Utilizing the potential of infrastructure renovation programs

An explorative research on how goals can be controlled and synergies can be utilized in infrastructure renovation programs

S.J.N. Bindels - TU Delft - MSc. thesis - May 2021

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by

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Preface

While looking back at the graduation process, I like to compare this process with the training I did simultaneously to be able to run a marathon. During both the graduation process and the marathon process, I typically wanted to achieve something every day. This resulted in keeping on reading and writing to make sure I did not miss anything important. Even though the information gained was irrelevant for my thesis, I still wanted to include it since it was an interesting insight. Regarding my workouts, I kept on increasing my mileage every Sunday, while my knee was not stable. Deleting the paragraph I wrote or skipping a workout was not a possibility that had my preference, as it felt like a waste.
However, writing that paragraph did indirectly help me to obtain an overview of available knowledge and set up my research as it is now. In addition, resting my legs instead of running allows them to fully recover and perform for the full 100% on a next workout.
I learned that the achievement of graduating and finishing after 42.2 kilometres of running requires patience besides hard-working. The most important lesson I learnt is to not be afraid to take a step back sometimes because it might turn out to be a step forward in the end anyways.

Throughout the writing of this MSc thesis, I have received a great deal of support and assistance. I would like to acknowledge my supervisor, Martijn Leijten, for the effort you put into my research: your feedback was very valuable. Furthermore, I would like to thank my chair of the committee, Marleen Hermans, for her insightful feedback that pushed me to sharpen my work. Also, thanks to Ad Straub for his great involvement in the process. Last, but not least, I would like to thank Martine van den Boomen for her wonderful collaboration and guidance. She motivated me with an always positive attitude in combination with her expertise and excitement in doing research.

Also, I would like to thank everyone at AT Osborne, who were always open to discuss aspects of this research. I felt very welcome and enjoyed my time. In particular, I would like to thank Sandra Brouwer and Geertje van Engen, for their enthusiastic, warm attitude and constructive feedback that resulted in leaving the Teams meeting with my thoughts a bit more structured than when I tuned in. It has been incredibly valuable (and pleasant).

I would also like to thank my family and friends. Patrick, Kitty, Bas & Karlijn, thank you for supporting and encouraging me. My friends for their positive support on every single moment of the day and the fact that they were easily persuaded to walk/run/play board games/have a drink with me as a great distraction. Lastly, Frank, I would like to thank you for your never-ending support and for always having some back-up chocolate available.

Hopefully, I succeeded in the goal of conducting a research that will contribute to scientific knowledge and at the same time provide actual usefulness to current practice. I hope you will enjoy reading the result!

S.J.N. Bindels
Delft, April 2021

Executive Summary

Introduction
In the upcoming years in the Netherlands, the Dutch government will be focusing on renovating infrastructure assets. In the years to come the end of the life cycle of many infrastructure assets will be reached and in addition, the load and use of constructions have increased over the past decades. It is important that renovating existing infrastructure assets does not fall behind, this has happened in the past as not enough effort has been invested into the militance which could be due to economising. Lastly, renovation projects became an inexpensive alternative to replacement.

Moreover, a shift from organizing each project individually to a more program-oriented approach has been observed in renovating infrastructure. Programs can be defined as bundling the organization of related projects which in turn achieves synergy. Synergy is a prominent feature of a program and is described as "achieving benefits that are not possible when projects are managed individually" for example, utilizing economies of scale and repeating processes is a fundamental aspect therefore, the managing of the budget and planning can be successfully achieved.

In addition to the above, another trend that has observed within infrastructure renovation programs is the broadening of the scope, whereby it is becoming increasingly apparent that non-functional goals that focus on adding value (secondary goals) are outlined for construction programs. Previously, goals were only defined in the functional aspects of renovation (primary goals) whereas, secondary goals such as sustainability and spatial planning are now set up.

Problem statement
Observed trends have highlighted that infrastructure renovation programs (IRP) are currently not being utilized to their full potential. It has also shown that scientific research is falling behind with its response to the trends observed and there have been minor studies conducted to examine how achieving diverse program goals in IRP can be controlled. Moreover, not enough attention is paid on how a synergy can be optimally utilized in infrastructure renovation programs.

