidelines and common approaches. It involves harnessing the power of existing standards and standardized solutions to address recurring challenges and achieve consistent and repeatable outcomes. The approach leverages the utilization of standardized solutions to drive efficiency, compatibility, and reliability while introducing inventive elements that enhance value, differentiation, and adaptability".*

Another term that has a strong relation to this concept is industrialization or industrialized construction. Industrialized construction is a set of construction methods that advances the process from design through construction by employing intelligent manufacturing and automation techniques (Qi et al., 2021). This term refers to the use of prefabricated components and standardized processes in the construction industry to increase efficiency and sustainability.

The term industrialized construction has a strong relation to the concept of standardization, but not to the concept of innovation.

There are many potential benefits of utilizing innovation based on standardization such as an increase in productivity, improvement in working conditions, better quality, reduction of construction waste, and higher sustainability performance (Viana et al., 2017). Modularity as one of the innovations based on standardization example is a key enabler of mass customization, which seeks to simultaneously achieve two seemingly conflicting goals which are high product variety and high volume, by delivering products that fulfil the specific requirements of different customers through flexible process and organizational structures. Additionally, the delivery of buildings is tailored to specific requirements.

3.3.4. Diffusion of innovation

The diffusion of innovation theory is an established theory developed by Everett Rogers that refers to the spread and adoption of innovation in a society or social system(Rogers, 2003). Rogers defines diffusion of innovation as "the process by which an innovation is communicated through different channels over time among the members of a social system"(Rogers, 2003). The theory proposes that in a social system, the adoption of innovation does not happen simultaneously but rather a process where some people are more apt to adapt than others. Normally, the initial groups of adopters are relatively small, and the adoption of innovations follows a bell-shaped curve (as can be seen in Figure 3-1) (Rogers, 2003). A classification of different groups of individuals based on their willingness to adopt new innovations is listed below (Rogers, 2003):

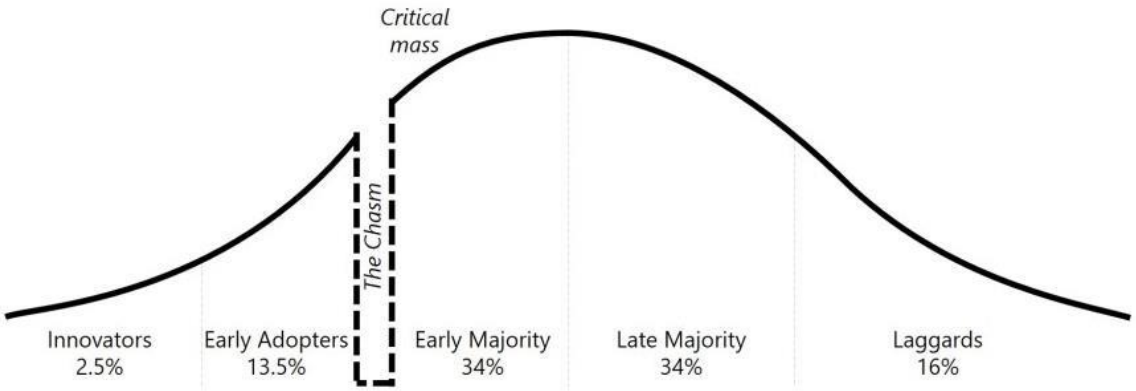

Figure 3-1. Diffusion of innovation (Rogers, 2003)

a. Innovators: First individuals to adopt a new innovation. Characterized by their adventurous and risk-taking nature, frequently searching for novelty and open to experimentation. Typically, these people are well-informed, have a high tolerance for uncertainty, and are willing to invest both resources and time in exploring the latest idea. Innovators play a crucial role in introducing innovations to the rest of society.
b. Early adopters: Individuals with high influence who adopt innovations after the innovators. Early adopters are respected members of their social networks that often occupy leadership roles or have high social status. They have a high interest in new ideas with quick recognition to the potential benefits of an innovation. Their adoption acts as a mark to others, creating a sense of social proof and accelerating the diffusion process.
c. Early majority: Represent most of the population that tend to adopt innovation once the path has been paved by the early adopters. This group are cautious and deliberate in their decision-

making process and rely on the experiences and recommendations of the early adopters. They place importance on social norms and seek a certain degree of acceptance before adopting an innovation.

d. Late majorities: Adopts an innovation after most of the population has already done so. Late majorities are more sceptical and resistant to change compared to the early majority. This category of people waits until the benefits of an innovation are well established, and the risks associated with non-adoption become clear. They frequently adopt because of peer pressure and practical considerations.
e. Laggards: last group to adopt an innovation. Laggards have a high resistance to change and are typically traditionalists. They often have a low socioeconomic status, limited exposure to new ideas, and may feel threatened by technological advancements or social shifts. This category of people may adopt an innovation only when it becomes an absolute necessity or when the previous method is no longer viable.

The transition from early adopters to the early majority is one of the most difficult processes in the diffusion of innovations and is known as "crossing the chasm" in the scientific literature (Moore, 2001). Crossing the chasm exists because there is a difference between the characteristics of early adopters and the early majority (Moore, 2001). Early adopters perceive the potential of innovations to help them achieve a particular vision, whereas the early majority must be persuaded that the innovation will meet its current needs (Moore, 2001).

3.3.5. Innovation Decision-Process

Roger Diffusion of Innovation theory gives a framework for understanding why new ideas and technologies are presented and integrated (or not) into an organization (Roberts et al., 2021). In this theory he called the Innovation decision process, he also proposes a model to illustrate the decision process of innovation (Rogers, 2003). The model can be utilized to understand and study how individuals or organizations in different contexts make decisions regarding the adoption of innovations (Rogers, 2003). As can be seen in Figure 3-2. Innovation decision process, the Innovation Decision Process consists of five stages, which are:

a. Knowledge: Individuals become aware of the innovation and gain information about its features and benefits through various sources (e.g., media, personal networks). The level of knowledge about innovation can vary among individuals, which plays a significant role in shaping their next decision-making process.
b. Persuasion: individuals develop attitudes and form opinions, evaluating advantages, disadvantages, risks, and benefits, and considering how the innovation aligns with their needs and goals. In this phase, the model acknowledges the role of psychological factors in the decision-making process such as perceived relative advantage, compatibility, complexity, and social influence (Roberts et al., 2021). This stage usually occurs through interactions with opinion leaders, influencers, or through marketing efforts.
c. Decision: individuals commit to either adopt or reject the innovation. They assess the innovation based on information they have gathered while also considering their personal beliefs, preferences, and values.
d. Implementation: individuals move into this stage once they have decided to adopt the innovation. This entails taking actionable steps to put innovation into practice, which may involve getting the appropriate resources, learning new skills, or altering existing systems to accommodate the innovation.
e. Confirmation: after an innovation has been adopted and implemented, individuals evaluate the outcomes and consequences of their decision. Individuals evaluate whether the innovation met their expectations, delivered the anticipated benefits, and if it created value or utility.

Positive experiences may benefit and strengthen the decision to adopt, while negative ones may result in dissatisfaction and reconsideration of the decision.

Rogers (2003) argued that the main factors that influence decision-making are the characteristics of the decision-making unit and the characteristics of the innovation. However, decision-making units might include a variety of individuals with different speeds and willingness to adopt (Hofman, 2020). Some could be categorized as an innovator, while others could be part of the late majority. For this reason, they should be approached differently to improve the innovations' chance of success (Moore, 2001).

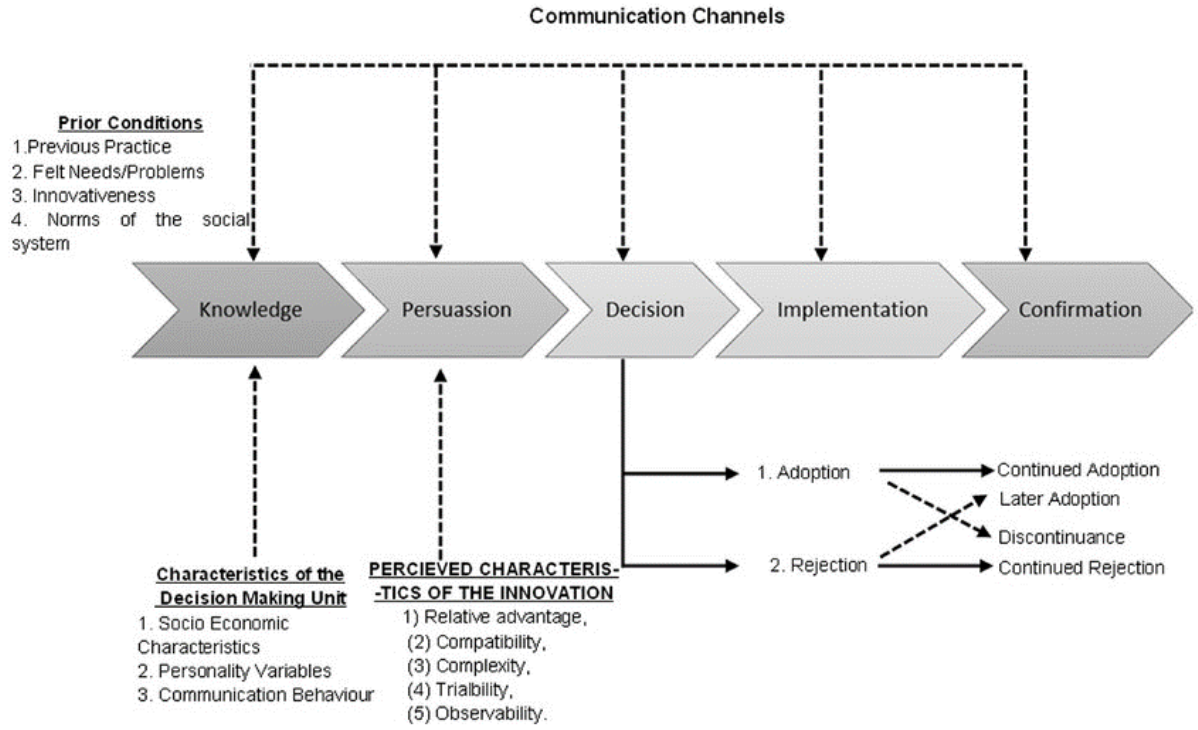

Figure 3-2. Innovation decision process (Rogers, 2003)

3.3. Programme

The following section will provide the theoretical framework for a programme that is derived from academic literature. Programme is one of the relevant concepts for this research, as the research intends to understand innovation acceptance in a construction programme.

3.3.1. Definition of a programme

A programme plays a crucial role in the realm of project management, serving as a framework for grouping existing projects or defining new ones, and facilitating the coordination of activities to achieve a set of major benefits. The academic literature provides a variety of definitions of programme. For instance, a program is referred to as a change action (i.e., projects and operational activities) that is put together on purpose to achieve strategic or tactical goals (Thiry, 2002), A temporary, flexible group set up to coordinate, direct, and oversee the implementation of a set of related projects and activities in order to reach the organization's strategic goals and deliver results and benefits (OGC, 2011), or a framework to group existing projects or making a new one to focus all the activities needed to achieve large benefit (Pellegrinelli, 1997). This research utilized the programme definition established by the Project Management Institute, large number of literatures defined it similarly (Lycett et al., 2004; Pellegrinelli et al., 2007; Rijke et al., 2014; Shehu & Akintoye, 2009):

"A programme is a group of related projects, subprograms, and programme activities managed in a coordinated way to obtain benefits not available from managing them individually" (Project Management Institute, 2017b)

Programmes are increasingly being adopted to implement organizational transformational strategies and integrate multiple projects. Programmes exist to create value by improving the management of projects in isolation (Pellegrinelli et al., 2007). Thus, while they create benefits through better organization of projects, they do not in themselves deliver individual project objectives.

3.3.2. Programme management

Programme management is more than a scaled-up version of project management, as programmes also contain aspects that are outside the scope of individual projects within a programme (Lycett et al., 2004). Whilst project management is typically focused on performance in terms of quality, cost, and time, programme management operates more on a strategic level to create synergies between projects and deliver a package of benefits through the coordination of a series of interconnected projects (Lycett et al., 2004). Programme management requires a different approach than project management takes a broader organizational scope and considers the interactions between projects (Rijke et al., 2014).

Traditionally, programme management is viewed as an extension of project management focusing mainly on the definition, planning, and execution of a certain objective (Lycett et al., 2004; Pellegrinelli et al., 2007). The modern view that stems from strategic planning however sees a broader role to programme management in terms of value creation for the organizations that are involved beyond the performance of projects in a certain programme (Thiry, 2002).

Programme management provides a framework that integrates and reconciles competing demands for resources, providing a context and control framework for the projects of the programme (OGC, 2011). It often involves changes to the culture, style, and character of organizations. The environment in programme management is complex as it consists of multiple stakeholders with different views and conflicting needs, while emergent inputs always influence the process (Thiry, 2007). Processes that can be applied in project management often cannot be applied easily to programme management, as programmes frequently have a finality that cannot be defined clearly and require a process that is both cyclic and aimed at reducing ambiguity.

3.3.3. Characteristics of a programme

This subchapter provides a short explanation of the characteristics of programmes that are found in academic literature.

- Consisting of multiple interrelated projects: a programme consists of multiple projects that run in parallel or (partly) sequential (Lycett et al., 2004; Project Management Institute, 2017b). The integration between projects enables synergies through better planning and coordination of projects and through better prioritization of projects (Pellegrinelli, 1997). The synergy through programme might lead to innovative solutions that may not be achievable through individual projects that operate in isolation.
- Knowledge transfer and learning: programmes facilitate knowledge transfer and learning across projects (Lycett et al., 2004). Lessons learned, best practices and innovative ideas can be shared and disseminated better within a programme environment.
- Sharing common resources: a programme has a characteristic of sharing (revolving) resources from one project to another in a programme (Lycett et al., 2004; Shehu & Akintoye, 2009). This is done to maintain quality, ensure a steady supply of workforce, and make knowledge management more effective.

- Life cycle: the life cycle of a construction programme differentiates it from a project by its pattern of activities over time (Pellegrinelli, 1997). Unlike a project with a clearly defined deliverable and finite time horizon, a programme follows a looping or cyclical process. A programme begins with the phases of definition and planning, moves into project delivery, and then progresses to renewal and dissolution (Pellegrinelli, 1997; Thiry, 2007). This cyclic nature allows for the assessment of benefits, evaluation of emerging opportunities, and pacing of the programme's progress. By operating in waves, the programme can adapt to changing circumstances and ensure ongoing effectiveness (Thiry, 2007). The five phases of a programme, as described by (Pellegrinelli, 1997) include initiation, definition and planning, project delivery, renewal, and dissolution.

3.3.4. Innovation partnership within a programme

One of the ways to develop and implement innovation is by utilizing innovation partnership as its procurement procedure (Lenderink et al., 2022b). The innovation partnership is a relatively new method that is used to procure R&D services for the development of solutions for a specific need or problem, and subsequent procurement of one or more of these solutions on a commercial scale (Georghiou et al., 2014). In other words, it is a procedure that is meant for the procurement of innovation.

The innovation partnership has three phases: the competitive dialogue phase, the research and development (R&D) phase, and the commercial phase (PIANOo, 2016). The competitive dialogue includes a suitability assessment, a negotiation procedure, and agreements on intellectual property (IP). In the R&D phase, the innovation is developed whereas in the commercial phase, the innovation is purchased without a tendering procedure. Innovation partnership has a lot of room for choices to be made by the client regarding the organizational structure, costs, and IP of the innovation (PIANOo, 2016). As a result, different innovation partnership procedures may have the same name, but they can vary widely in terms of content. Also noteworthy is that a client can choose to incorporate a clause to end the partnership if it does not seem reasonable for any of the parties to continue the cooperation.

The innovation partnership offers some advantages over traditional procurement procedures. One main advantage is that it leaves ample room for innovation within the market, allowing for the exploration of new and creative solutions (PIANOo, 2016). Additionally, it fosters increased interaction between client and contractor, facilitating a collaborative approach to problem-solving and the development of solutions (PIANOo, 2016). After the R&D phase, the innovation can be purchased without a prior tendering procedure. Aspects like these and the room for innovation and interaction that exist within innovation partnership make this procedure more transparent compared to the other more traditional procedures.

Depending on the extent and degree of innovation, innovation partnership has downsides including lengthy planning and procurement periods (PIANOo, 2016). In addition, the choice of contractors is restricted to the procedure's participants, meaning that market-developed solutions and ideas cannot be incorporated into the innovation partnership at a later date.

Compared to a pre-commercial procurement such as Small Business Innovation Research (SBIR) and Pre-Commercial Procurement (PCP), the innovation partnership differentiates itself by combining the research and development phase with the large-scale purchase of the developed solution (PIANOo, 2016). This means that innovation partnership integrates the pre-commercial and commercial phases into a single procedure. Additionally, pre-commercial procurement offers more flexibility compared to innovation partnerships as specific research and development contracts are not bound by Part 2 of the Public Procurement Act (PIANOo, 2016).

3.4. Formulation of hypotheses

In exploring the intricacies of the acceptance of innovation within the construction programme, a particular focus of this research is to understand the role of uniqueness bias. Uniqueness bias refers to the tendency of individuals within a project-based environment to perceive their projects as distinct, warranting unique solutions and approaches. This phenomenon is assumed to have implications for how innovation based on standardisation is perceived and accepted in the construction programme.

The literature suggests that such bias can influence the decision-making process, potentially leading to resistance against standardized solutions that are considered for perceived unique project requirements. To investigate this phenomenon and its implications in the research context, two hypotheses are proposed. These hypotheses will guide the empirical study, to answer Sub-Research Question 3: "How do the factors that influence the acceptance of innovation based on standardization relate to uniqueness bias?".

- Hypothesis 1 (H1): The presence of uniqueness bias within the development and implementation of innovation based on standardization is recognized by internal or external parties in the programme.
- Hypothesis 2 (H2): The presence of uniqueness bias negatively affects the acceptance of innovation based on standardization in a construction programme.

Both of the hypotheses will be answered by performing semi-structured interviews towards individuals (both internal and external parties) working in the development and implementation of innovation based on standardization. By testing the hypotheses above, the study creates the relationship between uniqueness bias and the acceptance of innovation based on standardization, providing deeper insights into the decision-making process of innovation within the construction programme.

3.5. Conclusion

Within this chapter, information is gathered from academic literature on the concepts related to the research. First, information about uniqueness bias is gathered starting from behavioural science. This is because the concept was first established in that area of study and there is very minimal information about the influence of uniqueness bias both within the innovation acceptance and in the project management area. From behavioural science, uniqueness bias is defined as the tendency of individuals to perceive themselves or their actions as more unique and special than others, where those who perceive themselves as such tend to compare themselves to others in a way that enhances their self-image or social status. In project management, uniqueness bias refers to the tendency of planners and project managers to view their projects as singular and unique, often neglecting to learn from previous projects or compare their plans to existing knowledge. This bias is said may inhibit knowledge transfer by overlooking valuable insights from similar completed projects, and a tendency to reinvent the wheel.

On the concept of innovation, this research adopts the definition of innovation from OECD, where innovation is an implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. This research categorises the type of innovation as process, product, incremental, and radical innovation. For innovation to be implemented in a social system, a theory about the diffusion of innovation is presented, stating that the adoption of innovation does not happen simultaneously but rather a process where some people are more apt to adapt than others. Normally, the initial groups of adopters are relatively small, and it follows a bell-shaped curve, where the theory categorizes five different groups of individuals based on their

willingness to adopt new innovations. The theory of innovation-decision process by (Rogers, 2003) is also presented, where it states that the main factors that influence decision-making are the characteristics of the decision-making unit and the characteristics of the innovation, where the decision-making unit might include a variety of individuals with different speeds and willingness to adopt.

Theory about programme and programme management is also presented here, where this research defines a programme as a group of related projects, subprogrammes, and programme activities that are managed in a coordinated way to obtain strategic benefits that would not be available if the projects are managed individually. A programme exists to create value by improving the management of projects in isolation. Programme management on the other hand provides a framework that integrates and reconciles competing demands for resources, providing a context and control framework for the projects within the programme. Programme management demands changes in the culture, style, and character of an organization.

The concept of innovation partnership, as one of the ways to procure innovation is also presented. The procurement method typically has three phases: competitive dialogue, research and development, and commercial phase. Compared to traditional procurement procedures, the innovation partnership offers some advantages from providing ample room for innovation within the market, increasing interaction between client and contractor, and facilitating a collaborative approach to problem-solving and development of a novel solution.

Based on the literature provided, two hypotheses aimed at dissecting the role of uniqueness bias in the acceptance of innovation within the construction programme are formulated. Hypothesis 1 states that the presence of uniqueness bias in the development and implementation of standardized innovation is recognized by internal or external parties, and Hypothesis 2 suggests that this bias negatively impacts the acceptance of such innovation. The validation of these hypotheses is achieved through semi-structured interviews with relevant internal and external stakeholders that are involved in the development and implementation of innovation based on standardization.

In conclusion, the literature review proved that there has not been any research that tries to understand the influence of uniqueness bias on the acceptance of innovation, and even more within the context of a construction programme. The large research gap demands more exploratory research to understand the nature of uniqueness bias.

Chapter 4:

Document review and Exploratory interview results

This chapter presents the findings from both the document review and exploratory interviews, aiming to answer SRQ-1: "What is the process of innovation acceptance in a construction programme?" First, the results from the document review are shared, providing an overview of the selected case study, *Programma Bruggen en Kademuren* (PBK), including its background, organizational structure, and contracts.

Following this, the insights gained from exploratory interviews are presented, explaining the process of innovation development and the stakeholders involved in the process. Understanding the programme and how innovation develops helps in creating specific criteria for semi-structured interviews. It also helps in forming questions to understand how the uniqueness bias influences innovation acceptance within the programme.

4.1. Document review result

In this section, the findings from the document review are shared. A list of the reviewed documents and their corresponding codes is available in Section 2.2.1 Data collection: document review.

4.2.1. Programma Bruggen en Kademuren (PBK)

Background of PBK

Historically, Amsterdam has always been connected with its waterways. The city has hundreds of historic bridges and quay walls linking its various districts and neighbourhoods. Many of these structures, some of which were built centuries ago, were designed for significantly lighter traffic than what they bear today. As a result, these structures are now approaching the end of their lifespan and are in varying states of disrepair.

Due to the size of the assignment, the usual project-based way of working is not sufficient. That is why, the *Programma Bruggen en Kademuren* (PBK) is tasked to assess these structures. Its core mission is to ensure their safety, maintain their historical integrity, and when necessary, renew them [DR3MS]. While executing these tasks, the programme places significant emphasis on preserving the city's accessibility and the quality of life for its residents.

Programme's goal

Driven by its main mission to build a resilient city with bridges and quay walls that are both safe and future-ready for present and future generations, the programme has four goals [DR4PP]:

- Guaranteeing the safety and functionality of the bridges and quay walls.
- Ensuring a functioning city throughout the assignment.
- Create a realisable programming before the renewal task.
- Optimizing, innovating, and evaluating processes and working methods.

Programme's scope

The bridges and quay walls programme have in its scope approximately 855 road bridges and 212 kilometres of quay walls spread across the entire city of Amsterdam [DR6PR]. By tackling the structure on a large scale, the programme sees which overarching themes and bottlenecks cause complexity and delays in the delivery. The programmatic approach makes it possible to

continuously improve ongoing work and address these themes across projects and with stakeholders.

4.2.2. Programme's organization

PBK is an ongoing construction programme operating under the jurisdiction of the Municipality of Amsterdam [DR3MS]. This programme, alongside other construction programmes, is situated in the space and economy department, alongside the Municipality's engineering bureau.

Departments within the programme

PBK comprises four main departments: strategy and development; data, recovery, and urgent team; preparation; and realization [DR1AP].

1. Strategy and Development
   The strategy and development department are responsible for establishing the macro-level direction of the programme. The department ensures transparent communication by providing periodical updates to both internal stakeholders and the public. This department is where the Innovation and Quality team resides, which is responsible for exploring innovative ideas within the programme through living labs.
2. Data, Recovery, and Urgent
   The data, recovery, and urgent department is mainly responsible for assessing, monitoring, and evaluating the condition of the structures within the programme scope. Through their evaluations, they provide insights into the lifespan of the structure and the necessary interventions, which could range from minor repairs to a complete reconstruction, depending on the state of the asset.
3. Preparation
   The preparation department ensures that all prerequisites for a project are in place before construction begins. Their responsibilities encompass managing the stakeholders within the location, especially with local entities like houseboats and citizens, and the acquisition of relevant permits and contracts required to start a project. The result of their preparation typically is a "project chart", which will be provided to the realization department to start the project.
4. Realization
   Tasked with project execution, the realization department manages both traditional and innovative partnership-based projects. In collaboration with a variety of external partners, this department oversees a project's entire trajectory, from its initial design phase until its completion.

Living labs

To explore innovative solutions applicable to bridge and quay walls in Amsterdam, PBK established a living lab. A living lab is an organization formed within PBK under the supervision of the innovation and quality team (see Figure 4-1). It serves as a platform for exploring new ideas through both innovation partnerships and identifying innovation opportunities in the regular work [DR3MS]. Living labs collaborate with market parties and knowledge institutes, creating a triple helix shape [DR3MS]. In certain cases, it includes additional stakeholders such as citizens and experts, forming a quadruple helix model. In the living labs, the programme focuses on innovative, non-validated solutions that are currently not available as such on the market (e.g., new products, process, services, or application of existing techniques coming from another sector) [DR3MS]. PBK has set up five distinct living labs based on specific themes, each focused on exploring innovative solutions for the construction programme which are monitoring and sensor, test, logistics, renewal, and life extension [DR3MS]. However, as of 2022, some of the labs

merged, resulting in only three living labs right now which are the monitoring and sensor, renewal, and life extension (Gemeente Amsterdam, 2022).

Within a living lab, there are a lot of ideas being explored. When a certain living lab decides to develop an innovative idea even further, it would need to perform more tests on the idea's feasibility, scalability, and performance. To do this, the living lab creates a smaller organization that focuses on developing one specific innovation called a field lab [DR3MS].

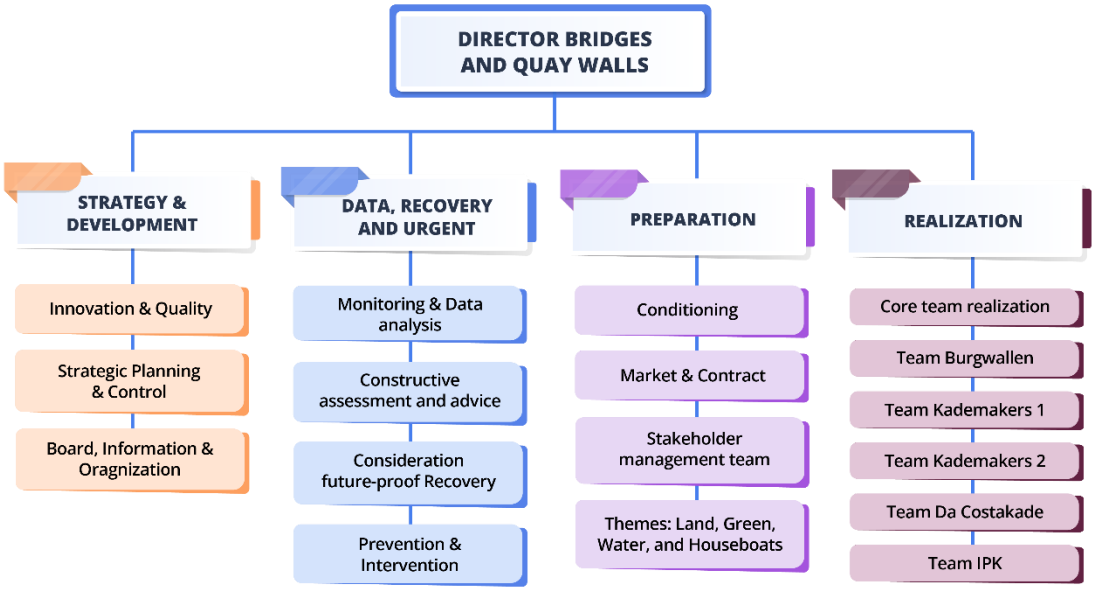

Figure 4-1. PBK organizational structure (adapted from [DR8OP])

Field lab

A field lab is a smaller organization that is composed of individuals with a strong connection to the innovation being developed. The field lab's primary role is to test the performance, feasibility, and scalability of the innovations [DR3MS]. Successful validation ensures that these innovations can be seamlessly integrated into a multitude of forthcoming projects, thereby amplifying the programme's innovative reach and impact.

The field lab brings together a multi-disciplinary team. It typically includes members from the originating living labs, the innovators who could be from various domains (e.g., market parties, academic institutions), and a key member called the production team [DR3MS]. The production team is comprised of a mix of individuals from different departments within PBK and the municipality's engineering bureau, specifically individuals from the realization departments. These are professionals who are involved in the ongoing traditional projects.

The production team is a key member since typically, a field lab necessitates a tangible location for innovation testing, and this often translates to parallel operation with ongoing traditional projects. The reasons why it is operated in parallel with the ongoing projects are twofold. First, as mentioned previously, a field lab usually requires physical space for assessing and developing innovation [EI01]. Secondly, the professionals driving the traditional projects, particularly those at the operational level, provide the foundational know-how and have a direct stake since any developed innovation would potentially be implemented in their very projects [EI01].

Usually, the establishment of a field lab starts with an innovation pitch, where individuals from the living lab articulate the potential benefits of the innovation to all potential field lab members. If perceived positively, all the stakeholders, including the production team, assimilate the field lab, providing the groundwork for parallel innovation development. However, if declined, the living labs might escalate the matter to higher management, ensuring the best decisions for the programme's broader objectives [EI01]. The details regarding the development process of innovation within the programme are explained in the next sub-chapter: development of innovation within the programme.

4.2.3. Partnership with market parties

Market parties are involved in various types of work within the programme. As the research focuses specifically on the quay wall, this section only explains the partnerships performed by the programme related to the quay wall deliveries. Generally speaking, there are three main cooperation agreements that pertain to the quay wall delivery, which are SOK-IB (Engineering services agreement), SOK Kademakers, and SOK IPK. This section provides brief explanations regarding the three, to give perspective on the type of partnerships being done in the programme.

- SOK-ID: a multi-year collaboration agreement performed between PBK and the engineering consultancy to acquire engineering services [DR2HM]. These services encompass research and conservation advice, programming of renovation work, conditioning and preparation of safety measures and renewal works, and (sometimes) design and supervision of implementation, delivery and transfer of the work. As such, the SOK ID parties collaborate greatly with the preparation and realization department of the programme. This partnership predominantly addresses the programme's traditional delivery.
- SOK Kademakers: a multi-year agreement that is typically performed to carry out the delivery of the quay wall with the contractors [DR1AP]. The services within this agreement revolve around the design and realization of the project. The parties bound by this agreement are in close coordination with the programme's realization department, and their efforts addressed the programme's traditional delivery means.
- SOK IPK: collaboration agreement between PBK and the parties selected for the innovation partnership related to the quay wall delivery. IPK stands for "*Innovatie Partnerschap Kademuren"*, which basically translates as innovation partnership for quay wall. Their assignment consists broadly of innovative research and development, followed by the possibility of applying the innovations on a larger scale within the programme [DR1AP]. Currently, there are three consortia that are working under this agreement. Methods that the consortia being developed are said to have advantages over traditional replacement methods that potentially can preserve more trees, return houseboats more quickly, and less disruption as roads can still remain open to traffic and electric equipment is utilized [DR1AP].

4.2.4. Innovation within the programme.

Innovation within the programme is aimed at realizing the first two of the programme goals which are guaranteeing the safety and functionality of the city and ensuring the city continues to function throughout the assignment [DR3MS]. It is important to note again that the programme realizes its projects both in a traditional and innovative manner. While developing certain types of innovation through IPK, at the same time, the programme performs renewal on some of the most urgent structures by a traditional method. This is done to ensure the optimization of time usage, as innovation within the IPK requires time for its development. At the same time, within the programme, the pursuit of innovation is performed by the living labs, within the innovation and quality team. When there is a decision to develop an innovation, the living labs will get in contact with the realization team of the traditional project, to pitch the ideas. The steps and phases of its development are explained in the result of the exploratory interview, Section 4.2.3.

4.2. Exploratory interview result

In this section, the findings from the exploratory interview are shared. A list of the individuals being interviewed, and their corresponding codes is available in Section 2.2.2 Data collection: exploratory interview.

4.2.1. Related stakeholders in the development of innovation

This section list and explain briefly about stakeholders involved in the development of innovation in PBK. Its role within innovation development is received from information gathered in the exploratory interview. A better understanding of their roles within the development of innovation can be found in the next chapter: Development of innovation within the programme.

Table 4-1: Related stakeholders in the development of innovation within PBK

Stakeholders	Role within the innovation development
Living Lab	- Explores innovative ideas that have the potential to achieve the programme's goal in a more optimal way. - Gather related stakeholders to develop innovation, creating a field lab. This includes operational-level individuals who work within the realization team to deliver projects in a traditional manner. - Gather potential stakeholders who might be interested in owning or funding the innovation. This may come from departments within the Municipality of Amsterdam, or even external parties, depending on the type of innovations. - Monitor the development progress of innovation and inform the evaluation of the programme's director.
Internal parties - Realization department – Traditional project delivery team	- Provides place for innovation development. - Have authority on whether to accept or reject innovation development within their project location. - Around 10% of the traditional project budget goes into the development of innovation. - When this stakeholder accepts a plan for innovation development, they will essentially be the one who leads the development, from the testing ground phase to the transition phase, through a team called "production team". - This stakeholder will be the one who implements the innovation once the development is finished.
Internal parties - Realization department - IPK Team	- Monitor the development progress of innovation being developed by consortia that won the innovation partnership contract.
External parties – SOK ID	- Collaborate with the preparation department and traditional project delivery team for the realization of projects. - One of the stakeholders that might come up with an innovation, which will be informed to the living lab to be explored further. - When the realization department decides to pursue a pilot project for innovation, these stakeholders are involved in the development of the innovation as well.

External parties – IPK	- Develop their innovation within a location that is different from the traditional project location. - Perform the testing ground by themselves and inform the progress of the realization department – IPK team. - When the pilot project is finished and the development is successful, this stakeholder will implement the innovation on a larger scale within the projects on the programme.
Municipality of Amsterdam Asset manager	- Owner of the structures, who will eventually manage the structures once the project is finished. - One of the potential stakeholders who fund the innovation. - Establish requirements for the project before it starts.
Knowledge institutes	- Assists living labs, along with other stakeholders in performing research to test the feasibility and performance of certain innovations. - One of the stakeholders that might come up with an innovation, which will be informed to the living lab to be explored further

4.2.2. Development of innovation within the programme

Generally, there are four phases within the innovation process in PBK. The first phase is the initiative phase, where ideas are explored in various ways within the living lab. If an innovative idea is perceived to have potential within the programme, living labs will create a field lab and the innovation will then be tested first on the testing ground phase. In the testing ground phase, a pilot project is created to test the innovation. If the result of the pilot project is considered to be successful based on certain criteria, it then goes into the transition phase. This phase generally assesses the scalability of the innovation. The last phase that the innovation goes into is the implementation and transfer phase. These four phases apply to every innovation being developed within the programme, including the innovation developed within the innovation partnership.

I. Initiation phase of innovation

The initiative phase explores innovative ideas that can be applied to PBK. Living labs under their designated themes perform this exploration phase. They are the ones who explore innovative ideas by consulting various stakeholders. The sources of where the innovation comes from are two: market-driven and problem-driven, as can be seen in Figure 4-2. Initiation phase (own illustration). For example, one might come from an existing problem when doing the traditional work within PBK, where later the problem is consulted with the market parties. One could also be a suggestion that comes from the market parties themselves, or from knowledge institutes with an interest in trying something new in the programme.

When an innovation is perceived to have potential in the programme, living labs later create a field lab where the innovation will then be tested and developed. As mentioned in the previous sub-chapter, the production team is an essential member of the field lab since they are the one who provides the physical location of the field lab. Additionally, they are also the ones who lead the development of the innovation and eventually implement the innovation when the development is finished [EI01].

For the successful establishment of a field lab, a compelling pitch by the living lab is crucial. This pitch must elaborate on the innovation's benefits for both the specific project and the

broader programme to all potential stakeholders [EI01]. Stakeholder acceptance is paramount, as it directly influences the allocation of a suitable development location for the innovation. Ultimately, this acceptance determines whether the innovation will see the light of day or remain undeveloped. The next three phases deal with the testing and development and are performed within the field lab.