Considering these observations, it is becoming crucial to respond to this lack of knowledge to utilize synergy and control in both primary and secondary program goals. This research study aims to improve control over program goals and to utilize synergy in IRP. Therefore, the following main research question has been established:

> *How can infrastructure renovation programs in the future gain more control of their program goals and utilize the potential program synergy?*

Research approach
The method used to answer the main question is twofold, it consists of a literature study followed by empirical research. The literature study elaborates on the synergies that program management can utilize, how control is gained and the barriers that come with this. The empirical research consists of conducting three case studies and their synthesis. Firstly, outlined are the way program goals are controlled and synergy is utilized in practice, data is collected by analyzing policy documents and conducting semi-structured interviews. Second, by comparing the cases, interpreting them, and studying existing literature, potential solutions arise for both improvements in controlling program goals and utilizing synergy. By organizing a focus group with experts, barriers are prioritized through weighting, and proposed solutions for overcoming the barriers are validated.

Results
Through conducting the literature study, an understanding of program management is obtained. This has allowed for a deeper understanding to be gained of the control approach, and utilization of synergy and barriers that come with both processes. The literature study is significant for understanding the key concepts of program management and forms a proper foundation for coming up with improvements.

Program management
Although the concepts program, project, portfolio and multi-project management have been used inconsistently in practice, the literature study has provided clarity on the definition of these concepts. Control over programs can be achieved by running through the four stages of the program life cycle: (1) identification, (2) shaping the program, (3) gaining control, and (4) closing off the program. Programs have a fortunate opportunity to utilize synergy because of its coordination and alignments of a group of related projects. Synergy manifests itself in programs in various ways; a type of synergy is that the alignment of projects within a program induces the opportunity of setting up long-term, value-adding strategies. Furthermore, sharing the same resources, results not only in continual quality but allows for a stable supply workforce and saving budget. Collectively organizing planning and budget come with positive effects as well hence, program management induces synergy in different forms.

Controlling Infrastructure Renovation Program goals
Highlighting the difficulties that arise when monitoring the progress of program goals, it has been found that problems are often encountered whilst drawing up program goals and their key performance indicators, this is particularly challenging for secondary program goals. In addition, transferring measured data into interpretable information causes difficulties. The proposed solution to gain control over both the primary and secondary goals of IRP is to shift the focus of control on performance this in turn would take control of the process. To be more specific, although key performance indicators are not always tangible, this can be overcome by setting up process indicators that track the program's success over the course of the program. Regarding obtaining interpretable information, careful and constant attention to the connection between which content is essential and how this is acquired is critical. Hence, focusing on the process can give guidance and achieve success. Within this way of working, keeping goals and indicators focused and active is vital. It should be an iterative approach whereby continuously assessing, developing and monitoring.

Reflecting upon the improvements that need to be considered in relation to the program organization, the implementation of three solutions are suggested. Firstly, stimulating a collaborative working environment when executing tasks and creating awareness of the beneficial collective program management approach is essential as there has been a lack of commitment to this approach. It is important to create awareness and actively control that collective interests are a priority. Secondly, implementing a change management procedure has been suggested, in which the effect of the change for all program goals is measured. In this way, it is apparent when a change in the scope is functional for achieving program goals. Lastly, the program management team should prioritize what needs to be coordinated on program level and what should be organized for all projects individually. In the organization of the program, the roles and responsibilities of the key team members should clearly be defined to ensure that the program can rely on the various underlying teams.

Utilize Synergy
The empirical research performed has generated in new synergy benefits that have not been described in scientific literature previously. The first new synergy benefit found in this approach is the opportunity of giving more content and solidity, which empowers political urgency. Furthermore, the collective program approach can remove obstacles that are in the way of performing research. Another advantage found, shows that a broader knowledge base can be used for decision-making this is because knowledge from more projects is available as opposed to organizing each project individually. Lastly, approaching risks collectively enables a comprehensive overview consequently, the findings of the empirical research have resulted in new contributions to existing literature.

To utilize all forms of synergy, the barriers of finding the balance should be found between making the program manageable and utilizing synergy found in a collective approach. Due to the size of the programme and the difficulty that could arise as a consequence of collectively addressing several matters in one program, it is key to ensure that it does not become unworkable and cluttered. Therefore, it is imperative to strike balance between keeping the program manageable and utilizing synergy benefits by a collective approach. This equilibrium can be be found by a combination of working in departments on tasks and practicing an integral way of working. The integral way of working can be encouraged by focusing on the commitment to the program management approach throughout the whole organization.

To utilize the advantages of conducting research collectively, the focus should be directed upon the developments of the application-oriented innovation. Associating the innovation directly to the program goals is a way to stimulate contentment. Additionally, knowledge institutions have a proper understanding of the expected potential of innovations therefore, it is recommended to involve them in the process of innovation

development to ensure application-oriented innovations.

Recommendations

In order to utilize the program's potential, it is recommended to program managers to notice and understand the forms of synergy accessible by consulting literature and previous program plans. Reflecting their own program on the theoretical potential will help examine the possibilities. Once a program management team is aware of the opportunities for synergy, decisions can be made on the programming, planning,budgeting and organization.