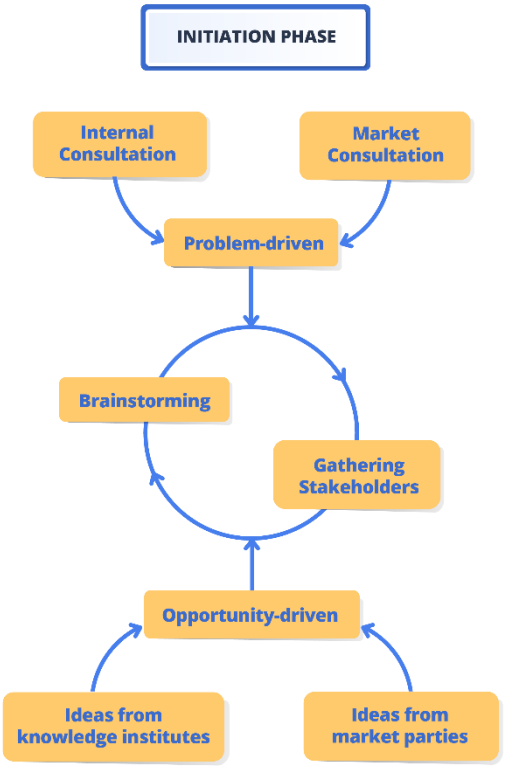

Figure 4-2. Initiation phase (own illustration)

II.Testing ground

The testing ground phase in the innovation process of PBK involves a small-scale pilot project to test the viability of the innovation. The pilot project is happening within the field lab, and such involves all of the field lab members, including members of the living lab, innovators, the production team, and occasionally knowledge institutes and relevant experts.

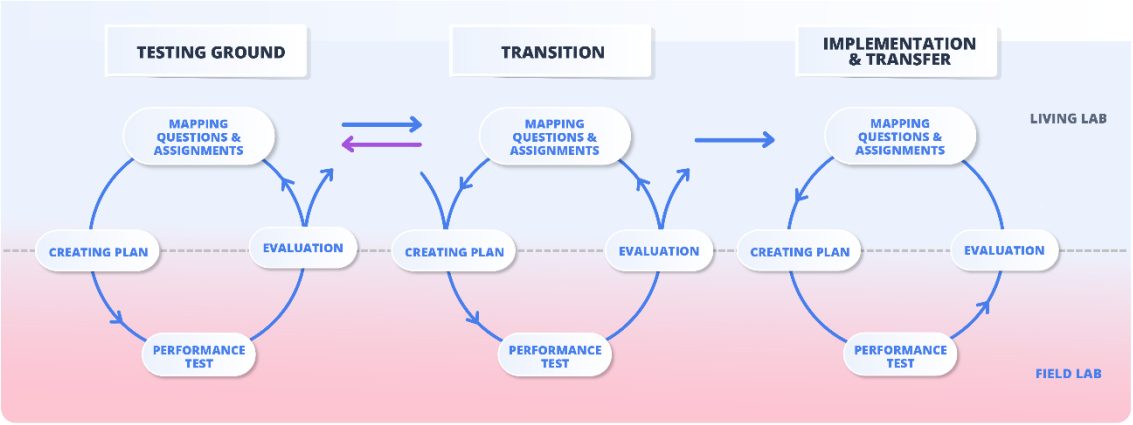

Figure 4-3. Innovation process in PBK (own illustration)

The testing ground, transition, and implementation and transfer phases typically have four main stages of activity, as can be seen in Figure 4-4. The first one is mapping questions and assignments that need to be delivered on the pilot project, a responsibility held by the living lab members. After the questions and assignments are listed, a plan to approach the pilot project is created collaboratively by both the production team of the field lab and the living labs, in conjunction with other relevant stakeholders. The plan is then performed by the production team to assess the performance of the innovation in the location where the production team does their project. Later, after the performance test is finished, an evaluation is then performed. This evaluation is a collective effort both by the living labs and the production team. The result of the evaluation will then determine whether the innovation will go to the next phase or not. In some cases, multiple iterations of this phase may be needed to explore different possibilities for utilizing the innovation.

It is important to note that the stage of the innovative ideas being developed might be different for every case. A certain innovation could already be at a high Technology Readiness Level (TRL) when it started, whereas another might be at a low level. In practice, with an innovation that is already in the high TRL, some activities mentioned previously might be skipped.

Formally, the head of innovation and quality informs the PBK directors about the plan for the testing ground, including the pilot project steps, resource requirements (e.g., financial, time), and evaluation outcomes. The directors are usually informed in the form of a yearly plan or a memo. The directors have the authority to approve or reject the continuation of innovation development, but in practice, they often delegate this decision to the head of innovation and quality. However, complex situations or high investment costs may require the head of innovation to escalate the decision to the directors.

The outcome of this phase is uncertain. The living lab always at least performs a qualitative check on how they expect the outcome of the innovation. With this uncertainty, support, and acceptance of the stakeholders to the innovation play a pivotal role. Negative views from certain stakeholders can impede the process of developing the innovation. The support needed for each innovation might vary. In one case, huge support from a director who wants to pursue using a certain innovation is enough to smoothen the process. On the other hand, that might not be the case.

It is important to note again that the production team has quite a significant informal power when it comes to support and acceptance of innovation. Normally, the field lab for the pilot project is placed in an ongoing project. For the innovation to get a proper place to start the pilot project, the living lab must convince the operational team that works on the ongoing projects regarding the performance and benefit of the innovation, so that they may agree to take part in developing the innovation. This is because the operational team will be the ones who are going to develop and implement the innovation. A strong opposition in this group will have a negative impact on the development of innovation even though they do not necessarily have a formal role to refuse an innovation.

In conclusion, the testing ground phase is a critical step in the innovation process of PBK, requiring collaboration among stakeholders and careful evaluation to determine the feasibility of the innovation before moving forward to the next phases. Stakeholders' support and acceptance have a significant influence on the success of innovation development during this phase.

III. Transition phase

In the transition phase, the innovation is tested for its scalability. The primary goal is to ensure that the innovative ideas being developed can be effectively implemented in as many projects in PBK as possible, aligning with the overall programme goals.

The scaling-up test is conducted within the field lab of the innovation. During this phase, the production team has a higher responsibility as opposed to the living labs. The innovation and quality team within the living lab continues to participate in the process, focusing on monitoring and observing the direction of the innovation's development.

Similar to the testing ground phase, the transition phase consists of four main stages which are mapping the questions and assignments needed for the scaling-up test, devising a comprehensive plan for the test, conducting the test, and evaluating the results. As before, the plan and evaluation results are reported to the PBK director by the head of innovation and quality. If the field lab discovers the necessity to revisit the testing ground phase during this process, the innovation returns to the first phase for further refinement.

The success of this phase indicates that the innovation can be effectively implemented in a majority of the projects within PBK. An innovation is considered to be successful if the result of the scaling-up test is in accordance with the expected performance criteria, and there is enough support from the relevant stakeholders, including the PBK directors.

IV. Implementation and transfer phase

In the implementation and transfer phase, innovations that have successfully passed the pilot project and scalability test are implemented in PBK projects. During this phase, the production team assumes full responsibility and collaborates closely with relevant contractors and/or consultants to ensure the successful implementation of the innovation. This phase also follows a similar pattern to the previous two phases, involving the mapping of implementation questions and assignments, creating a detailed plan, executing the implementation and transfer, and concluding with an evaluation. The process and result of this phase are informed to the PBK director by the production team leader.

During the implementation process, the innovations are thoroughly tested against relevant construction standards. Once an innovation meets the requirements of the standards, it is then transferred to the asset manager within the Municipality of Amsterdam. To ensure optimal maintenance, the asset manager receives detailed knowledge and information about the

innovation, including its description and usage mechanisms. As of January 2023, there is only a limited number of innovations that have progressed to this final phase.

4.2.3. Dynamics within the programme

PBK is no exception to encountering various dynamics. Initially, the programme was envisioned to undertake extensive reconstruction of the bridges and quay walls within its scope [EI02]. However, after more evaluations and research carried out in collaboration with market parties and knowledge institutions, it became evident that the condition of these assets was not as critical as initially believed. As a result, the programme's most of future projects shifted from undertaking complete reconstructions to extending the lifespan of existing structures, resulting in a lower renewal project than what was initially thought.

The COVID-19 pandemic further influenced PBK's trajectory. The pandemic significantly impacted Amsterdam's tourism sector, leading to reduced municipal revenues. This financial strain resulted in a shift in priorities for the city, which eventually reduced the yearly budget of the programme [EI03]. Furthermore, the prevailing material inflation meant that the originally planned works were no longer feasible within the predetermined budget.

4.3. Semi-structured interview criteria

Following preliminary exploratory interviews, this research specifically zooms in on the innovation development phase where resistance to accepting innovation happens. As there are various innovations being developed within the construction programme, the research tries to select one particular innovation as an example of innovation based on standardisation: parametric design. Parametric design as an innovation is being developed in PBK in many segments. First, it is developed as a method to substitute traditional ways of designing. It is also developed by some of the consortia within the innovation partnership. The selection of parametric design as a scope helps the research to perform a deeper analysis for one specific subject, as opposed to a broad one.

With that in mind, the individuals who are prioritized for the semi-structured interviews are those who are involved in the initiative phase and development of parametric design as an innovation. The research also intends to understand the different perspectives of uniqueness between different stakeholders. As such, the individual role should come from a variety of organizational levels, such as individuals working on the strategic level management (e.g., programme director) that has a high-level overview of the organization, tactical level (e.g., head of a certain team) which are the intermediate level, and operational level (e.g., project leader) that focus on the day-to-day running. Adding more, an understanding of how external parties (e.g., contractor, consultant) perceive uniqueness may also be beneficial, hence it is added to the potential candidate as well.

Defining Strategic, tactical, and operational

To understand where the interviewees' (specifically internal interviewees') roles and responsibilities are positioned within the strategic, tactical, and operational levels of the programme organization, the researcher provides the interviewees each the definition and asks them where they think they are located on. Utilizing the definition by Muñoz et al (2012), this research defines the three levels as follows:

- Strategic level: This level focuses on long-term goals and the overall direction of the organization. It is concerned with high-level decisions that shape and guide the organization's overall direction.
- Tactical level: This level focuses on medium-term goals, bringing the gap between strategic and operational levels.

- Operational level: This level is centred around day-to-day activities, short-term goals, immediate problem-solving, and monitoring of daily activities.

Lists of Interviewees

To gather information from individuals who meet the specified criteria, the researcher initially seeks recommendations from the three interviewees during the exploratory interviews. Furthermore, during the semi-structured interviews, the researcher also requests suggestions for potential candidates to interview. **Error! Reference source not found.** presents a list of the interviewees, along with their respective roles and positions within the organizational structure of the program.

Table 4-2: Lists of interviewees for the semi-structured interview

No	Code	Role	Position	Detail
1	R1OL	Project Manager	Operational level	Traditional
2	R2OL	Project Manager	Operational level	Traditional
3	R3OL	Project Manager	Operational level	Innovation
4	R4OL	Design Team	Operational level	Traditional
5	R5OL	Technical Manager (IPK)	Operational level	IPK
6	R6OL	Technical Manager (IPK)	Tactical level	IPK
7	R1TL	Technical Manager (IPK)	Tactical level	IPK
8	R2TL	Technical Manager	Tactical level	
9	R3TL	Technical Manager	Tactical level	
10	R4TL	Technical Manager	Tactical level	
11	R5TL	Head of Conditioning	Tactical level	
12	R6TL	Head of Living labs	Tactical level	
13	R1SL	Director of Realization	Strategic level	
14	R1EP	Programme Manager	External Parties	SOK-ID
15	R2EP	Project Leader	External Parties	SOK-ID
16	R3EP	Project Manager	External Parties	IPK
17	R4EP	Project Manager	External Parties	SOK-ID
18	R5EP	Technical Manager	External Parties	IPK
19	R6EP	Programme Manager	External Parties	IPK

4.4. Semi-structured interview questions

To be able to understand the existence of uniqueness bias on the innovation (based on standardization) acceptance within the programme, the semi-structured interview questions were tailored in a specific way. This is because the researcher cannot explicitly bring out the topic of uniqueness bias, as it would unconsciously make the interviewee tailor their answer towards the topic. This is undesirable, as it would potentially portray or gather unreliable information. A more thorough explanation regarding the selection criteria and the structure of the semi-structured interview can be seen in Appendix C.

General issues within the innovation acceptance

Firstly, the researcher starts by bringing out questions about the interviewee's views in regard to innovation in general on the programme, and what they perceive as challenges within the topic of innovation acceptance. In other words, the starting question does not bring out any related topic about uniqueness bias, expecting that the interviewee may bring up the issues themselves.

Uniqueness of a project and innovation based on standardization.

Afterwards, the researcher explains the study in more detail, stating that its focus is on the innovation based on standardization, and stating that there is an assumption that there is resistance on accepting innovation based on standardization. To this topic, the researcher points out one example of innovation based on standardization, parametric design, an innovation that is developed within a variety of locations in the case study programme. The subsequent questions move deeper into the parametric design, to see the interviewee's perception regarding such innovation, and its feasibility on the programme. The questions can be seen in Appendix C.

The topic then goes into the concept of project uniqueness, and whether the existence of project uniqueness resulted in challenges in developing or implementing innovation based on standardization. This topic is crucial since uniqueness bias by definition is a result of a strong perception of an individual in regard to their project uniqueness, leading them to neglect standard solutions, which in this case is the innovation that promotes standardization. By asking these topic, the researcher expects to gather information regarding the perception of project uniqueness and its influence on innovation acceptance.

Collaboration within the development of innovation and different perceptions of uniqueness.

Lastly, the researcher asked questions on problems the interviewees encountered during the collaboration of innovation development and implementation within the programme. Afterwards, the researcher asks questions on whether the problems the interviewee encountered during the collaboration have a relation towards the different perceptions of project uniqueness. With these questions, the research expects to gather information in regard to the problem during the collaboration of innovation development and implementation in the programme, and whether the variety of perceptions of uniqueness creates issues within it.

4.5. Conclusion

This chapter answers the research's first sub-research question and provides a more in-depth explanation of how the case study programme works, specifically regarding the development of innovation. To answer that, both document review and exploratory interviews were performed. Information gathered from both activities is also utilized to craft the semi-structured interview questions and criteria for the selection of interviewees.

Case study: *Programma Bruggen en Kademuren* (PBK)

PBK is an ongoing construction programme that is tasked with assessing, maintaining the historical integrity, and increasing the lifespan of hundreds of historic bridges and quay walls that link the city of Amsterdam. The programme consists of four main departments, which are strategy and development departments; data, recovery, urgent department; preparation department; and realization department. To deliver the task optimally and quickly while ensuring a functioning city throughout the assignment, the programme combines both traditional and innovative work. This means that while developing innovation, the programme runs projects that deliver the product using traditional methods. The pursuit of innovation within the programme generally can be divided into two, from exploring and developing innovation internally through the living labs and field lab, and through a special procurement method called innovation partnership (*Innovatie Partnerschap Kademuren*, or IPK).

Within the development and implementation of the programme, there are several stakeholders involved. Within the programme, a designated place is required to develop an innovation. The development of innovation internally from the living labs will take place in parallel with the

ongoing traditional project, while the innovation developed within the IPK will have its own designated place. For the innovation developed internally to be able to take place in an ongoing traditional project, it has to include workers (e.g., project managers) from the project to join the innovation development. People within the ongoing traditional project can give a rejection, for example when they see that the innovation would not benefit their project, or when they see that the innovation impacts the project negatively. Within this process, knowledge institutes will support the process of innovation development by offering their research expertise.

Generally, in the programme, there are four phases of innovation development. First, ideas are explored within the initiative phase. When an idea is perceived to have potential by the innovation team, a field lab consisting of a variety of stakeholders is established to develop the innovation. A testing ground phase is where a pilot project of the innovation is carried out within the field lab location. When the testing ground phase is successful, the innovation goes into the transition phase where a scaling-up test is performed to see whether the innovation can be applied optimally on a larger scale or not. Afterwards, the innovation is implemented in the projects within the programme and then will be transferred to the asset manager of the structures.

Like any other programme or project, it also experiences a variety of dynamics. For PBK, initially, the programme was expected to do many renewal projects. However, after some evaluation, the condition of the assets within the scope turned out to be not as severe as initially thought. Together with the material price inflation and the COVID-19 pandemic, the priority of the programme shifted from a complete renewal to more on extending the life of the asset.

Process of innovation acceptance in a programme

The process of innovation acceptance within the case study programme aligns with several aspects of Rogers' (2003) Innovation Decision Process. This theory delineates the decision-making process of adopting innovations into five phases: knowledge, persuasion, decision, implementation, and confirmation. The case study, however, adapts this process to suit the construction industry's specific needs. Unlike commercial products, construction innovations often necessitate development before adoption. Consequently, the programme introduces an additional 'development' phase to the standard innovation-decision process. The sequence thus changes: knowledge, persuasion, decision, development, implementation, and confirmation. This extra phase reflects the complexities and customization required in construction innovations, diverging from Rogers' linear model while still adhering to its fundamental principles. One notable complexity is the potential for failure during the development phase.

Moreover, the case study highlights the simultaneous occurrence of the knowledge and persuasion phases in the initiation phase of innovation development. Stakeholders with diverse backgrounds and interests are brought together and persuaded to participate in the innovation's development within the programme. These stakeholders, possessing varying levels of knowledge about the innovation, represent the different categories of adopters, ranging from Innovators to Laggards in Rogers' theory. One example is the living lab, a stakeholder that typically initiates the innovation development. This stakeholder which is responsible for exploring novel ideas that can be implemented within the programme might be highly likely to fall into the category of innovators within the Innovation Diffusion Theory. On the other hand, individuals working in the operational level of the programme’s organization, one’s who are actively involved in the technicality of a project, may have a more risk-averse nature and opt for a method of work that has a higher certainty. This characteristic of a behaviour may fall into the category between early majority, or late majority, in the Innovation Diffusion Theory. In summary, each stakeholder contributes unique perspectives, significantly influencing the collective decision-making process.

Semi-structured interview

The result of the document review and exploratory interview concludes that the development of innovation within a programme involves stakeholders from various backgrounds, knowledge, and responsibilities. This means that each stakeholder may have different views and attitudes towards the idea of developing certain innovations. Reflecting these findings, the semi-structured interview selects interviewees from various organizational levels (i.e., strategic, tactical, and operational) and external parties to capture diverse perspectives on the adoption of innovation. To help understand the resistance regarding innovation based on standardization, this research utilizes parametric design as an example. Parametric design is selected as an example of innovation based on standardization because, within the case study, such innovation is being developed in a variety of places, both internally within the living labs and also in the innovation partnership. Recommendations for interview candidates are sought during both exploratory and semi-structured interviews, to examine factors that influence the acceptance of innovation based on standardization and uniqueness bias across a variety of stakeholders.