Also, it is recommended for program managers to be aware of the tension between project and program management. Dissipating this tension is not crucial, however, it is wise to keep an eye on it to make sure it is in proportion and healthy.

Besides, a recommendation to program managers is to focus on the attitude of the program team towards the collective program approach, since research has shown its importance. Communicating effectively and working together helps to create this awareness.

Furthermore, it is recommended that program managers reflect on their program by identifying the current way they are monitoring and compare the barriers that were recognized in this study related to their program. Thereafter, program managers can assess what benefit is desirable and has the most potential. Based upon this reflection, program managers can decide which solutions have the most potential for increasing efficiency and effectiveness of their program. Hence, the program manager can use this research to concretize actions on how to achieve improvements of their program.

In addition, enabling the power of the iterative process is recommended. It is proposed to do while setting up and developing KPIs, and during the transformation from data to interpretable information. Moreover, to find a balance between flexible/general and fixed/elaborated control, implementing iterative reflection can give footing. This can be translated into the program organization by actively making room, at a fixed moment, for meetings and discussions for reflection.

Due to the vast information and the numerous improvements proposed within this research, it could potentially be overwhelming therefore, the improvements are structured in the light of the program management cycle to give a comprehensive overview of the findings. However, since every program is unique, each program will slightly derogate from the program management cycle. Consequently, it is recommended to couple the suggested improvements to the program phases.

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List of Acronyms

IRP	Infrastructure Renovation Program
RTP	Road Tunnel Program
FPP	Flood Protection Program
BQWP	Bridges and Quay Walls Program
KPI	Key Performance Indicator
BC	Barrier correlated to controlling program goals
S	Program Synergy
BS	Barrier correlated to utilizing program synergy

I

Introduction

This part of the research focuses on introducing the subject of this research and clarifying the relevance. Also, the methodology of this research will be discussed. This has been presented in chapter 1 Problem Definition and 2 Methodology

(ANP, 2019)

1
Problem Definition

With a total value of approximately 300 billion Euro, the civil infrastructure is the most valuable public property in the Netherlands (Westenberg & Bleijenberg, 2020). In the upcoming years several impressive infrastructure renovation programs will be executed. Examples of these renovation programs are the replacement and renovation program of Rijkswaterstaat of more than 130 constructions (bridges, tunnels and highways) all over the Netherlands (Rijkswaterstaat, 2020) and the flood protection program, from Rijkswaterstaat and the regional water authorities, that include 1300 kilometers of dikes and 500 sluices and pumping stations (HWBP, 2019).

1.1. Research context

Focus on renovation

Renovation instead of substitution of the current infrastructure assets will be the point of attention in the upcoming years. There are several reasons to elucidate this alteration in the approach.

Firstly, many existing infrastructure assets reach the end of their life cycle in the near future, during the same period of time (R. Koops, 2020). This is caused by the fact that most of the infrastructure assets are built during the same period around 1950 and 1970 (van den Boomen et al., 2019). A second reason is the fact that the use and therefore the loading frequency of constructions have increased, what results in accelerating the requirement to repair. The initial design of an infrastructure asset is based on assumptions that differ from both those contemplated, and the reality. For example, during a period of 70 years, 16 times as many cars used the infrastructure than calculated in advance (Rijkswaterstaat, 2020). The third reason that renovation will be the point of attention in the coming years is that some people state that too little maintenance has been carried out. When it comes to economising, maintenance is often the first thing cut (R. Koops, 2020). Westenberg and Bleijenberg (2020) agree upon the statement that maintenance has not been well-liked. This accumulation of lack of maintenance results in an even more urgent need to renovate (Westenberg & Bleijenberg, 2020). According to Maxime Verhagen, chairman of interest group *Bouwend Nederland*, maintenance has been neglected because of a budget deficit (Vogels, 2020). The postponed maintenance of Rijkswaterstaat is increased in 2018 to 873 million euros (Wensing, n.d.). Luckily, renovation has made it to a more prominent spot on the political agenda due to the visibility of a lack of safety of the assets that may cause accidents (Hartsema, 2018). Fourthly, renovation projects became an inexpensive alternative to replacement. For this reason, more and more effort is put into renovation (van den Boomen et al., 2019).

In short, focus will lay upon renovating infrastructure assets. Firstly, in the coming years the end of the life cycle of many infrastructure assets is reached. Furthermore, the load and use of constructions have increased. Since little effort is put into maintenance, and replacement costs are high, focus will lay on renovating existing infrastructure assets.

Infrastructure renovation programs

In general, a shift to a more program-oriented approach is commonly observed in the construction industry. Instead of a policy that focuses on a single project, program management focuses on a set of projects (Spijkerbroer et al., 2015). As Shehu and Akintoye (2009) conclude in their research based on many different definitions of program management, a comprehensive definition is *"aligning and coordinating a group of related projects to achieve benefits that are not possible when projects are managed individually."*

Within the infrastructure renovation sector, this program management approach has also been widely implemented. Firstly, because infrastructure renovation assets influence one another, geographically and functionally, which makes a program management approach an opportunity (Asgarpour & Neef, 2019). Also,

existing infrastructure can be used efficiently with this collective way of working (Asgarpour & Neef, 2019). Strategic and tactical goals that are often relevant within infrastructure renovation will be encouraged by using a program (Shehu & Akintoye, 2009; Thiry, 2002). Furthermore, since renovating existing infrastructure assets will be the point of attention in the upcoming years, these significant tasks will fit with a program (Gemeente Amsterdam, 2019). Lastly, because infrastructure renovation projects could be reasonably the same operation, a collective approach is efficient and effective (McKinsey & Company, 2019).

Utilize synergy

This shift can also be clarified because of the outstanding opportunity to utilize synergy. This synergy is a prominent characteristic of a program and is described as "achieving benefits that are not possible when projects are managed individually". Synergy manifests itself in programs in various ways.

Projects within programs that share the same resources will result in continuous quality, a stable workforce supply, and a more successful knowledge management method. (Lycett et al., 2004; Shehu & Akintoye, 2009). It also has a beneficial impact on budget and planning (Asgarpour & Neef, 2019; Olomolaiye, 2007). The integral way of managing impacts the process positively by improved alignment of projects (Pellegrinelli, 1997), this results in networking synergies (Morris & Pinto, 2007). Besides this, long term visions are feasible because of programs (Pellegrinelli, 1997). The repetitive character of projects within a program results in more experience and fewer uncertainties called organizational learning (Asgarpour & Neef, 2019).

Infrastructure Renovation Programs goals

Besides the transfer to a more collective approach, another trend that has been observed is that of broadening the scope of infrastructure renovation programs (Vlist et al., 2016). In the past, when goals were defined for new construction programs, only the functional aspects of renovation (primary goals) were defined. Nevertheless, more and more often, non-functional goals that focus on adding value (secondary goals) are defined for construction programs, such as sustainability and spatial planning. In addition to the primary functional aspect of a renovation, when the construction is at the end of its life cycle, infrastructure renovation programs often define non-functional goals that focus on adding value (secondary goals).

For instance, the flood protection program from Rijkswaterstaat and the regional water authorities is an infrastructure renovation program that utilizes this method. Besides the functional goals of preventing the Netherlands from floods by strengthening dikes, locks, and pumping stations, they set up more environmental and process-related goals. Additionally, some of the sub-goals concentrate on sustainability and spatial quality (HWBP, 2019).

So, besides primary functional goals, secondary goals focused on adding value are set up in Infrastructure Renovation Programs.

Controlling goals on program level

A greater span of control is required with the increasing number of components and actors involved (Leijten, 2017), which is the case for programs compared to projects. Control over program management can be achieved by running through the four stages of the program control life cycle; identification, shaping the control approach, gaining control, and closing the program (Lycett et al., 2004; Prevaas, 2018; Thiry, 2007).

However, if program control is executed on a high level of detail, it can lead to immoderate bureaucracy levels, which could cause inefficiency within the program. (Lycett et al., 2004; Westerveld & Hertogh, 2010). Moreover, this can lead to conflict between the management on the program level and the project level because of fading goals (Lycett et al., 2004). The flexibility required in a program clash with the bureaucracy as a potential consequence of program control (Pellegrinelli, 2002). So, controlling at the program level is difficult, and the experienced need to be bridled to benefit from the benefits that program management potentially could provide.

1.2. Research gap and objective

Infrastructure renovation projects that require attention in the upcoming years are often bundled into a program. Those programs have goals that both focus on the function of the assets and a broader perspective.

However, the trend of formulating not only functional goals but also broader program goals requires additional control efforts. Even though project management does focus on researching an approach to integrate more secondary goals in the organization of control (Fernández-Sánchez & Rodríguez-López, 2010; Lam, 2020), program management does not. Besides, minor studies have been executed investigating how control can be gained to achieve these diverse program goals in Infrastructure Renovation Program (IRP).

Moreover, the synergies described earlier require organization and control in order to be beneficial. Although these efforts are of great importance to succeed (Prevaas, 2018), they are not always included in current program management approaches. Far too little attention is paid to how synergy can be optimally utilized in IRP.