Lastly, the semi-structured interview questions are crafted to explore the underlying presence of uniqueness bias in the acceptance of innovation based on standardisation within the programme without directly mentioning the bias, thereby avoiding influence on the interviewees' responses. By first discussing general attitudes toward innovation and its challenges, and then focusing on parametric design, the interview gradually directs interviewees to consider the impact of project uniqueness on the adoption of standardized innovations.

Chapter 5

Results

This chapter presents the result of the thematic analysis performed on the transcript of the semi-structured interviews. A total of 19 interviews were performed, consisting of six individuals from the operational level, seven individuals from the tactical and strategic level, and six individuals coming from the market (external parties). This chapter intends to answer two sub-research questions, which are SRQ-2: "What are the factors that influence the acceptance of innovation based on standardization?", and SRQ-3: "How do the factors that influence the acceptance of innovation based on standardization relate to uniqueness bias?".

As mentioned in Chapter 4, in order to answer both SRQ-2 and SRQ-3, questions for the semi-structured interview are categorised into three sections. By the nature of the questions, findings gathered from the semi-structured interview would not only revolve around uniqueness bias and innovation based on standardization but also about issues related to the acceptance of innovation in general within the programme. Consequently, this chapter divides the findings into two parts. Part 1, detailed in section 5.1, presents results and analysis related to the findings on the concept of uniqueness bias and innovation based on standardization within the programme. Part 2, in section 5.2, presents results and analysis about the acceptance of innovation in general within the programme. Afterwards, based on the findings, the existence of the uniqueness bias within the innovation acceptance in the programme is discussed in section 5.3. Next, important findings will be categorized to craft a preliminary framework which will be discussed more in the next chapter. Finally, a conclusion for this chapter is presented.

5.1. Part 1: Uniqueness bias, and innovation based on standardisation.

This section provides results related to uniqueness bias and innovation based on standardization from the thematic analysis performed on the semi-structured interview. To know whether the findings have a correlation with both concepts, definitions of uniqueness bias and innovation based on standardization from Chapter 2 are utilized. The findings will be divided based on the three sections of the semi-structured interview, which are: general issues within the innovation acceptance, uniqueness of a project and innovation based on standardisation, and collaboration within the development of innovation and different perceptions of uniqueness (See more in Appendix C)

5.1.1. General issues within the innovation acceptance

In the first section of the interview, the researcher asked several general questions regarding the interviewee's perception towards innovation and their perception of what the current challenges within the innovation development and implementation in the programme are. In this section, it is yet to be addressed any related concepts towards uniqueness bias, based on the assumption that the interviewee might independently raise these issues, allowing for the collection of untailored responses. However, within this section, not one single issue related to the uniqueness, or uniqueness bias was presented by all of the 19 interviewees. Answers that the researcher gathered instead were issues related to innovation in general, from the dynamics of the programme (i.e., scope and budget reduction), the high number of stakeholders involved within the programme, and many others. As the gathered findings were not discussed in relation to uniqueness bias and innovation based on standardization, but more on issues related to the acceptance of innovation in general within the programme, it will be explained further in Part 2.

5.1.2. Uniqueness of a project and innovation based on standardisation.

As a brief review, within this section, the topic of project uniqueness was brought up by stating that by definition, a project is a temporary endeavour to create a unique product, service or result (Project Management Institute, 2017a). The researcher then asked what in the interviewee's perception makes one quay wall project apart from the other, within the context of the case study programme. The project's uniqueness is then linked with the pursuit of a standardization approach within the programme, and the researcher asked whether the uniqueness of the project poses challenges in the pursuit of standardization. The researcher also brought up one example of innovation based on standardization that is developed within the programme: parametric design and asked the interviewee's perception of that particular innovation towards the programme.

Difference between one quay wall project from another in the case study

Based on the interviews, aspects that differentiate one quay wall from another within the programme were acquired. These aspects are:

- Quay wall dimensions (i.e., height, depth, width)
- Location
- Soil properties
- (Monumental) trees
- Water sewage, cables, and pipes
- Aesthetics of the quay wall
- Stakeholders involved (e.g., houseboats, restaurant owners, or related departments within the Municipality of Amsterdam)

Higher uniqueness due to lower work volume

Several interviewees pointed out that due to changes in the programme scope which resulted in a lower work volume, the pursuit of innovation based on standardization is not as fruitful as what was initially thought. This is because the lower the number of structures (i.e., quay wall) within the scope, the lesser the repetitive work would be, which eventually more custom work. As generally developing innovation based on standardization requires some capital, the attempt to standardize with the reduction of scope is seen as counterproductive as the pursuit potentially complicates the process rather than streamlining it.

One of the interviewees suggested that quay walls that are suitable for the standardized approach, for instance, parametric design, are those that have similar characteristics and are relatively long. Those “ideal” structures are stated to have been taken up by the consortia within the innovation partnership (IPK) [R1OL]. This means that other quay walls left have relatively unique characteristics that make the pursuit of standardization impractical or costly.

The pursuit of standardization by innovation generally can be profitable when there is a large amount of work volume. And for the market parties, profit is their priority. This is supported by three of the market parties being interviewed [R3EP, R4EP, R6EP]. Two mentioned that a plan for pursuing innovation based on standardization was initially within their proposal. One of the interviewees from the market parties stated that in their company, they had developed parametric design quite far, but did not propose the idea further since they did not see any good business case in doing so due to the reduced scope [R4EP]. Other external parties that still pursue parametric design within the innovation partnership consortia utilized parametric design not as much as what they initially proposed, stating that the variability in the underground aspects of the quay

walls (i.e., water sewage, cables, and pipes) is too large and developing a parametric design to a point where it would cover all of the uniqueness would cost too much investment [R6EP].

"We never pitched it (parametric design) because of all the changes from when the programme started. From our bureau, we are already a few steps further in terms of its (parametric design) development where we also integrate Artificial Intelligence into it. When the programme started the scope within the contract was very large. We thought it would be interesting to add it. So, we wanted it, but now there is not enough work. The scope is less. So, we never made a pitch. I think it's only mentioned in our initial plan". [R4EP]

Standardization pursuit reduces freedom in control of a project.

Three interviewees coming from the strategic and tactical levels of the programme organization expressed that within their experience working on the project, they experienced resistance in some of the operational levels when trying to implement or develop innovation based on standardization [R1SL, R5TL, R6TL]. The resistance is stated to come from the perception that the standardization approach diminishes the project manager or planner's control over their project. It is stated that people value the ability to control project elements highly. This control is associated with fostering creativity, while standardization is often seen as limiting. One of the interviewees compared standardization to working in a factory, deeming it repetitive and boring.

This attitude could be reflective of the work culture at the Municipality of Amsterdam, which seems to prize a high degree of freedom in the workplace. An instance provided by an interviewee involved a significant quay wall project run by the maintenance department but not integrated into the broader programme. When an idea was proposed to incorporate the project into the programme's to enable knowledge sharing and process uniformity, the project manager expressed concerns about a loss of autonomy. Ultimately, the project was brought into the programme, necessitating the appointment of a new project manager who was amenable to the standardisation practices.

"At the beginning of the year, there was a major Quay wall project that was still under the supervision of the Department of Maintenance. And they basically were doing the same as my project managers. So, I asked them why we didn't add that project to the program. Why keep it a separate project within the city, just you know, because it's a huge project. But let's insert it under my part of the program and exchange knowledge and everything. And that project manager said I'm losing my freedom if I get to be part of the program because you are working on standardizing processes standardizing the way we work together with the contractor standardizing the techniques you're using and I'm a project manager I want to be in charge and make my own position". [R1SL]

5.1.3. Collaboration within the development of innovation and different perceptions of uniqueness

Within this section, questions regarding collaboration in innovation development and implementation were asked, and the interviewees were also asked whether they experienced issues within the collaboration, in particular issues related to the different perceptions of the uniqueness of a project. During this section, from all of the interviews, the researcher did not acquire any issues that related to the perception of uniqueness, uniqueness bias, or standardization. Instead, the issues being gathered in this section lean more towards general issues on the innovation development within the programme. Such issues are:

- Resistance from the established way of working.
- Too many stakeholders involved in the programme.

- Innovation poses a negative impact towards project objectives.
- Coordination issues within the innovation development.

As the issues being mentioned do not relate towards uniqueness bias and innovation based on standardization, but more to the issues of development and implementation of innovation in general, it will be explained further in Part 2 of this chapter.

5.2. Part 2: Innovation acceptance within the programme

Within this section, findings related to the acceptance of innovation in general within the programme are presented. The findings are categorised into three: preconditions for innovation, barriers for innovation, and enablers for innovation. The categorization into three sections is derived from the answers obtained in the semi-structured interviews, aimed at understanding the factors that influence the acceptance of innovation within the programme. The precondition, barrier, and enabler are defined as follows:

- **Precondition:** Fundamental elements that must be present within a construction programme for innovation to take place.
- **Barrier:** Factors or conditions within a programme that hinder or prevent the introduction and implementation of innovation.
- **Enabler:** Factors or conditions within a construction programme that actively promote, support, and facilitate the introduction and successful application of new ideas, processes, or products.

5.2.1. Precondition of innovation within the programme

Based on the semi-structured interview and combined with the result from both the document review and the exploratory interview, the preconditions for innovation within the programme are presented.

5.2.1.1. Space requirement

One of the most crucial preconditions for developing and implementing innovation is the presence of a suitable place to do it [R1SL, R7TL]. This has been mentioned in Chapter 4 on the innovation development phase, where the testing and developing phase of innovation through the pilot project in the programme necessitates the availability of an appropriate place. This applies both to the innovation being developed internally within the living labs and also to innovation being developed within IPK. In the case of the innovation being developed in IPK, by contract, it already has a pre-determined place. However, this is not the case for innovation that is being developed internally. It requires seeking a place for development within the ongoing traditional projects. This precondition is brought again by two of the interviewees, stating that specifically for innovation being developed internally, to start its development or implementation, a suitable location (through the ongoing projects) to do it needs to be available [R1SL] [R7TL].

5.2.1.2. Mindset requirement

The development of innovation by nature has some degree of uncertainty. Within the semi-structured interview, three points that have related towards the mindset requirement are found, which are:

- Embracing uncertainty: an innovative mindset characterized by a high tolerance for risk. Given that innovation can involve trial and error, stakeholders must be willing to face and manage potential failures [R3TL]. Uncertainty posed by innovation needs to be seen not as a barrier, but as an opportunity for learning and growth.
- Long-term vision: a mindset that prioritizes long-term gains over short-term efficiency is crucial [R7TL]. Internal stakeholders within the programme need to value the potential long-term

benefits of innovation, such as efficiency, sustainability, or safety improvements, even if they introduce short-term disruptions or costs [R1SL].

- Adaptability: embracing innovation requires adaptability- the openness to modify traditional practices and the possibility of the entire project management process [R3EP]. This includes being open to new technologies, methodologies, or materials that may not have been tested within the specific context of the construction industry.

"Mindset matters a lot when it comes to innovation. It's important for everyone involved — the stakeholders, our team, the builders, and really, every single person in the mix. You've got to keep an open mind. If you're aiming for innovation, you've got to be okay with the fact that sometimes you might land on a great idea, but a lot of the time, it's not going to work out and you'll have to start over. It's not always a smooth ride, and sure, it can get pretty disappointing, but that's just part of the game". [R1TL]

5.2.1.3. Financial investment requirement

In the realm of innovation development and implementation, financial investment plays a critical role [R6TL, R7TL, R4TL, R1EP, R2EP, R3EP]. This funding is essential for conducting pilot projects and for testing the innovation's scalability within the program [R7TL]. The sources of funding for innovation development are diverse [R7TL]. For instance, market parties may provide financial investment, typically resulting in their acquisition of the innovation's ownership. Alternatively, the entity experiencing the problem that the innovation addresses (i.e., problem owner), such as a cable company in the case of cable-related innovation, might fund the development.

Another source of funding could be internal, such as other departments within a municipal organization. For example, if an innovation aims to enhance sustainability, the sustainability department within the Municipality of Amsterdam could provide the necessary financial support [R7TL]. Additionally, NGOs may offer grants to living labs for developing innovations. Contractual agreements may also stipulate that 10 per cent of a traditional project's budget is allocated for the development of innovative solutions.

The requirement for financial investment is closely linked to the ownership of the innovation. Innovation, whether it's a product or a process, constitutes intellectual property. This property might be subject to an open innovation model, where there is no exclusive intellectual ownership, or it could be proprietary, owned by an individual or entity. Regardless of the ownership model, financial resources are imperative for development.

"For innovation to take root and grow, it's crucial that there's someone who takes responsibility for it—an innovation owner. This could be a specific department within the municipality or even an external party, like the companies that own the cables and pipes we might be innovating for. Essentially, this owner, or 'sponsor' of the innovation, is the one who supports it financially. They must be ready to invest in the innovation's success. While there's room for negotiation—on conditions like what happens if the innovation doesn't work out or how profits are shared if it does—there must still be a sponsor who's committed to funding the innovation. And sometimes, we might choose to be our own sponsor". [R3EP]

5.2.2. Barriers to innovation within the programme

This section presents the barriers towards developing innovation in the programme. The barriers are divided into four categories: programme dynamics, work culture, governance issues, and operational constraints. It is critical to acknowledge the interconnected nature of these barriers; the presence of one can often exacerbate the impact of another, thereby compounding the complexity of overcoming them in the pursuit of innovation.

5.2.2.1. Programme's dynamics

When discussing the challenges of innovation development and implementation within the programme, one of the most common arguments brought up by the interviewees was the budget and scope reduction. Eleven out of nineteen interviewees suggested that the budget and scope reduction create difficulties in various ways for innovation development and implementation.

Less amount of work volume

A common argument behind this issue is that the reduced scope and budget resulted in a lower amount of work within the programme than what was initially expected. This barrier is mentioned by 5 individuals working in the strategic and tactical level, 3 from the operational level, and 3 from the external parties. As explained in the previous chapter, assessments, and evaluations of the structures within the programme scope reveal that the structure's condition turned out to be not as severe as initially thought. This resulted in a significantly lowered amount of work in the programme than what was initially thought [R1EP]. As developing innovation requires financial investment for its development and implementation, some interviewees were sceptical about whether it would pay off its development cost considering the lowered work volume.

"I do believe it (innovation) is needed. But the thing is, for PBK is that the scope is continuing to change. So, when it started, the scope was around 800-plus bridges and 200 kilometres of quay walls. And now the scope has changed because we have more insight because of all the research. And I think that's difficult for innovation. If the scope doesn't change then you can go for innovation because it's a long-term investment. You must put money out first and it will cost a lot but in the long run, it will come back to you. But if you cannot provide the long-run vision, then innovation is a lot of times not efficient. Like it won't pay itself back". [R4OL]

This barrier does not only pose challenges to developing innovation within the living labs but also to the innovation being developed in the IPK. Typically, innovation being developed within the IPK has a large amount of investment, meaning that the expense can only be paid off when there is a large scale of work.

"I think innovation is not necessary anymore. I think it's really changed now with the budget or the scope. I still think it's good. But innovation is not something small. The way we did it is really large. It takes about, I think for us around six years. It costs a lot of money, a lot of investments from us, and from the three combinations of IPK. So, it's a big deal. The way we did it is only doable when there's a lot of scope, it's the only way. If six years ago the scope was how it is now, I don't think the innovation would be thought of. I don't think innovation is needed in the current state. No" [R1TL].

Innovation objectives and constant scope changes

A total of 3 interviewees noted the challenges posed by frequent shifts in the programme's scope, especially when it comes to fostering and integrating innovations [R1SL, R1OL, R4OL]. All of the interviewees come from the internal organization of the programme, where one interviewee works in the strategic and tactical level, and the other two comes from the operational level.

Innovations are typically tailored based on certain specific objectives, making their benefits sensitive to alterations in the programme's direction. A point highlighted was those certain innovations, developed with the original scope as a reference, found their potential benefits compromised when introduced into a changed context.

" We are starting to finish a lot of the innovations, some of them, especially in the assessment of the state of our assets, have been very helpful, very useful. But because of those innovations, the scope

is downscaled and all of the innovations that were started to get up to speed, they don't match the current scope of the programme anymore." [R1OL]

The occurrence of this situation might lead to resource allocation issues, where time and money invested in developing innovation can be seen as a waste if the innovation being developed becomes irrelevant. This barrier could also potentially lead to fatigue in developing innovation, where stakeholders might become tired of attempting to innovate because they perceive that the goalposts are always moving, which in the end might lower the motivation to innovate.

Difficulties in finding a location for innovation development and implementation.

To develop and implement an innovation, a prerequisite of a suitable place needs to be fulfilled. This is noted by a total of 4 interviewees that all comes from the internal organization of the programme. 3 is from the strategic and tactical level, while one interviewee works in the operational level. The reduction of the budget of scope within the programme resulted in two things: a lowered number of ongoing projects, and a lowered number of (renewal) projects in the future [R1SL, R1EP, R7TL]. This creates difficulty in finding a suitable location for the development and implementation of certain innovations, slowing down the innovation development process [R3OL, R1EP, R7TL].

"It's hard to find projects for implementation, and sometimes it takes some time to find a location where to implement it. We can't innovate in every project that we do, we also must do normal projects. Because of the budget limits, we don't have that many projects. At this moment we have nine quay walls outside the construction, three of which are already part of IPK, the innovation project, innovation contract. So that only remains like six projects and then if the innovation team comes up with an idea, I must choose one of those six and then they come up with a new idea. It's a matter of numbers and it's a matter of time". [R1SL]

5.2.2.2. Traditional work culture

A prominent theme identified from the interviews is the resistance to change within traditional work cultures. This theme, highlighted by nine interviewees from both internal and external parties, emphasizes the reluctance among internal workers in the programme to deviate from long-standing work practices. Among these interviewees, four are working on the strategic and tactical level, two from the operational level, and three represent external parties. This resistance poses significant challenges to the acceptance and implementation of innovation.

Resistance from established practices

A notable barrier to the adoption of innovative methods in PBK arises from the reliance on established practices. This issue mainly happens within the traditional delivery project, where traditional methods, which have been relied on for successful project delivery over a long time, form trust and familiarity among the staff members. Established practices often create confidence in individuals. Comparing it to a novel method, the already established practices are ready with a high degree of reliability. It is a method that is familiar to the workers, where regulations and permits are already established and in favour of the established way of work [R4OL]. This is because an already-established practice by default has a proven reliability, from standards and permits that have already been established for it [R4OL]. One of the interviewees mentioned this sentiment, emphasizing that many have the tendency to rely on what they know because of their proven background in the specific solutions.