The objective of this study is to fill in the previously described research gaps. The result of this research will include improvements that can be implemented to control IRP goals at the program level. In addition, improvements to utilize synergy on program level in IRP will be presented.

1.3. Research question

In order to achieve the research objective, this report will answer the following main question:

> *"How can infrastructure renovation programs in the future gain more control of their program goals and utilize the potential program synergy?"*

In order to answer the main question in manageable steps, the main question will be sub-dividend into the following sub-questions:

1. *What is program management, what forms of synergy can it utilize and what barriers can be experienced in applying this management?*
2. *What characterizes infrastructure renovation programs, and what are the commonly defined goals?*
3. *Which improvements contribute to control infrastructure renovation program goals?*
4. *Which improvements contribute to utilizing synergy in infrastructure renovation programs?*

1.4. Relevance

The relevance of this research can be distinguished in societal, practical, and scientific relevance. All three different types of relevance will be defined in this paragraph.

Societal relevance

Since public authorities are responsible for safeguarding public values, they execute these renovation programs, and therefore they are often in charge of controlling these programs. This reflects the societal relevance of this research. Improving control of program goals could breach the trend of failing construction programs. Furthermore, utilizing synergy more optimally is a great opportunity. Lastly, the programs' secondary goals often have to do with public values; examples are sustainability and spatial quality. Control over these program goals can contribute to achieving those goals, which is of paramount social importance.

Practical relevance

This research is conducted in accordance with AT Osborne. A consultancy firm that has its expertise in managing and advising on complex construction projects. AT Osborne aims to expand knowledge about the way renovation programs are controlled. It is believed that this will contribute to executing programs within the construction industry successfully, which underlines practical relevance. Furthermore, a trend has been observed: A decrease in the number of contractors that sign up for tenders of large, complex projects in the sector of ground, road, and hydraulic engineering (McKinsey & Company, 2019). The main reason is the dynamic market and how risks have been dealt with (McKinsey & Company, 2019). Renovation projects and programs can be seen as complex. This practical problem in the construction industry can be overcome when public authorities have more control over the programs of their projects, resulting in reduced risks and better accessibility.

Scientific relevance

This research will add scientific knowledge to program control. Nowadays, success is sporadic in significant project management, and a focus on program management can increase efficiency and effectiveness what can overcome these problems. Research has been done on program control but not yet specifically on infrastructure renovation programs. This is, however, relevant since renovation programs will be the point of attention in the upcoming decade; many exciting assets will be at the end of their life cycle in the following years, and replacement costs are high. Giving insights into the barriers limiting having control over programs will contribute to the scientific knowledge that is already available.

Furthermore, while research has been done on integrating sustainability into construction project portfolio management (Siew, 2016) or into project management (Dasgupta & Tam, 2005; Fernández-Sánchez &

Rodríguez-López, 2010; Hendiani & Bagherpour, 2019; Šaparauskas, 2007), it is not done extensively for program management. This research aims to provide knowledge on controlling program goals on the program level. Moreover, little research has been found that surveyed program management in the construction industry, since program management is more elaborately investigated in general (Best Management Practice, 2011; Prevaas, 2018) or in specific sectors such a pharmaceutical (Miterev et al., 2016) and the public sector (Abdullah & Vicridge, 1999).

1.5. Structure of research

This thesis comprises four themed parts that consist of chapters, as shown in 1.1 Structure of Research. The first part, Part I: Introduction, consists of this chapter, the problem definition (CH1), and a chapter that explicates the methodology used (CH2). Part II: Literature Review deals with a chapter on program management and its synergy (CH3) and a chapter on infrastructure renovation programs (CH4). Part III: Empirical Research focuses first on the methodology applied (CH5), following by depicting the essential information per case (CH6) that derived from the multiple-case study. Then, an interpretation of this information will be given, both on control of IRP goals (CH7) and its synergy (CH8), whereby literature presented in Part II: Literature Review assists this analysis. Lastly, the results will be validated (CH9) through an expert meeting. The last part, Part IV: Conclusion and discussion, present the research findings. The discussion (CH10) will focus on the validated results and their importance and contribution to the field. The discussion explores the underlying meaning of this research. Also, limitations will be presented. Lastly, the conclusion (CH11) will answer the research questions and provide program managers with recommendations.

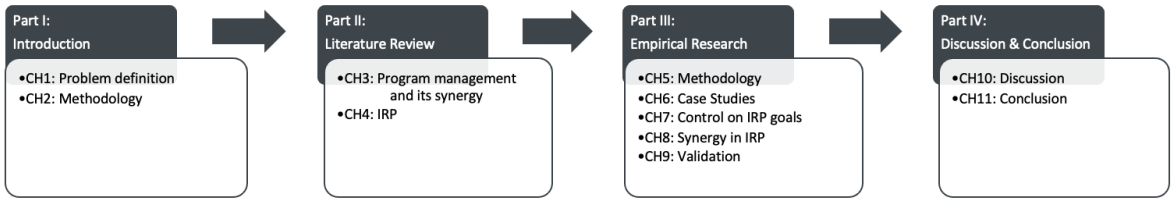

Figure 1.1: Structure of Research

2
Methodology

The method used for answering the main question and its sub-questions is presented in this chapter. This chapter will address all parts conducted in this research.

2.1. Scope

It is essential to ensure that a feasible scope is set for the research given the time frame. This research focuses on controlling program goals and utilizing synergy in Dutch Infrastructure renovation programs.

Firstly, this research is written in light of Dutch infrastructure renovation programs. The focus on this sector is applied in Chapter 4 Infrastructure Renovation Programs. The reason to focus on the Netherlands is that renovating infrastructure will be the point of attention in the upcoming years, as described in Chapter 1 Problem Definition. This clarifies the reason for focusing on renovating infrastructure programs as well. Another reason for focusing on renovating infrastructural assets is because conducting this research on all construction projects in a multitude of sectors, results will probably be too generic. This will result in conclusions that can not provide enlightenment. In addition, the trend of adding broader goals is observed in infrastructure renovation programs, which empowers the relevance. This research tries to contribute both societal as scientific knowledge by responding to these trends.

Secondly, a decision is made to investigate programs in a particular phase. Prevaas (2018) distinguishes four different stages within the life cycle of a program management approach. At first, during the orientation stage, the decision will be made whether a program management approach will be used. Then, during the edify stage, the program will be shaped and formalized with a program plan as result. During the execution phase, the focus will lay upon realizing the program, which includes watching over and criticizing the progress of the goals. Lastly, the phasing down stage will be finalized.

This research will focus on the execution phase, so there has been chosen for a program management approach already, and goals on the program level are set up. The reason for this delimitation of the thesis is that this research aims to investigate how control is organized during the program.

So, the scope as described safeguards that the used data is alike, and that generic conclusions can be drawn to for infrastructure renovation programs.

2.2. Strategy

This paragraph shows the strategy applied in this research regarding several considerations. First, this main research question starts with "how" what shows its explorative character Yin (2017). The research also consists of a constructive approach; the main goal is to improve program management in the context of infrastructure renovation programs. Mainly qualitative analyses are executed since the research goal is to comprehend processes, which is in this case controlling goals and utilizing synergy. Results will be analyzed and processed in a contemplative way. Both an inductive and a deductive approach will be used in this research. The literature study on program control, infrastructure renovation programs, barriers and synergy will be inductive. Research that makes use of the case study has a more deductive character.

2.3. Method

Different methods are used to answer the different sub-questions used within this research. The following paragraphs will specify these methods.

Part I: Introduction
This part of the research has focused on introducing the subject of the study. The relevance has been clarified. It consists of both the previous chapter on the problem definition, as well as the current chapter on the methodology of the research.

Part II: Literature Study
This part of the research aims to form a literature overview to give insights on program control in infrastructure renovation programs. Firstly, program management is sifted through, including characteristics, forms of synergy and barriers. Then, infrastructure renovation programs come to light. Aspects, incentives, and goals for infrastructure renovation programs are reported. When program management is understood, and infrastructure renovation programs are mapped out, the empirical research can be conducted.

This part is divided into two chapters, each chapter answering a sub-question. The research questions that will be answered in this part are:

1. *What is program management, what forms of synergy can it utilize and what barriers can be experienced in applying this management?*
2. *What characterizes infrastructure renovation programs, and what are the commonly defined goals?*

Literature study is conducted to discover the ins and outs of program management and its control. Also, infrastructure renovation programs will come across. Google Scholar, Elsevier, TU Delft repository, and Scopus are the databases used as a source for papers and research. The keywords that have been applied are "program management," "construction industry," "infrastructure," "program synergy," both separately as collectively. Since much research has been done on program management in many different disciplines, a selection must be made. This will be done based on the impact of papers, in which the measured citations is a criteria that will be used. Also, the selection will be made based on the quality and recentness of the papers. Snowballing of papers will be used; interesting papers will lead to relevant references to other interesting papers.

Part III: Empirical Research
This part of the research aims to analyze the process of control on program goals and utilization of synergy in infrastructure renovation programs in practice. In addition, improving these processes will be an objective as well. This will be done according to the literature review conducted in part II. The research questions that will be answered in this part are:

3. *Which improvements contribute to control infrastructure renovation program goals?*
4. *Which improvements contribute to utilizing synergy in infrastructure renovation programs?*

There has been chosen for a multiple case study as methodology for the empirical research. First the consideration of doing a case study will be discussed, which will be be illustrated in more detail in Chapter 5 Methodology In-Depth Case Studies. Then, the methodology per chapter included in this part is clarified.