"I think it is always hard to, if you have a new idea, to make it common. Because there are a lot of people who think they know how things work since they have a lot of experience in certain

solutions. So, bringing something new and trying it out, there can be some resistance among those people." [R4TL]

The resistance due to the established practices is also evident to the external parties working with PBK, proving the existence of the barrier even more. As described by an engineering consultancy, a significant segment of the PBK staff consists of individuals who have been executing tasks in a particular manner for decades.

"Accepting new ways of working is challenging. There are many people at PBK, primarily those from the Municipality of Amsterdam, who have been doing their jobs for 20 to 30 years. They question why there should be any change when the traditional methods have worked so far. And I think that's one of the main barriers." [R1EP]

Several interviewees pointed out that those who have extensive experience with traditional methods tend to be hesitant about adopting new techniques. Their reluctance is not merely a matter of being unacquainted with innovations but also arises from a concern about the risks that these changes could introduce. The uncertainty involved in developing and implementing new ideas could potentially result in adverse outcomes for a project, such as cost overruns or delays [R4TL, R5TL].

This resistance is often compounded by the responsibilities that come with project management roles. Project managers and planners are tasked with ensuring the successful delivery of a project, which naturally inclines them to be more risk averse. They weigh the potential benefits of innovation against the possibility of jeopardizing the project's success, leading to a preference for the tried-and-true over the untested [R1OL, R3OL, R4OL, R1SL, R3TL, R4TL].

5.2.2.3. Governance issues

Within the programme, diverse tasks are tackled, from traditional delivery to innovative ventures (i.e., IPK, living labs). Despite established communication methods, around eleven interviewees suggest that a disconnect persists between departments. This disconnect is particularly evident in the realm of innovation development. Many team members only become aware of new innovations when they are presented to them, despite the fact that operational-level staff will be the ones to carry out their development and implementation. This disconnect has resulted in feelings of exclusion from the innovation ideation and exploration process.

Lack of coordination

The large size of the programme, with its variety of tasks—from innovation exploration in living labs to the duties of the innovation partnership (IPK) and the traditional project deliveries—has inadvertently contributed to this disconnect. While many individuals are preoccupied with their own responsibilities, the programme as a whole is bustling with activities [R2OL]. This vast array of undertakings makes it challenging for members to keep informed of what others are doing [R4TL]. This issue was raised by a total of 11 interviewees: five from the strategic and tactical level of the internal organization, three from its operational level, and three from external parties.

Various stakeholders, both internally and externally, have mentioned a lack of coordination within the programme. Internally, many are unaware of their colleagues' tasks and activities. This ignorance breeds feelings of isolation, which, in turn, poses barriers to the introduction and integration of innovation as there is no clear path for sharing and scaling new ideas.

"They (innovation departments) think of things over here and then at a certain moment it will go to the registration, but we are not connected, so we don't know what they do. It is like a black box,

you think of the way you do and, yes, it works. So why would we incorporate innovations? I think that is one of the challenges within the programme". [R2OL]

External parties confirm these sentiments, noting challenges in identifying responsibility within the programme. Their interactions with the programme often reveal communication gaps; after informing one party about a plan or initiative, they find themselves having to reiterate the same information to another member who seems uninformed. This suggests not only isolated communication but also a lack of a unified direction. These external perspectives underscore the pressing need for improved coordination and clarity within the programme.

"What I see in the program is that lots of people have good intentions and they are trying to do their best, inventing new ways or new solutions. But there is no, that, for instance, the management of the program does not. How should I say it? You have to manage all these initiatives and lots of people are undertaking initiatives, but there's no coordination. I think when you as a program you would like to innovate, etc. Then you should coordinate all those initiatives. But now it's all these initiatives are defined on a very low level the on the working level. People do their best. But one of the initiatives is going to the left side and the other initiative is going to the right side. There's no coordination". [R1EP]

The lack of coordination barrier might imply that the programme management has not successfully established a strategy for managing and coordinating a variety of initiatives. This could result in a diffusion of efforts, where initiatives may unknowingly work against each other rather than cohesively. At the same time, Moreover, the ongoing perception of disconnection among participants indicates that the current communication mechanisms may not be adequately meeting the program's complex requirements. This situation underscores the need for a strategic approach to innovation—one that ensures collaborative effort toward a common goal, underpinned by an overarching vision that directs all initiatives within the program.

Lack of direction

The realization process, a vital phase in the project's lifecycle, faces significant delays. These delays, as highlighted by a technical manager during an interview, are attributed to external challenges such as accommodating stakeholder concerns [R5TL]. This concern was highlighted by eight interviewees, all from the internal organization. Of these, six are from the strategic and tactical level, while the remaining two are from the operational level. This delay presents a question: should the team prioritize making up for lost time or focus on fostering innovation? Innovations, while beneficial, require substantial effort and could further jeopardize the project's delivery schedule. This dilemma has bred tension within the organization. Some are intent on addressing the delay, while others are eyeing the potential long-term benefits of innovation. This barrier, much like the previously discussed one, indicates that different segments of the program are operating in isolation. Moreover, before innovations can be effectively integrated, there is a critical need for a clear and stable foundational process to be communicated and understood by all participants in the program. Without a solid base in fundamental processes and structures, any move toward innovation could be premature, potentially causing additional complications and inefficiencies.

"If you want to innovate, you need to have your basic renewal chain in order. The base must be OK. And if everything is clear and people know what they need to do and where we are going, then, now it's time. To do to have innovation here. So, the first you have to do is add the passive support your base has to be the base. The base level must be OK, that's the main thing. To start your innovation. Sometimes this side of the programme does not know that the other sides exist, so how can they

learn from each other? That is why first you have to get the base in order to implement innovation." [R4TL]

Large number of stakeholders involved in the programme.

Around eight interviewees shed light on the challenges faced in innovating due to the large number of stakeholders within the programme. The eight interviewees consisted of 2 individuals working in the strategic and tactical level, three from the operational, and five from the external parties. The interviewees brought forward the complications of managing different expectations from the variety of stakeholders within the programme. The requirements from a variety of departments within the municipalities ranging from asset managers to departments overseeing archaeology and aesthetics, were perceived as overwhelming. One external participant expressed, *"In this program, it's all about boundary conditions and requirements... Maybe you should decide with fewer requirements and conditions on the table, and the puzzle isn't that complex"* [R1EP].

The diversity of these requirements not only acts as a barrier to innovation but also considerably decelerates the decision-making process. This is also validated by one of the internal parties being interviewed, stating that the realization of the projects within the programme is currently delayed mainly due to stakeholder management issues [R4TL].

It was emphasized that having multiple stakeholders with varying and sometimes conflicting expectations makes it challenging to gain consensus. "*In Amsterdam, many parties are involved... and it sometimes takes very long before they make a decision*," reflected one participant from the external parties [R5EP]. This sentiment echoes the shared belief among the interviewees that a key decision-maker or a system is essential to prioritize and streamline requirements, creating a better space for innovation development and implementation.

In short, there is a perception that the programme is currently burdened by the sheer volume and variety of stakeholder inputs, which complicate the innovation development and implementation process.

5.2.2.4. Operational constraints

This issue was raised by nine interviewees, all from the internal organization. Among them, five belong to the strategic and tactical level, while the remaining four are from the operational level.

Project managers, primarily tasked with traditional project delivery within the programme, bear the responsibility of sticking to these constraints. Consequently, when presented with the prospect of integrating innovation, they typically seek tangible evidence of its potential benefits and clarity on its impact towards their project. This caution stems from their inherent risk-averse nature, aiming to ensure that any integration of innovation doesn't adversely affect project delivery. As one interviewee expressed, *"So you always need the required time to get up to speed to implement it. Time is money... Time is also sometimes not available because project planning keeps running forth".* [R1OL]

This sentiment was echoed by a director, who stated, *"The majority of my team are project managers... for them, innovation can be a struggle because it's a risk in their project management"* [R1SL]. Additionally, a prevalent mindset among project managers is viewing their tasks in isolation, focusing solely on individual projects rather than considering them as part of a broader programme. As a project manager revealed, *"I don't care about your innovation because that's not part of my project".* [R1OL]

Several external parties echo the sentiment that many individuals within PBK approach their tasks with a project-centric perspective, rather than viewing them as interconnected components

of a broader programme. One external participant noted: *"Lots of people working for the program have experience with projects. But a series of projects does not constitute a program. There's an overarching theme that defines a program. While I'm part of the program, the essence of it often feels lost because people have difficulties in investing (in innovation). Many seem to operate as if they're handling individual projects or a mere portfolio, failing to recognize the nuanced differences between a project, a portfolio, and a program".* [R1EP]

Compounding this risk-averse approach, the realization process's delays, as touched upon in the prior sub-chapter, play a significant role. Challenges in stakeholder management, resulting in these delays, lead the operational team to prioritize mitigating these lags over developing innovation.

Furthermore, the interviews reveal that the introduction of innovation often occurs during an ongoing project. Such mid-project integrations present significant challenges. Once a project's objectives and boundaries are established, any alteration, such as the infusion of innovation, necessitates a comprehensive review of the project plan, leading to additional time and resource expenditures. An interviewee aptly summarized this challenge:

"Late-stage changes in the construction process are expensive. Optimal integration of innovations requires early planning, allowing for flexibility and cost-efficiency. But introducing changes late in the timeline, after significant planning, eventually leads to added expenses and complexities".[R1SL]

5.2.2.5. Identified barriers within the organizational role.

A total of eight barriers that hinder the development and implementation of innovation were found during the semi-structured interview. This section presents a comparison of the categories of individuals who mentioned the barriers. As mentioned earlier in this chapter, the category of the interviewees is divided into three: strategic and tactical level, operational level, and external parties. Such a comparison can be seen in Table 5.1.

Table 5-1: Distribution of identified barriers to innovate within the interviewee categories.

Barrier		Internal parties		External parties (6)
		Strategic & tactical level (7)	Operational Level (6)	
1	Less amount of work volume	5	3	3
2	Innovation objectives and constant scope changes	1	2	-
3	Difficulties in finding a location for innovation development and implementation	3	1	-
4	Resistance from established practices	4	2	3
5	Lack of coordination	5	3	3
6	Lack of direction	6	2	-
7	Large number of stakeholders involved in the programme	2	3	5
8	Operational constraint	5	4	-

From Table 5.1, it can be seen that among the eight barriers, four barriers were identified both by the internal and external parties, and four other barriers were identified exclusively by the internal parties.

Barriers identified both across internal and external parties.

Four barriers have been identified by both internal and external parties: less amount of work volume, resistance from established practices, lack of coordination, and the involvement of a large number of stakeholders in the programme. The shared recognition of these barriers suggests that their impact extends beyond internal organization, indicating that these are likely fundamental issues within the programme organization or process.

When both internal and external parties experience the same barriers within a programme, this suggests that the innovation challenges are not confined only to the internal mechanisms and operations of the programme but are also perceptible to the external parties within the organization. For example, the barrier of "less amount of work volume" is experienced by both internal and external parties. From the perspective of external parties, a decrease in work volume leads to fewer opportunities for collaboration, which potentially leads to a decline in engagement and investment in innovative practices. From the perspective of internal parties, the issue raises concerns about the efficiency and cost-effectiveness of maintaining innovation development efforts. Similarly, the barrier of "lack of coordination" that is experienced across the internal and external parties suggests systemic issues within the integration and alignment of innovation development efforts. For external parties, the lack of coordination manifests in the inefficiencies or redundancies when interfacing with the programme, while the internal parties experience it as a lack of communication, and confusion between departments.

Barriers exclusive to internal parties

The barriers identified exclusively by internal parties, such as innovation objectives and constant scope changes, difficulties in finding a location for innovation development, lack of direction, and operational constraints point to internal operational challenges. These challenges might stem from the programme's internal governance, procedures, or decision-making processes that are not necessarily visible or relevant to individuals working with external parties. This is in line with the process of innovation development within the case study programme presented in Chapter 4, where internal stakeholders (i.e., living labs, and realization departments) hold the responsibility of exploring innovative ideas and gathering related stakeholders to start developing innovation.

For example, the barrier of "innovation objectives and constant scope changes". This barrier, as explained previously creates difficulty for internal teams to maintain a consistent approach to innovation. The lack of visibility of these changes to external parties is highly likely because external parties are not involved in the internal planning processes and are only engaged once strategic decisions have been finalized. This also applies to barrier "difficulties in finding a location for innovation development", where internal stakeholders are typically responsible for the allocation of space and resources for innovation projects.

The external parties also do not experience the barrier of "lack of direction". Internal stakeholders may feel that there is insufficient guidance on how to prioritize between projects and innovation development, which could result from unclear communication or lack of alignment between different departments' goals. This challenge might not be as apparent to external parties as their interaction is only limited to certain specific projects.

It is important to note again that within the semi-structured interview, both the strategic and tactical levels of the programme's organization are merged into one category due to limitations on individuals being interviewed coming from the strategic level of the organization. This limitation could lead to several consequences. One example is that the insights that are unique to the strategic level might be diluted as they are not sufficiently represented, resulting in an

incomplete understanding of the challenges of innovation development and implementation perceived by the strategic level.

5.2.3. Enablers of innovation within the programme

5.2.3.1. Positive business case

A positive business ace is a crucial enabler for innovation development and implementation, as mentioned by six of the interviewees. The decision by market parties to engage in innovation comes not only from technical feasibility or strategic alignment but is equally a question of economic viability [R4TL]. For the market parties, innovation must have a clear potential of being profitable to warrant investment [R1EP]. Market parties are ready to commit resources to pursue innovation, as long as there is a clear path to not only regain their investment but also to secure a profit.

The requirement is a fundamental aspect of their business model for innovation. it necessitates a business environment where innovation is not just supported but also financially rewarded. This also opens a dialogue on the types of business models that could effectively motivate innovation while ensuring its financial viability. A positive business model would balance risk and reward, offering sufficient incentive to stimulate the market parties' creative endeavour and financial commitments.

A positive business case is not solely about encouraging market parties to innovate, but also to incentivise them to share their unique knowledge with the programme [R4EP]. Each market party possesses a specialized expertise that comes from investment in research and development. This knowledge is a valuable asset, as it is a result of substantial effort and financial input. Providing a compelling business case is one of the ways to encourage market parties to share their insights more freely.

"One ongoing challenge is that innovation has to be financially supported. Our company is ready to invest in innovation and indeed, we have invested millions. We're willing to do this as long as there's a clear business case showing that we'll see a return on our investments. I think it's common that everybody wants innovation, but not everyone is prepared to pay for it. However, I want to clarify that's not the situation here. We've had productive discussions with the municipality about the business side of things. Sure, we don't always get exactly what we want, and that's fine. Ultimately, for us to continue this path, the numbers have to add up. The business case must be solid — it's got to be profitable in the end". [R3EP]

5.2.3.2. Contractual agreement

The presence of a contractual agreement that is specifically designed to foster and implement innovation (e.g., innovation partnership) can significantly encourage creative effort. An innovative-focused contract is considered an enabler because it provides a conducive environment for innovation by accommodating the inherent uncertainties that come with the pursuit of innovation development [R5OL]. Traditional contracts may often be rigid, leaving little room for the trial-and-error process that is important to innovation [R1OL].

Additionally, a contractual agreement that supports innovation development tends to distribute risk more equitably between the contracting authority and the contractors. This sharing of risk is crucial, as it provides a safety net that can help both internal and external parties within the programme to explore their creative solutions. Lastly, such contracts can include provisions for intellectual property rights, ensuring that innovators can reap the benefits of their contributions, thus adding another layer of incentive.

"I think within the innovation partnership, there was a lot of time and, I don't think money, but at least there is a mindset that innovation may fail". [R5OL]

5.3.4. Summary of preconditions, barriers, and enablers

A synthesized overview of the precondition, barriers, and enablers are organized into a table for clear reference and analysis.

Table 5-2: List and summary of precondition, barrier, and enabler to innovation within the programme

Precondition	**Summary**
Space requirement	A suitable location is essential for the development and implementation of innovation, whether it's being developed internally or through innovation partnership.
Mindset requirement	Successful innovation development hinges on stakeholders' willingness to embrace uncertainty, prioritize long-term gains, and adapt traditional practices to new methodologies or technologies.
Financial investment requirement	Innovation requires dedicated financial backing, either from market parties, the problem owners, internal departments, or NGOs, to support pilot projects and scalability test.
Barrier	**Summary**
Less amount of work volume	Diminished work volume and the changing scope of the construction programme raised doubts about the economic feasibility of innovation, with stakeholders concerned that the required upfront investment may not yield returns without a substantial and consistent workload.
Innovation objectives and constant scope changes	Frequent scope changes in the construction programme undermine the alignment of innovations with their intended objectives, leading to potential waste of resources and innovation fatigue among stakeholders as shifting goalposts decreases motivation to innovate.
Difficulties in finding a location for innovation development and implementation	The reduction in the construction programme's scope and budget has led to fewer projects available, presenting challenges in finding suitable locations for innovation development and implementation, which in turn slows the overall innovation process.
Resistance from established practices	Reliance on established practices within PBK poses a significant barrier to innovation, with a strong preference for proven methods over new, untested ideas due to their reliability and the associated risks of change, which is further reinforced by the risk-averse nature of project management roles.
Lack of coordination	The large and varied nature of the construction programme has led to a lack of coordination, with individuals and departments often working in isolation without a unified direction for innovation, resulting in communication gaps and disjointed efforts that undermine the programme's innovative potential.
Lack of direction	The project's realization phase is hindered by delays and tension between catching up and fostering innovation, highlighting a need for a clear, shared direction and a solid foundational process as a prerequisite for successful innovation integration.

Large number of stakeholders involved in the programme	The large number and the variety of stakeholders within the programme complicate decision-making and slow down innovation, as managing varied and sometimes conflicting expectations makes it difficult to reach a consensus and prioritize actions conducive to innovative development.
Operational constraint	Project managers in the programme, prioritizing traditional delivery and risk-averse by nature, require concrete proof of innovation benefits and reassurance that it won't derail project timelines, fostering a project-centric rather than program-centric approach that further impedes the integration of innovation, especially when changes occur mid-project.
Enabler	**Summary**
Positive business case	A strong business model is key for innovation, requiring market parties to see clear potential for profit and a balance of risk and reward, encouraging them to invest and share their expertise.
Contractual agreement	Contracts specifically designed for innovation, such as innovation partnerships, facilitate creative efforts by accommodating uncertainties and equitably distributing risks, thus incentivizing innovation development.