Verschuren and Doorewaard (2010) lists five different research strategies to use; a survey, an experiment, a case study, a grounded theory approach, and desk research. To ensure that the right strategy for the research will be chosen, decisions between three key elements will need to be made: breadth versus in-depth, quantitative versus qualitative research and empirical versus desk research. This practice-oriented study will have an in-depth, qualitative, and empirical character. This results in a case study approach with a comparative nature.

The study will be “in-depth” because of the deep dive in the explicit way control has been executed and the in-depth validation of several elements of the control process. In addition, a requirement to get to validated specific recommendations for IRP will require an in-depth investigation of the current way of working, barriers and potential solutions. A qualitative approach has been chosen because results will be analyzed and processed in a contemplative way. Furthermore, this study will have an empirical character because of investigating existing phenomena in practice. Discovering a real-world case as a methodology can give insights into critical contextual conditions pertinent to the case (Yin, 2017).

The method of multiple-case studies is chosen over a single case study to avoid the risk of deductive theory confirmation and generalizing observations (Yin, 2003). Analyzing the process in practice will be done using case studies, and data retrieving is done by interviewing program management team members and diving into program policy documents. The selection of cases and its methodology applied will be discussed in detail in Chapter 5 Methodology In-Depth Case Studies.

First, cases will be independently observed and analyzed in Chapter 6 on both the way control on goals is organized as the way synergy is utilized. In addition, barriers related to those processes that should be overcome are intended to be found. Then, in 7 systematic differences in the manner of control are gained by comparing the cases. Besides, barriers described per case are merged and analyzed. The underlying problem of the barriers is found by analyzing the systematic differences. Furthermore, those barriers are put in the context of the literature presented in Part II: Literature Study. Lastly, solutions for barriers related to controlling program goals are proposed based on literature and on applied solutions in practice resulting from the case comparison. Focusing on the clarification of the barriers enables to find an effective solution to tackle the barriers. The result of this chapter are clarified barriers with suggested solutions. A separate chapter compares the cases leading to synergy recognized in practices and how they utilize them. Those are put in the context of literature shown in Part II: Literature Study. Then, barriers related to this process per case are combined and linked to the forms of synergy they sabotage to see what synergy is not utilized in its full potential. Those barriers are hereafter put in the context of literature presented in Part II: Literature Study. This leads eventually to solutions for barriers. The result of this chapter is a form of synergy that is not acknowledged in literature yet. Furthermore, barriers and potential solutions are proposed. Through a focus group, barriers of both the process of controlling program goals as utilizing synergy are weighted to set priority. The proposed solutions are validated in this session. This is further elaborated in Chapter 9 Validation Expert Session.

Part IV: Conclusion and Discussion
The final results of the research will be presented in this part. The discussion (CH10) will focus the results and their importance and contribution to the field by analysing the main findings in combination with existing literature. In this way, the discussion explores the underlying meaning of this research. The conclusion will answer the main research question by combining all the results and deduce this.

2.4. Validity

Internal Validity
Internal validity is the level of reliance on the research and its degree of influence by other factors or variables. Like the one used within this research, the qualitative research method comes with pressure on data collection (Verschuren & Doorewaard, 2010). Several considerations can minimize this. Firstly, through interviews and case-related documents, the data has been collected. Using multiple input sources in a case study allows addressing a broader interpretation (Yin, 2003). Also, findings and conclusion in a case study are likely to be much more powerful and accurate if those are based on multiple sources of information (Yin, 2003). Also, interviewees received the same introduction information that caused the alignment of the interpretation. Besides, an expert session is organized in order to validate the results. Furthermore, there has been chosen for semi-structured interviews rather than structured or non-structured interviews because this way of interviewing has the potential to reveal more detailed information. Lastly, the interviewees' minutes are transferred to the interviewees to check on misunderstandings, which decreased the uncertainty of other factors' influence.

External Validity
External validity indicates the degree to which research results can be generalized. Case studies have, in general, not an extremely strong external validity (Verschuren & Doorewaard, 2010). However, this study attempts to maximize external validity.

Firstly, the case sampling has been based on several criteria that have been appropriately chosen, as explained in Chapter 9 Validation Expert Session. Furthermore, per case, interviews with different people with varying positions within the program have been used as sources. With this variation of interviewees, validation rises. On top of this, multiple respondents have been interviewed, which improves external validity since subjectivity is diminished. Also, results only mentioned by one respondent of one case are illuminated as subjective and not taken into account during the interpretation of the results since subjectivity is inconsistent with generalizing.