5.3. Influence of uniqueness bias in the acceptance of innovation

The semi-structured interviews conducted in this study did not yield significant evidence that links the concept of uniqueness bias to the acceptance of innovation within the construction programme. While interviewees did report an increase in project uniqueness due to a reduction in the programme's scope which in turn complicates the pursuit of the standardization approach, this should not be mistaken for a direct manifestation of uniqueness bias in rejecting innovation.

Uniqueness bias, as defined by our literature review, is the tendency of planners or project managers to regard their projects as distinct, potentially impeding knowledge transfer and increasing the likelihood of underestimating risks. This bias is often associated with a reluctance to adopt standardized solutions based on prior experiences.

Hypothesis 1 (H1): The presence of uniqueness bias within the development and implementation of innovation based on standardization is recognized by internal or external parties in the programme.

The semi-structured interview results do not provide clear evidence that the presence of uniqueness bias is recognized by internal or external parties within the programme. While the interviews touch upon various aspects related to the challenges of implementing innovation based on standardization, there is no explicit mention or recognition of uniqueness bias as a concept affecting these processes.

The findings do suggest that factors such as organizational culture, reliance on established practices, and the perceived uniqueness of projects due to scope reduction play a role in shaping attitudes towards innovation. However, these are not directly linked to an awareness of "uniqueness bias" as defined in the literature review. Therefore, based on the semi-structured interview result, Hypothesis 1 is not conclusively supported.

Hypothesis 2 (H2): The presence of uniqueness bias negatively affects the acceptance of innovation based on standardization in a construction programme.

The interview results also do not provide substantial evidence to support the claim that uniqueness bias negatively affects the acceptance of innovation based on standardization in the construction programme. While there are indications of resistance to standardization and innovation, this resistance seems to stem more from other factors, such as organizational culture, operational constraints, and challenges related to programme dynamics.

The reluctance to develop and implement innovation based on standardization appears to be influenced more by practical considerations (e.g., reduced work volume, financial investment requirements, operational constraints) rather than bias towards perceiving each project as unique. The data suggest a complex interplay of factors affecting innovation acceptance, but uniqueness bias as a distinct, influencing factor is not clearly outlined. Therefore, Hypothesis 2 is also not conclusively supported by the data.

In conclusion, the research methodologies employed in this study do not support a conclusive analysis of the influence of uniqueness bias on the acceptance of innovation. Furthermore, the study was unable to identify definitive factors that contribute to uniqueness bias or to determine the extent of its impact on both external and internal parties involved in the construction programme.

5.4. Conclusion

The thematic analysis of the semi-structured interviews within the construction program yields conclusions that address sub-research questions SRQ-2 and SRQ-3, focusing on the factors that influence the acceptance of innovation based on standardization and the role of uniqueness bias in this process.

To answer SRQ-2, which examines the factors influencing the acceptance of innovation, the analysis identifies three main categories: preconditions, barriers, and enablers. The study highlights essential preconditions necessary for fostering an environment conducive to innovation. These include the availability of a suitable location for development and implementation, a mindset among stakeholders that is open to uncertainty and prioritizes long-term vision, and the presence of dedicated financial backing. In terms of barriers, the study outlines eight challenges that hinder the process of innovation. These include program dynamics such as reduced work volume and scope changes, a traditional work culture resistant to change, governance issues resulting in a lack of coordination and clear direction, and operational constraints. These barriers present a complex environment within which innovation, especially when it involves standardization, must be navigated. On the other hand, the study identifies key enablers that facilitate innovation. A positive business case and contractual agreements specifically designed to support innovation are seen as crucial. Such enablers provide the necessary financial and structural support, encouraging stakeholders to invest in and pursue new ideas.

To answer SRQ-3, which focuses on the relationship between these factors and uniqueness bias, the findings do not indicate a significant impact of uniqueness bias on the acceptance of innovation based on standardization. Uniqueness bias, understood as the tendency to perceive projects as distinct and thereby impeding knowledge transfer and risk assessment, does not prominently feature in the challenges associated with innovation acceptance. Instead, the reluctance to adopt standardized innovation appears to be influenced more by practical considerations such as organizational culture, operational constraints, and challenges related to program dynamics.

In conclusion, the finding suggests that the acceptance and implementation of innovation are more directly affected by practical organizational factors. These factors include the dynamics of the program, work culture, governance issues, and operational constraints, as well as the presence of conducive business and contractual environments.

Chapter 6

Framework Development

6.1. Introduction

Based on the result of this empirical research, this chapter intends to craft a framework that consists of ways to provide better space for the development of innovation within a construction programme. This chapter is presented as follows. First, Section 6.2 explains the aims of the framework. Next, Section 6.3 provides a description of how the framework is being developed. Afterwards, details about evaluating the expert are presented in Section 6.4. Adjustments are made based on the evaluation to create the final framework which is explained in Section 6.5. Lastly, a conclusion of this chapter is presented.

6.2. Framework objectives

As mentioned in Chapter 5, the research intends to utilise findings gathered in Part 2, to propose a solution that can help facilitate the acceptance of innovation development and implementation within the construction programme. Such a solution is presented in the form of a framework.

Previously, findings regarding the acceptance of innovation within the programme are categorized into three aspects: preconditions, barriers, and enablers. All the lists of preconditions, barriers, and enablers can be seen in the table below.

Table 6-1. Lists of preconditions, barriers, and enablers to innovate within a programme.

Name	Lists
Precondition	Place requirement
	Mindset requirement
	Financial investment requirement
Barrier	Less amount of work volume
	Innovation objectives and constant scope changes
	Difficulties in finding a location for innovation development & implementation
	Resistance from established practices
	Lack of coordination
	Lack of direction
	Large number of stakeholders involved in the programme
	Operational constraint
Enabler	Positive business case
	Contractual agreement

The objective of the framework is to create space for innovation development and implementation within the programme by reducing the barrier and enhancing the enabler to provide a better precondition for innovation to be developed within the programme. The framework is intended to be utilized by the public client, specifically for an ongoing programme.

6.3. Development of the preliminary framework

A total of three intervention plans are proposed within the framework. The intervention plans are crafted based on the results of the semi-structured interview, and suggestions received within it. Below are the details of the three intervention plans being proposed.

Intervention 1: Establishing a clear baseline and direction.

The development of this intervention plan is a response to the barrier of "lack of direction", a barrier noted in the case study programme as detailed in Chapter 5 of the research. This issue primarily originates from a substantial reduction in the scope and budget of the programme, leading to a notable decrease in work volume and a consequent shift in operational focus. Coupled with delays in the realization process, these changes resulted in a fragmented approach within the team. Different members, influenced by these alterations, have found themselves diverging in focus — some prioritizing immediate project completion, while others engage in long-term innovation development. As a result, this divergence makes workers operate in isolation, where departments and teams pursue their objectives independently and without a unified direction. This disjointed effort not only undermines the efficiency of the programme but also stifles the potential for impactful innovation. The necessity for this intervention plan is further supported by insights from the semi-structured interview. One interviewee emphasized the need for a clearly established baseline for the programme, pointing out the inefficiencies and misalignments resulting from varied perceptions among workers about the programme's current status and its direction. This feedback has been instrumental in highlighting the critical need for a clear, unified direction to align efforts across the programme, thereby laying a foundation for fostering an environment conducive to innovation.

With that in mind, this intervention plan is aimed at providing clarity on the current state of the programme, providing future direction and its implication towards the pursuit of innovation. The action plan that is recommended to execute this intervention is as follows:

1. Programme assessment: Conduct an evaluation of the programme's current status, considering all ongoing projects, resources, and overall objectives.
2. Directional decision: Engage key stakeholders, including senior management, to determine the programme's primary direction. This decision will be foundational in guiding subsequent actions and innovation efforts.
3. Impact analysis: Assess the implications of the chosen direction, particularly regarding existing and future innovation initiatives.
4. Communicating & feedback channels: Inform the direction being taken and establish mechanisms for employees to provide feedback or seek clarifications.

The implementation of this intervention plan is anticipated to reduce several barriers and enhance enablers to innovate within the programme. Specifically, it targets:

- Lack of Direction: This plan addresses the lack of direction by establishing a clear baseline and strategic focus, providing essential clarity for all programme members.
- Lack of Coordination: With a well-defined programme direction, it becomes easier to coordinate various activities and departments. This clarity helps in aligning the different innovation initiatives, ensuring they are working towards common goals rather than in isolation.
- Resistance from Established Practices: By clarifying the programme's direction, the plan aids in overcoming resistance to change, helping team members understand how new practices and innovations align with broader programme goals.
- Good Business Case: The clarity achieved through a well-defined programme direction enables both internal and external parties to identify and leverage opportunities for innovation, enhancing the overall business case for these initiatives.

- Mindset to innovate: With a clear direction, stakeholders are more likely to embrace the necessary mindset for innovation. Understanding the programme's goals can foster a culture that values long-term gains and adaptability.

Intervention 2: Innovation section within the programme forum

Another barrier that this research intends to address is the "lack of coordination", as detailed in Chapter 5. Within the programme, both internal and external parties have highlighted a significant disconnect in terms of communication and awareness of others' activities. This issue is evident in the area of innovation development and implementation, where many are unaware of ongoing innovation projects unless they are directly informed or involved. As a result, individual efforts on novel initiatives often become isolated and uncoordinated, leading to duplicated efforts and a lack of synergy.

With such an issue, there is a need to establish a place where information revolving around the implementation of innovation can be continuously shared. As such, a section within the programme to share information about the progress of innovation is proposed. The aims of this section are to enhance transparency, foster coordination, and keep all stakeholders informed about ongoing initiatives. The action plan that is recommended to execute this plan is as follows:

1. Section designation: allocating a dedicated section or segment within the programme forum, either online or offline, to share updates about innovation within the programme.
2. Content curation: defining types of content to be shared in the section. This could be for example updates on ongoing innovation projects, pilot project experiences, success stories, lessons learned, and opportunities for collaboration.
3. Regular updates: ensure regular updates of the information in the innovation section to keep it current and relevant.
4. Interactive elements: Features such as a Q&A section to encourage engagement and discourse within the forum may be added.
5. Archiving & Accessibility: establish a portal for archiving all updates from the innovation section to ensure its accessibility for all programme members or potentially the municipality where the programme resides as well.

The implementation of this intervention plan is anticipated to reduce several barriers and enhance enablers to innovate within the programme. Specifically, it targets:

- Lack of coordination: This plan addresses the coordination barrier by providing a shared space for regular updates on innovation progress, making the development process more transparent and potentially fostering opportunities for collaboration both from the internal and external parties.
- Good business case: The centralization of innovation information can aid in identifying and developing a solid business case for innovation. The platform may also provide opportunities for innovation to find a suitable problem owner or potential funder that could invest in the development of innovation.
- Mindset to innovate: Continuous exposure to information about innovation successes and challenges may inspire and motivate team members to engage in innovative practices.

Intervention 3: Contractual flexibility for innovation integration

During the semi-structured interview, one significant barrier identified regarding the acceptance of innovation development and implementation was the perceived negative impact of innovation on project objectives. As mentioned in the precondition to innovate, the development of innovation within the programme necessitates a space. In the case of innovation being developed internally, its development (i.e., pilot project) typically is integrated into ongoing traditional

projects which are constrained by predetermined scopes, budgets, and timelines. The introduction of innovation development or implementation, with its inherent uncertainties, is perceived as a risk by project managers and team members who are responsible for meeting these project objectives. Compounding this issue with the fact that the development of innovation is not within the responsibility of a project manager, as stated by the interviews, creates resistance in accepting innovation, especially when they perceive little to no direct benefit to their project. This reluctance is further worsened by the current delays in the project realization process, adding pressure to become more risk-averse which eventually creates a tendency to utilize the traditional way of working instead.

To address this, this research proposed to introduce contractual flexibility for the integration of innovation as the third intervention plan. This plan is aimed to minimize resistance to accepting innovation by establishing contractual provisions that distribute responsibility. This intervention is intended to allow for the integration and testing of innovations developed internally within the programme, without compromising the project's scope, budget, and timeframe. Such innovations are distinct from those developed under the Innovation Partnership (IPK), as the innovation partnership contract is specifically designed to develop innovation. The recommended action plan to implement this intervention plan is as follows:

To address this, an introduction of contractual flexibility for the integration of innovation is proposed as a intervention plan. This plan aims to minimize the resistance to accept innovation by creating contractual provisions that share responsibility for innovation and allow for the integration and testing of innovation without compromising the project's scope, budget, and time. The action plan that is recommended to execute this intervention plan is as follows:

1. Pilot project contracts and an ongoing project: this plan is intended to be used when a new pilot project is to be developed on an ongoing project.
   - For an already existing project contract, introduce provisions that allow for adjustments when there is a development or implementation of innovation.
   - Outline criteria and processes for when and how a contract can be adjusted, ensuring all stakeholders are aligned.
2. Pilot project contract and a new traditional project: this plan is intended to be used when a new pilot project is to be developed on a soon-to-be-realized (new) project.
   - When initiating a new project and a pilot project, if possible, draft a separate contract for both
   - Allocate a dedicated budget and timeline for the pilot project, ensuring it does not cannibalize the resources of the main project.

The execution of this intervention plan is expected to address several barriers and enablers. It targets:

- Operational constraint: By introducing contractual flexibility, the plan supports project managers and other team members within the traditional project to take risks associated with the innovation development as it reduces the potential negative impacts on the project scope, timeline and budget.
- Resistance from established practices: The reduction of the negative impacts on the project scope may reduce this barrier, as one of the reasons for the resistance from established practice is due to risk-averse behaviour.
- Contractual agreements: Contractual flexibility is a form of contractual agreement that provides better room for innovation development.

- Mindset to innovate: The less risk received by the workers in the project to develop innovation may motivate them to be less restrictive on pursuing novel initiatives, hence providing a better mindset to innovate.

Table 6-2 provides lists of barriers and enablers being addressed by each of the intervention plan that is previously presented

Table 6-2: Barriers and enablers being addressed within the intervention plans.

Intervention plan	Barriers being addressed	Enablers being enhanced
Establishing a clear baseline and direction	• Lack of direction • Lack of coordination • Resistance from the established practice	• Positive business case
Innovation section within the programme forum	• Lack of coordination	• Positive Business case
Contractual flexibility for innovation integration	• Operational constraint • Resistance from the established practice	• Contractual agreements

6.4. Expert evaluation

The credibility of qualitative research lies in evaluating how accurately the findings reflect the perspectives of both the researcher and the research's audience (Creswell & David Creswell, 2018) The purpose of the expert evaluation is to review the proposed solutions and framework of this study with a panel of experts from the construction sector.

6.4.1. Evaluation approach and expert session

With the use of expert evaluation, the intervention proposed within the framework is validated. The following are the criteria utilized to select the expert:

1. Working in an ongoing construction programme within the Netherlands.
2. Has a role within the strategic level of the programme organisation (e.g., programme director).

As a result, below are the experts that are selected:

Table 6-3: Lists of experts being selected for expert evaluation.

Expert code	Role/responsibility	Programme	Date of interview
E1	Programme director	PBK	25/Oct/23

The expert evaluation was carried out through semi-structured interviews, detailed in the Appendix D. Initially, the experts shared their perspectives on the preconditions, barriers, and enablers identified in this research. They assessed the recognisability of these aspects, highlighted any missing elements, and suggested areas where explanations could be further elaborated. Concluding the interview, they commented on the framework's applicability, thereby validating its relevance and practicality.

Each interview was conducted independently and spanned approximately one hour. With prior consent, all interviews were recorded and transcribed. The results, as described in Section 0, were

integrated into the final framework, presented at the conclusion of this chapter. To maintain confidentiality, the identities of the experts and the contents of the transcripts have been anonymised.

6.4.2. Expert evaluation results (E1)

Preconditions, barriers, and enablers of innovation

In the first part of the expert evaluation, insights were gathered regarding the framework's outlined barriers, preconditions, and enablers for innovation within the programme. Firstly, the expert recognized all eight barriers presented in the study, affirming their relevance and presence within the organizational context. This acknowledgement underscores the relevance of these barriers in impeding innovation within the case study programme. The expert also recognized all three identified preconditions necessary for fostering innovation.

One noteworthy observation was made regarding the work culture barrier, where the expert identified an additional factor: the freedom control in work culture. This aspect highlights a significant challenge in the Municipality of Amsterdam, where a strong preference for autonomy in project management hinders effective direction and coordination, which complicates the implementation of providing direction and coordination, pursuit of standardized practices, and development of innovations.

Furthermore, the expert critiqued the current contractual agreements, which are presented as enablers, suggesting that in their present form, they act more as barriers. This is attributed to the contracts not promoting a shared responsibility in developing innovation, leading to a lack of accountability and engagement in innovative efforts among individuals within the programme. This feedback provides a crucial perspective, suggesting the need for reevaluating and possibly restructuring the contractual frameworks to better support and encourage innovation. This feedback also strengthens and confirm the need for a contract that shares responsibility on developing innovation, which is being addressed in Intervention 3: Contractual flexibility for innovation integration.

Applicability to recommended solutions towards barriers and enablers.

1. Intervention 1: Establishing a clear baseline and direction.
   The expert evaluation recognized the effort to establish a clear baseline and direction within the programme, noting that similar activity has been performed within the case study, which is presented in the form of a document outlining the programme's path and its impact on innovation. When the expert was asked regarding their opinion on why such barriers were still present in the result of the research, it was stated that both the lack of direction and coordination happened due to the constant changes in the number of workers within the programme. As the programme experienced a budget and scope reduction, the number of workers was significantly reduced as well. This does not only apply to the internal workers but also to external parties working in the case study programme. When asked regarding what a good solution could be to tackle the issue, the expert suggested that, within the action plan proposed, adding an evaluation on whether to reduce the workforce to better align with the current programme's workload would be helpful. This adjustment is seen as crucial for optimizing resource allocation and enhancing the overall efficiency of the programme.
2. Intervention 2: Innovation section within the programme forum
   Regarding the innovation section within the programme forum, the expert feedback was particularly positive, emphasizing the utility of such an initiative. The expert pointed out the current difficulty in staying updated with the development of innovation within the programme, a challenge that even he himself faces. The introduction of a dedicated section for

innovation updates was therefore seen as a vital step towards enhancing transparency and communication. This section could serve as a centralized platform for sharing updates on innovation projects, fostering a more informed and collaborative environment among stakeholders.

3. Intervention 3: Contractual flexibility for innovation integration
   Just as previously mentioned, the expert suggested that within the current status of the case study programme, the contractual agreement that is being utilized on the project being delivered traditionally and innovation within the living labs, is not optimally crafted to promote shared responsibility for developing innovation. The expert stated that there is a disconnection among various work segments within the programme. The expert stated that contractual flexibility might be able to tackle the issue, but for the case study, he believes that a new contractual and organizational framework needs to be established. The new framework should be designed to emphasize shared responsibility and facilitate close cooperation among different segments or departments of the workforce. Such a structural change is envisaged to encourage a more cohesive approach to innovation, thereby enhancing the programme's overall capacity for integrating and benefiting from innovative solutions.

6.5. Final Framework

Based on the evaluation performed with related expert towards the three intervention plans being proposed within the framework, adjustments are made. For intervention 1, a statement is added in Action Plan 3, impact analysis, stating a recommendation for assessment of the workforce efficiency in relation to the direction and the workload of the programme. Intervention 2 does not change compared to the initial framework, as there is no significant suggestion received. Lastly, Intervention 3 does not change as well, since the suggestion received is a significant change in the general contractual agreement in the programme which affects the variety of the programme works, and it does not fall into the scope of this research. The final framework can be seen on the next page.

6.6. Conclusion

This chapter presented a framework designed to facilitate the acceptance of the development and implementation of innovation within a construction programme. Through a synthesis of case study results, three targeted intervention plans were proposed and refined. These plans address barriers found from the research's empirical study such as lack of direction and coordination, and operational constraints, while leveraging the enablers from good business models and mindset shifts towards innovation.

The first intervention plan focused on establishing a clear baseline and direction for the programme, responding to the significant barrier of "lack of direction". This was further refined through expert feedback, which suggested including an assessment of workforce efficiency. The second intervention plan proposed the creation of an innovation section within the programme forum, aimed at enhancing transparency and fostering coordination. The third plan, centred on contractual flexibility, was designed to integrate the development of innovation more seamlessly into the projects within the programme without jeopardizing the project's objectives.

The expert evaluation played a pivotal role in validating and refining these plans. Their insights led to significant enhancements, particularly in the first intervention plan, where the suggestion to assess workforce efficiency in relation to the programme's direction and workload was incorporated. This adjustment underscores the framework's adaptability and responsiveness to expert critique, ensuring its relevance and practicality in the real-world context of construction programmes.

The final framework, as outlined in this chapter, offers a robust and flexible approach to fostering an environment conducive to innovation. It emphasizes the importance of clear direction, effective coordination, and adaptable contractual practices, providing a solid foundation for overcoming traditional barriers to innovation in construction programmes.

Figure 6-1. Intervention Framework

Chapter 7

Discussion

In this chapter, attention shifts from presenting results to interpreting them and comparing the literature review with the empirical findings in a broader context. The chapter is divided into two sections that explores the relationship between the research findings and the literature review as well as discusses the limitations of the research.

7.1. Interpretation of the results

This section discusses the research findings in relation to the research objectives, main research question, and sub-research questions by comparing them to the literature.

7.1.1. Existence of uniqueness bias

At the beginning of this research, there was an underlying assumption that uniqueness bias creates a barrier to the acceptance of innovation based on standardisation in a construction programme. The assumption was based on the idea that uniqueness bias could lead to a neglect of standardized solutions by favouring unique approaches instead. However, findings from the semi-structured interviews conducted in this study present a different picture. Contrary to the initial hypothesis, there was no significant evidence linking uniqueness bias to the acceptance of innovation. While an increase in project uniqueness due to a reduction in the programme's scope was noted, this phenomenon did not directly correlate with uniqueness bias. Instead, resistance to standardization appeared to be influenced more by organizational culture and a preference for working in freedom, rather than a direct result of perceived project uniqueness. The study also observed a reduction in the usage of innovation based on standardisation among market parties. However, this trend was attributed more to profitability concerns rather than an outright opposition to standardization. This also applies to the innovation being developed within the innovation partnership, where one interviewee suggested a reduction in the utilization of innovation based on standardization (i.e., parametric design) as the market parties' cost of the development far outweighed its potential profit. This observation shows a more complex landscape of the adoption of innovation, where economic factors play a significant role in the acceptance of innovation.

Uniqueness bias, as defined in the literature on project management, is the tendency for planners or project managers to view their projects as unique, potentially hindering knowledge transfer and risk assessment (Flyvbjerg, 2021). Yet, this research was not able to observe such a specific tendency. The absence of findings that clearly point to a perception of project singularity, as described by Flyvbjerg (2021), suggests that the manifestation of uniqueness bias in practice, which in this case is the acceptance of innovation, maybe more complex and less direct than what was previously assumed. Additionally, the limited direct evidence of how uniqueness bias impacts innovation acceptance also highlights the need for more refined methods that are capable of capturing the subtleties of such biases in organizational contexts.

In conclusion, while the concept of uniqueness bias is theoretically solid, its practical manifestation and impact on innovation acceptance within a construction programme might not be as straightforward. The findings from this research call for a re-examination of how uniqueness bias is conceptualized and studied in construction management research, future studies should

aim to develop more nuanced methodologies that can more accurately capture the complexities of behavioural biases in the construction organization settings.

7.1.2. Acceptance of innovation within a programme

This research performs document review and exploratory interviews to understand the acceptance process of innovation within a construction programme. Based on the result of both activities, the acceptance process of innovation within a programme turned out to be more complicated than what the theory of the Innovation-Decision Process by Rogers (2003) provides. To start with, the Innovation-Decision Process theory categorizes the process of deciding on innovation into five phases of knowledge, persuasion, decision, implementation, and confirmation (See Figure 3-2). An individual, with a variety level of knowledge, becomes firstly aware of the information and receives information about its features through a variety of sources. The individual then develops opinions regarding the innovation, assessing the innovation's relative advantage, compatibility, complexity, and social influence through interactions between other individuals or forums. Afterwards, a decision on whether to accept or reject innovation is made based on the information they have gathered and their personal beliefs, preferences, and values. If an individual were to accept the innovation adoption, the process then moves into the implementation of innovation. After implementing the innovation, the individual will evaluate the outcomes and consequences of their decision.

On the other hand, the document review and exploratory interview reveal four phases that the innovation went through in the programme. These four phases, which are the initiation phase, testing ground, transition phase, and implementation and transfer phase, encompass the process of accepting, developing, and implementing innovation. These phases of the innovation process within the programme add one more step compared to the innovation-decision process theory, which is the development of innovation. This is because, unlike any commercial innovative product, innovation within the construction industry requires development to be able to match the specific needs which in this case is the projects within the programme. As innovation needs to be developed first before being implemented, it poses more complexity in its acceptance process. Such complexity can be seen in the space required to develop innovation, where innovation that is developed internally within the programme takes place in parallel with an ongoing traditional project, whereas innovation being developed in an innovation partnership (IPK) already has its pre-designated location. The complexity can also be seen from the perspective of the potential funder of the innovation. The development of innovation may also fail or take more time than what was initially expected, adding more risk variables when deciding on accepting innovation.

Comparison between Innovation Decision Process theory and the acceptance of innovation within the programme

In examining the relationship between Rogers' Innovation Decision Process theory and the innovation acceptance process within the *Programma Bruggen en Kademuren* (PBK), a nuanced comparison emerges. The PBK's initiation phase closely mirrors the knowledge and persuasion phases from Rogers' theory. During this phase, the concept of implementing specific innovations is explored, and stakeholders are engaged and motivated to participate in the development process. This phase serves as a platform where stakeholders from diverse backgrounds and areas of expertise come together. Their collective knowledge, responsibilities, and insights play a crucial role in shaping their perceptions of the innovation's feasibility and potential benefits for the programme. Crucially, each stakeholder must develop a positive attitude towards the innovation for its development to advance.

Once the decision to develop the innovation is established in the initiation phase, the stakeholders move collectively into the development process, which in PBK, encompasses two distinct phases. The first is the testing ground phase, where the innovation is developed on a small scale, typically through pilot projects. This is followed by the transition phase, where the innovation undergoes testing on a larger scale. The progression through these phases is not always linear or predictable. Depending on the outcomes of the development process, an innovation may cycle through one of these phases multiple times, or its development may be halted if results are not satisfactory. This variation in the development process underscores the inherent uncertainties associated with the time, effort, and financial resources required for innovation development, factors that significantly influence stakeholders' perceptions of an innovation's viability within the programme.

Furthermore, the location for developing these innovations is also a key consideration. Innovations developed internally within PBK often occur in parallel with ongoing traditional projects, while those under the IPK have designated spaces for development. For internally developed innovations, project managers must carefully balance the impact of innovation development on the success of their existing projects, often taking on additional responsibilities. This increased workload and the associated risks can significantly influence how project managers and other team members perceive the benefits and feasibility of the innovation.

Upon successful completion of both the testing ground and transition phases, the innovation is ready for implementation in the programme's projects. After implementation, the innovation is transferred to the asset owner for maintenance. This stage aligns with the implementation and confirmation phases of Rogers' Innovation Decision Process theory. Here, the innovation is not only put into practice but also critically evaluated for its long-term viability and alignment with the programme's objectives. This final stage is essential as it confirms whether the innovation has achieved its intended goals and can be effectively integrated and sustained over time, reflecting a key aspect of Rogers' theory.

Innovation diffusion theory

The process of innovation development within the programme involves a collaborative effort among various stakeholders, each bearing distinct characteristics and responsibilities. The role and responsibilities of each stakeholder significantly shape their approach towards accepting and developing innovation. For instance, when a plan to develop an innovation is proposed, different stakeholders assume varying degrees of risk associated with the innovation's development. This difference in risk tolerance and responsibility influences their readiness to accept and adopt the innovation.

A critical example of this dynamic can be seen in the role of project managers in the traditional projects within the programme. When innovation is developed internally, it often integrates into ongoing traditional projects, necessitating the acceptance of project team members, particularly project managers. These managers face the challenge of balancing their project's objectives – time, scope, and budget – with the uncertain outcomes of integrating innovation. The acceptance of innovation involves allocating a portion of the project's budget (approximately 10%) towards the development of the innovation, introducing a level of risk that might impact the project's objectives.

This situation creates a form of resistance among project managers. Their risk-averse behaviour, driven by the potential negative impacts of innovation on their projects, aligns with the categories of 'early majority' or 'late majority' in Rogers' Diffusion of Innovation Theory. These groups are characterized by their cautious approach to innovation adoption, needing substantial persuasion

and evidence of benefits before committing. In the context of the construction programme, project workers, including project managers, have the tendency to reject innovation development if they perceive it as detrimental to their project goals or lacking clear benefits.

The risk-averse nature of these stakeholders, especially in the face of budget and scope reductions and delays in project realization, necessitates strategic interventions. One such intervention is contractual flexibility to integrate innovation. This approach aims to mitigate the risks associated with innovation adoption, thus reducing the apprehension of project managers and other key stakeholders. By offering contractual terms that account for the uncertainties and potential challenges of innovation, the programme can encourage a more receptive attitude towards innovation, easing the concerns related to project objectives.

7.1.3. Characteristics of a construction programme

This research identifies all of the characteristics of a programme being mentioned in the literature review on the case study. First the case study programme consists of a high number of interrelated projects. Not only interrelated projects, but the programme also establish an innovation project that goes in parallel with a traditional project. This signifies how the synergy through the programme provide spaces on pursuing innovative ideas that may not be achievable had the projects operates individually.

Other characteristics that were identified in the case study is that the programme shares resources among projects to maintain quality, ensure a steady supply of workforce, and increase the effectiveness of knowledge management (Lycett et al., 2004; Shehu & Akintoye, 2009). Within the case study, this characteristic can be observed as well in the development of innovation within the internal organization. The execution of a pilot project to develop innovation within the programme may draw resources (i.e., place, budget, and workers) from a variety of departments within the programme. However, the resistance from workers in the project to reject innovation might imply that the programme has yet to find the best way on effectively provide space on sharing resources.

7.2. Limitations of the research

Discussing the research limitations can provide valuable insight for future research. The limitations encountered in this research are as follows:

- Interdisciplinary challenges: the research combines concepts from behavioural science (i.e., uniqueness bias), innovation, and construction. Despite the efforts, the study was unable to incorporate experts from behavioural science. This interdisciplinary gap might have limited the depth of analysis, particularly in interpreting the influence of behavioural factors like uniqueness bias.
- Contractual influences: the study acknowledges the significant role of contracts in influencing the individual acceptance of innovation but does not delve into the specifics of these contracts. A more detailed examination of contract terms could provide a richer understanding of how contractual obligations shape individual acceptance of innovation.
- Scope of the master program: uniqueness bias as a concept did not align perfectly with the scope of the Construction Management and Engineering program, which the researcher took for this thesis. This mismatch may have restricted the exploration of this concept in a more context-specific manner relevant to construction management.
- Single-case study: The research employed a single-case study approach to fit within the time frame of the study. While this allowed for an in-depth analysis of a specific situation, it limits the generalizability of the findings to other contexts of construction programme.
- Exploratory nature of the research: given the exploratory character of the research and the limited previous research about uniqueness bias in the construction programme, the study

relied on literature from behavioural science and project management. This might have limited the direct applicability of findings to the specific context of the construction programme.
- Evaluation of the framework: the proposed framework was evaluated by only one expert due to time constraints. Multiple evaluations would have provided a more robust validation and diverse perspective on the applicability of the proposed framework.

Chapter 8

Conclusion & Recommendation

This chapter presents the conclusions of this study. First, the answer to the research question is presented in Section 8.1. Afterwards, recommendation is presented in Section 8.2.

8.1. Answering the research question

The main research question is a cumulation of four sub questions. As such, answering the sub questions will collectively answer the overarching research question.

"To what extent does uniqueness bias exist within the acceptance of innovation based on standardization in a construction programme?"

Answering SRQ-1: What is the process of innovation acceptance in a construction programme?

To answer the process of innovation acceptance within the programme, it is important to first understand the process of innovation development within it. In general, the phase of innovation development can be divided into four, which are initiative phase, testing ground phase, transition phase, and transfer and implementation phase. These phases apply to both product type innovation and process type innovation. Within the initiative phase, ideas about innovation within the programme are explored. When an idea is considered to have a potential benefit towards the programme, a consideration to develop the ideas further is made. This is where the development of innovation starts, where related stakeholders are gathered to help on the development of innovation. The stakeholders involved within the development varies depending on need, starting from the workers within the innovation department, workers from the ongoing projects, market parties, and knowledge institutes. The gathered stakeholders have each and their own interests and attitude, and resources towards the ideas, and each of them has the right to reject or accept the development of innovation. For example, the development of innovation requires a space for development, and to acquire that it typically incorporates workers from an ongoing project to join the innovation development. If the workers perceive the innovation in a negative way and reject the proposal, the development would not be started.

If all of the related stakeholders have already made a consensus to develop the innovation, the development then moves into the testing ground phase, where a pilot project is established to develop the idea in a small scale. If the result of the pilot project is perceived to be positive, it then moves into the transition phase where the innovation is tested on its scalability. On the other hand, if the result were the opposite, the testing ground phase might be executed once more, or the development of innovation might be cancelled. If the transition phase generates a positive result, the innovation will then be implemented on the projects within the programme, and transferred to the asset manager of the structures where the innovation is implemented.

Answering SRQ-2: What are the factors that influence the acceptance of innovation based on standardization?

The factors that influence the acceptance of innovation gathered from this research are categorized into precondition, barriers, and enablers. The categorization is based on the data gathered from the semi-structured interview. Preconditions are fundamental elements that must be present within the programme for innovation development and implementation to take place. Barriers are factors or conditions within a programme that hinder the introduction or

implementation of innovation. Enablers are factors or conditions within a programme that actively promote, support, and facilitate the development and implementation of innovation.

Three preconditions were identified that are essential for fostering innovation: availability of suitable place for development, mindset to innovate, and availability of financial resources to support innovation activities. Eight barriers were identified, which include: less amount of work volume, shifting innovation objectives and constant changes in project scope, difficulties in finding location for innovation, resistance from established practice, lack of coordination, lack of direction, large number of stakeholders, and operational constraint. Furthermore, this research identified two enablers that facilitate innovation, which are a positive business case that supports innovation, and contractual agreements that supports innovation.

Answering SRQ-3: How do the factors that influence the acceptance of innovation based on standardization relate to uniqueness bias?

This study explored the concept of uniqueness bias in the context of innovation acceptance within a construction programme. Uniqueness bias, as defined in the literature, is the tendency of project managers or planners to view their projects as uniquely different, which may hinder knowledge transfer and risk assessment. The research develops two hypotheses to answer this sub-research question: firstly, whether uniqueness bias is recognized by those involved in the construction programme (H1), and secondly, whether this bias negatively impacts the acceptance of innovation based on standardization (H2). However, the semi-structured interviews conducted did not provide significant evidence to support either hypothesis. While interviewees acknowledged challenges in implementing standardization due to factors like scope reduction, organizational culture, and reliance on established practices, they did not explicitly recognize or link these challenges to uniqueness bias.

The study found that while there is resistance to standardization and innovation within the construction programme, this resistance is more likely due to practical considerations such as operational constraints and financial requirements, rather than a perceived uniqueness of each project. The concept of uniqueness bias, as a distinct factor influencing the acceptance of innovation, was not clearly supported by the data. As a result, both Hypothesis 1 and Hypothesis 2 were not conclusively supported by the semi-structured interview results. The research concluded that the influence of uniqueness bias on innovation acceptance remains unclear, and the data did not identify definitive factors contributing to this bias or its impact on the construction programme.

Answering SRQ-4: How can the model or framework assist in fostering a better space for innovation acceptance in a construction programme?

The framework is built based on the preconditions, barriers, and enablers found from the empirical study, and is aimed to reduce several barriers, and enhance enablers to innovate. The framework is intended to be utilized by the public client, and for an ongoing programme. It consists of three intervention plans, which are: establishing a clear baseline and direction of a programme, creation of innovation section within the programme forum, and a contractual flexibility for innovation integration. The first intervention helps on providing clear direction to every worker within the programme, which would help on creating synergy in the effort of pursuing innovation. The second intervention helps on providing information revolving around innovation within the programme, keeping all the workers informed, motivated, and see opportunities that they might be able join in. Lastly, the third intervention helps on reducing the risk of innovation development posing negative impact on the project objective, which would provide more room for workers in projects to take innovation initiatives.

8.2. Recommendations

Recommendations are given both to public client and external parties working in a construction programme. Afterwards, recommendations for future research are given.

8.2.1. For public client

- Continuous update on programme direction: Public clients should regularly update all stakeholders on the programme's direction, especially concerning innovation. Since programmes are dynamic and are subjected to various external influences, understanding the program's evolving direction is crucial. This awareness helps internal workers appreciate the significance of innovation, thereby shaping their perception and support for innovative initiatives.
- Information sharing on innovation progress: It is vital to have an effective mechanism for sharing information about the progress of innovation within the programme. Public clients should establish clear channels for sharing updates on innovation development plans to both internal and external workers in a programme. This transparency helps in building a supportive environment for innovation and ensures that everyone is aligned with the programme's objectives.
- Contractual flexibility for innovation: The research heavily suggests that most of the time resistance to innovate within the internal organization of the programme comes from the fact the idea of innovation development might have a negative influence on the individual's ongoing responsibilities, resulting in a risk-averse behaviour. Public clients should consider incorporating flexibility into contracts, allowing workers more room to engage with innovation development without compromising their primary responsibilities. This flexibility can alleviate the risk-averse behaviour and encourage a more proactive approach to innovation.
- Prioritize long term partnerships with external partners: For successful innovation development and implementation, a long-term commitment is often necessary, both in terms of time and financial investment. Public clients should focus on building and maintaining long-term partnerships with external partners. These sustained collaborations enable external partners to recognize the viability and potential profitability of innovation projects in the long run, fostering a more supportive environment for innovative efforts.

8.2.2. For external parties

- Proactive communication with public clients and stakeholders: External parties should maintain regular and proactive communication with public clients and other stakeholders in the programme. This involves staying updated with the latest developments and looking for chances to work together on innovation. Keeping in constant touch ensures that external parties are well-informed about the programme's direction and can actively participate in innovative activities. This kind of ongoing communication also leads to opportunities for joint projects and partnerships that are essential for bringing innovation into the programme.
- Active sharing of innovation knowledge: It is important for external parties to share their knowledge and expertise about innovation with the programme. By offering their insights and innovative ideas, they can help to start and carry out new innovative projects. This not only helps to build a culture that supports innovation but also shows the value that external parties bring to the programme's advancement and success in adopting new ideas and practices.

8.2.3. For future research

Based on the identified limitations of this research, below are some recommendations for future research:

- Future research could actively involve experts from behavioral science. Such collaboration can deepen the understanding of the concept of uniqueness bias, on how it manifests the innovation acceptance, and how can it be effectively assessed.
- This research acknowledges the significant role of contractual agreement towards the acceptance of innovation within an individual. Future study could delve into how contractual agreements influence the acceptance of innovation within a programme.
- This research identified the influence of organizational work culture on the acceptance of standardization. Future study may delve into this topic.
- Due to the time limitations, the proposed framework is only evaluated by one expert, hence making the applicability of the framework limited. Further research is recommended that the evaluated framework be improved based on the suggested gathered in this research as well as performing new evaluation to gather insights on understanding the applicability of the framework in practice.
- This research only performs a single-case study, limiting the generalizability of its finding. Future study may incorporate multiple case study to enhance the generalizability of the results and provide more comprehensive understanding of how the findings apply across various contexts in the construction industry.

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Appendix A: Literature Search Plan

A.1. Research problem:

There is resistance to selecting innovation that is based on standardization in the *Programma Bruggen en Kademuren* (PBK), hindering its ability to achieve its goals efficiently. The resistance is believed to be derived from uniqueness bias that comes from the project manager/other stakeholders.

A.2. Main research question:

"To what extent does uniqueness bias exist within the acceptance of innovation based on standardization in a construction programme?"

A.3. Sub-questions:

1. What is the process of innovation acceptance in a construction programme?
2. What are the factors that influence the acceptance of innovation based on standardization?
3. How do the factors that influence the acceptance of innovation based on standardization relate to uniqueness bias?
4. How can the model or framework assist in fostering a better space for innovation acceptance in a construction programme?

A.4. Search plan:

The focus of this research is to understand how uniqueness bias influence the acceptance of innovation on a construction programme. From that particular focus, there are three concepts that are being combined: uniqueness, bias, innovation, and programme. To find related literature, it is essential to utilize a set of relevant keywords. The keywords being utilized in this research can be seen in Table A-1. The keywords are derived from concepts being included in the research, along with its synonyms.

Table A-1: List of concepts and keywords related to the research.

Concepts: Combine with **AND**					
Synonyms and/or related terms: combine with **OR**	*concept 1: Uniqueness bias*	*concept 3: Acceptance*	*concept 4: Innovation*	*Concept 5: Construction*	*Concept 6: Programme*
	Unique	Acceptance	Innovation	Civil engineering	Programme
	Uniqueness	Adoption	Novelty	Civil construction	Multi Project
	Uniqueness bias	Resistance	Advancement	Construction Industry	Portfolio
	Perceived uniqueness	Diffusion	Transformation		Programmatic Approach
	Bias	Barrier	Process Innovation		
			Technology		

A.5. Information resources to be used:

Table A-2 shows the source of information that this research is looking into.

Table A-2: List of information resource utilized in the research.

Information source	Which document type?
Scopus, ScienceDirect, Google Scholar, JSTOR,	Research/conference papers & articles
Web of Science	Research/conference papers & articles
TU-Delft Education Repository	Master and Bachelor thesis related to the subject matter

A.6. Steps of literature review

Below are the steps of performing literature review. It is important to note that the primary keywords have been established in Table A-1.

1. Using Boolean Operator "OR" for Initial Search: The keywords are initially combined using the Boolean operator "OR" in an academic search engine, resulting in a broad and comprehensive collection of literature.
2. Refinement with "AND" and Synonyms: To refine the search, additional relevant concepts and their synonyms are introduced using the Boolean operator "AND", effectively narrowing down the initially large pool of results.
3. Iterative Search Refinement: This step involves an iterative process of adjusting and adding keywords to continually refine the search results, aiming to reduce the number of relevant literatures to a more manageable size.
4. Keyword Adjustment for Optimal Results: If the search generates too few results, some keywords are adjusted or removed to create a balance between specificity and breadth, ensuring a sufficient range of literature is covered.
5. Abstract Reading and Literature Selection: The final step is reading or skimming of the abstracts of the resulting literature. This phase involves selecting the most relevant studies for the research, based on the detailed examination of their abstracts.

Appendix B: Exploratory Interview Protocol

B.1. Research introduction and objective

The programme faces challenges in adopting innovative solutions, particularly those based on standardization such as parametric design. There is a presumption that such challenges are attributed to uniqueness bias, where individuals perceive their projects are more distinct than they actually are. This bias hampers the programme's innovation goal, cost reduction, and progress acceleration.

B.2. Exploratory interview objective

There are two objectives that the exploratory interview intends to realize. First is understanding the process of how innovation came, was selected, and implemented in the construction programme. And secondly to identify individuals or groups involved during the development of innovation, along with their authority on accepting innovation.

B.3. Exploratory Interview questions

Below are the questions asked for the exploratory interview. With the "exploratory" nature of the interview, the author may ask questions that come up during the interview process.

Section 1: Innovation Exploration, Development, and Acceptance in PBK

1. Can you describe the overall process of how innovation is explored, developed, and accepted within the PBK?
2. Which stakeholders created the requirements on what kinds of innovation needed to be explored in PBK?
3. Which stakeholders are the critical decision-makers in developing innovation within PBK? Or who has the authority over each phase?
4. Do the critical decision-makers differ in every living lab?
5. Do the innovations developed by the consortia from IPK also develop their innovation within the living labs/field lab? or do they do it separately?
6. When exploring ideas, do the living labs focus only on a specific type of innovation? (e.g., process innovation, product innovation)
7. How many innovations in total are from all the living labs that are currently being developed?

Section 2: Stakeholders in the Decision-Making Process for Innovation Acceptance

Who are the main stakeholders involved in the decision-making process for innovation acceptance, and what are their roles and responsibilities?

1. Could you tell me where living labs are located on the Organogram? And which stakeholders create the living labs?
2. Could you tell me how many living labs are there in PBK?
3. Which stakeholders are involved in a certain living lab?
4. Which stakeholders create the requirements on what kinds of innovation that is needed to be explored in the living labs?
5. Which stakeholders decide who is going to be part of a certain field lab when developing an innovation?

Section 3: Importance of Stakeholder Support and Acceptance

With the number of stakeholders involved in developing innovation, what do you think is the importance of support and acceptance of each stakeholder during this process? Do you happen to experience issues related to it?

Extra

How does the budget cut that PBK experienced influence innovation development?

Appendix C: Semi-structured Interview Protocol

C.1. Purpose of the interview

The interviews mainly focused on gathering data from the industry to address four sub-research questions. Semi-structured interviews with different individuals from the client, research institute, contractor, and consultant that is involved in developing innovation in a construction programme will provide the information needed for the analysis phase of this research. Questions asked during the interview are based on the research sub-questions 2,3 and 4, which are:

SRQ-2 What are the factors that influence the acceptance of innovation based on standardization?

SRQ-3 How do the factors that influence the acceptance of innovation based on standardization relate to uniqueness bias?

SRQ-4 How can the model or framework assist in fostering a better space for innovation acceptance in a construction programme?

C.2. Selection Criteria

To understand how the selection criteria are created, it is crucial to grasp the research scope. This study possesses an exploratory nature due to the limited academic literature addressing bias in innovation acceptance within construction programmes. Construction programme as a form of temporary organization has a larger number of individuals working, more complex organization with a longer timeframe compared to a construction project. This created a complexity, and adding to the fact of limited research time, a lot of scoping down is needed.

Following preliminary exploratory interviews, this research specifically zooms in on the innovation development phase where resistance to accepting innovation happens. Amidst a multitude of innovations being developed within the construction programme, the research focuses on one particular innovation: parametric design. Parametric design as an innovation is being developed in PBK in many segments. First, it is developed as a method to substitute traditional ways of designing. It is also developed as a smaller subset within other innovations as well, such as the 3D-printing water sewage for quay walls, and some other innovations. The selection of parametric design as a scope helps the research to perform a deeper analysis for one specific subject, as opposed to a broad one.

Consequently, the individuals who are selected for the semi-structured interviews are those who are involved in the exploration and development of parametric design as an innovation. The research also intends to understand the different perspectives of uniqueness between different stakeholders. As such, the individuals should come from a variety of roles, such as individuals working on the strategic level management (e.g., programme director) that has a high-level overview of the organization, tactical level (e.g., head of a certain team) which are the intermediate level, and operational level (e.g., project leader) that focus on the day-to-day running. Adding more, an understanding of how external parties (e.g., contractor, consultant) perceive uniqueness may also be beneficial, hence it is added to the potential candidate as well.

C.3. Interview Structure

The interview is divided into four main sections. First, the introduction of the research is provided. The introduction refrains from explicitly disclosing the research focus on bias in innovation selection. The deliberate omission is intended to prevent potential interviewee response modification, a phenomenon where participants may unconsciously tailor their answers toward the perceived expectations of the interviewer. This approach seeks to elicit more candid

and authentic insights, allowing for a nuanced exploration of their experiences and perspectives. Afterward, general questions about the interviewee's roles, responsibilities, and experiences are asked. The third section is the main questions which the interviewee will be asked regarding the theoretical framework built for the case study. Lastly, the interview ends with some closing questions.

Introduction and confidentiality of the interview (maximum 5 minutes)

1. How would you like to be mentioned during reporting?
    - Name, function, organization
    - Only function and organization
    - Anonymous
    - Other requests
2. Do you agree to the recording of this interview? The recording will only be accessed and utilized by the author as part of the research analysis. After the research is finished, the recording will be destroyed.
3. Brief explanation about the research: research on the acceptance of innovation in a construction programme.

Introduction questions (maximum 5 minutes):

1. What is your name and role in the programme of bridges and quay walls?
2. Could you describe your tasks and responsibilities within the programme?
3. How much experience do you have in construction projects?
4. What is in your perception the purpose of the interview? And are you the right person to speak on this matter? (*If not decide whether to stop or continue*)

Main questions (maximum 45 minutes)

Code	Questions
Q1	What would be in your view the role of innovation in achieving the goal of a construction programme specifically on PBK? Do you think innovation is needed for the current state of PBK? What kind of innovation that you think needs to be developed in PBK (specifically on Quay Walls)?
Q2	What, in your view, are the primary challenges associated with the development and implementation of innovations within PBK? Please share your insights on the most significant hurdles you've encountered or observed during this process
Q3	In your perspective, what considerations do you have in mind when you think about accepting or rejecting an innovation?
Q4	Brief explanation: This research focuses on the innovation acceptance in PBK. Upon performing exploratory interviews, we noticed that there is resistance to accepting innovation based on standardization. We define innovation based on standardization as a creative and strategic implementation of novel or significantly improved products or processes with a structured framework of established guidelines and common approaches. It involves harnessing the power of existing standards and standardized solutions to address recurring challenges and achieve consistent and repeatable outcomes. Have you been involved in developing parametric design? From your perspective, What drove the decision to implement parametric design? Can you describe it and its key features?
Q5	Were there any specific reasons or factors that made it a suitable choice for PBK? What makes it stand out from other innovations you have been involved in PBK?

Q6	What kind of concerns or considerations that you encounter related to the compatibility of parametric design to the projects within PBK?
Q7	Do you personally foresee that this innovation can be useful in PBK? Why? (Follow-up if they say no) What do you think could enhance its application?
Q8	Were there any external factors (e.g., market trends, regulations) that played a role in shaping the approach to develop or implement parametric design?
Q9	When we talked about a project, a Project is a temporary endeavor undertaken to create a unique product, service, or result (PMI, 2006). What would in your experience set one quay wall project apart from other quay wall projects in PBK?
Q10	Based on that, specifically on Quay Walls Projects, what would in your experience contribute most to such differences?
Q11	Given the uniqueness you just explained, do you think that poses as a major challenge towards developing or implementing innovation based on standardization such as parametric design?
Q12	Moving to a broader perspective, many innovations are based on standardization. At the same time, many people perceive projects as unique. In your opinion, is there a way standardized innovations can be applied effectively to diverse projects?
Q13	Now I would like to specifically discuss parametric design. When developing this innovation, have you encountered an instance where other stakeholders have a different perception of that particular innovation? Why do you think that happened? Do you think the innovation can be reconciled? Which stakeholders are the most critical during the development of this innovation?
Q14	In developing innovation, collaboration with various stakeholders happened. Until now, have you encountered problems during this collaboration?
Q15	Have you encountered instances where other stakeholders have a different perception of project uniqueness compared to you? Could you provide an example?
Q16	How do you navigate situations where there is a different perception of a project's uniqueness and the views of your peers? Are there any challenges in reconciling these differences?

Information

	General question
	Specific question (Parametric design)

Closing questions (5 minutes)

1. Explain to the interviewee the study (Uniqueness bias). Is there anything you would like to mention related to this research that we have not asked you?
2. Now that you know the research, who do you think can be very beneficial for me to interview? (Tell them not to spoil the research for that particular person)

C.4. Expected outcome.

As mentioned previously, the result of the semi-structured interview will be analyzed by performing a thematic analysis to answer SRQ-2, SRQ-3, and SRQ-4. Q1 and Q2 intend to understand the interviewee's general perception and how they see innovation in the construction programme. Q3 until Q7 starts focusing on one specific innovation, parametric design, which is the scope of this research, as well as their personal perception of the innovation. Answers to these particular questions will help in gathering factors that create uniqueness bias, and the extent of it from a variety of stakeholders. Lastly, Q8 until Q14 connects the concept of innovation and uniqueness in a project. This will help in answering SRQ-4.

C.5. Email sent to interviewee.

The following paragraph below was sent via email to the interviewees:

Beste Collega's

Ik ben Put Gandhi Padma en ik ben afstudeerder aan de TU-Delft. Het PBK heeft samen met de TU-Delft een onderzoek gestart naar de omgang met innovatie binnen het Programma Bruggen en Kademuren.

In overleg met Team KWIK (Kwaliteit en Innovatie in de Keten) is gezien uw rol in het programma uw naam naar voren gekomen om geïnterviewd te worden over dit onderwerp.

Daarom zal ik binnenkort diepte-interview van ca. 1 uur met u inplannen. We zouden het op prijs stellen als u daar gehoor aan wilt geven.

N.B. Ik heb de voorkeur om het interview in de Engelse taal af te nemen aangezien ik niet Nederlandstalig ben. Mocht u daar een probleem mee hebben laat dat dan a.u.b. per omgaande weten.

Het interview zal dan in het Nederlands worden afgenomen waarbij mijn begeleider dan zelf de interviewer zal zijn. Dat heeft echter niet de voorkeur aangezien Ik de interviews verder moet uitwerken voor het onderzoek.

Alvast bedankt voor uw medewerking om beter zicht te krijgen op hoe we binnen het PBK met innovatie omgaan.

Met vriendelijke groet,

Putu Gandhi Padma

Appendix D: Expert Evaluation Protocol

To validate the framework, interviews are conducted with experts. Two criteria are utilized to select the expert, which are:

1. Working in an ongoing construction programme within the Netherlands.
2. Has a role within the strategic level of the programme organization (e.g., programme director).

The expert shall not be involved in the research, to make them independent. The interview is conducted independently and spans approximately one hour. Results from the expert evaluation will be integrated to the final framework. The expert evaluation protocol is as follows:

Confidentiality of the interview (maximum 5 minutes)

1. How would you like to be mentioned during reporting?
    - Name, function, organization
    - Only function and organization
    - Anonymous
    - Other requests
2. Do you agree to the recording of this interview? The recording will only be accessed and utilized by the author as part of the research analysis. After the research is finished, the recording will be destroyed.

Introduction and presenting the research's result (maximum 20 minutes)

Presents brief information about the research from its objective, research question, and its scope. Additionally, definition of the concepts utilized in the research is also presented. Presents the research empirical result and its analysis. Presents the preconditions, barriers, and enablers identified during the empirical research.

Questions asked:

1. Do you recognize those barriers?
2. Do you recognize those preconditions for innovation?
3. Do you recognize those enablers?
4. What do you think is missing from the preconditions, barriers, and enablers being presented?

Presenting the Framework (maximum 30 minutes)

Share the intervention plans and explain its reasoning.
Questions asked:

1. Do you recognize the action plans in this framework?
2. Of the proposed solutions, which ones are relevant to the practice?
3. Are there any other solutions that you think might be useful in improving the acceptance of innovation within the programme?

Closing questions (maximum 5 minutes)

1. Now that you know the research, who do you think can be very beneficial for me to interview? (Tell them not to spoil the research for that particular person).