II

Literature Study

This section presents the theoretical background from which the research will depart. Chapter 3 Program Management and its Synergy defines program management, points out the synergy it can utilize and described barriers that can be experienced in applying this management. Chapter 4 Infrastructure Renovation Programs will introduce what implies renovation. Then an overview of infrastructure renovation program characteristics will be given and the common goals of these programs will be sketched.

The research questions that will be answered in this part are:

1. *What is program management, what forms of synergy can it utilize and what barriers can be experienced in applying this management?*
2. *What characterizes infrastructure renovation programs, and what are the commonly defined goals?*

(KHN, 2020)

3

Program Management and its Synergy

In this chapter, program management and its control is examined. The goal of this chapter is to answer the first sub-question: *What is program management, what forms of synergy can it utilize and what barriers can be experienced in applying this management?*

This chapter first gives an overview of the definition of program management. Then, synergies of program management and how control can be obtained over program goals are issued. This will be the input for the empirical research. Lastly, existing barriers to program management are laid out in order to be able to answer the main question of this research.

3.1. What is program management?

Understanding the concept of program management will be realized by interpreting program management, by examining the definition of program management and, by examining types of programs. Besides, it is essential to understand the difference within the concepts of project management, portfolio, and multi-project management. Characteristics of program management will also be discussed according to the literature.

Definition

Various definitions have been observed for program management. A remaining confusion can clarify the lack of one clear description for program management among organizations and a lack of literature explicitly describing the definition (Shehu & Akintoye, 2010).

Thiry (2002) concludes that three critical elements in definitions for program management match one another: "programs are purposefully grouped to realize strategic and tactical benefits, usually cover a group of projects and their management must be coordinated." Those elements constitute with the definition set up by Shehu and Akintoye (2009), who based their research upon many known definitions, among them the meaning of Project Management Institute (PMI) and the Office of Government Commerce of the United Kingdom (OGC), that are leading according to (Martinelli et al., 2014). Since both Thiry (2002) and Shehu and Akintoye (2009) did extensive research on the many inconsistent definitions used for program management, their definition for program management is used in this research. Their definition is:

> *"Program management is aligning and coordinating a group of related projects to achieve benefits that are not possible when projects are managed individually"* (Shehu & Akintoye, 2009)

Types of program management

Best Management Practice (2011) does specify different types of programs and these types are based upon the reasons for coming into existence: vision-led, emergent, and compliance programs. First, vision-led programs are top-down in approach and have come into existence because of an organization's vision or policy. This type of program shows overlap with "collaborate with other parties in a goal-oriented way" and "pursue certain, complex goals," mentioned by Prevaas (2018). A starting point of a program are commonly its strategical objectives (Gray, 1997). Secondly, the emergent program has the incentive that change and benefits need coordination, and program management fits with this. This corresponds to "respond quickly to a development or change" and "provide overview and coherence". Lastly, compliance programs are programs where the program approach is unavoidable. This could be external such as legislative change. This fits the incentives of Prevaas (2018) of "having no guidance in the project approach," so a program approach is unavoidable. In addition, Shehu and Akintoye (2009) state that "the economic pressures, maturity, and limitations of project management and the dynamic nature of the construction industry clients' requirements"

could lead to deciding to go with a program management approach. This statement suits the previously mentioned type of program where the approach is unavoidable. Moreover, this economic pressure has also been observed in the United Kingdoms' construction industry as an incentive to go with program management (Shehu & Akintoye, 2009). However, Best Management Practice (2011) claims that a mix of these triggers can occur, which is in line with the segregation by Prevaas (2018).

Difference with Project Management

To understand the concept of program management, project management should be acknowledged, since this research will need a clear understanding of the difference between these two. The difference between program management and project management is its focus, and program management covers a group of projects.

The definition of project management according Project Mangagement Institute (2001) is "the application of knowledge, skills, tools, and techniques to project activities to meet project requirements." Additionally, Nicholas and Steyn (2012) defines seven key characteristics of project management to illustrate this concept: a single, definable goal and well-defined deliverables, being unique, being somewhat unfamiliar and risky, utilizing skills and talents from different professions and organizations, being a temporary activity, having something at stake, and being the process of working towards a goal.

Above it is described that program management is on a collection of projects. So, program management is on top of managing single projects of a program (Thiry, 2002), not a substitute for one another. Difference between those forms of management can be indicated with point out their way of controlling. Program control has less to do with planning, budget, and the progress of the specific projects but focuses more on program overall controls related to the program goals. Project control is more focused on output delivery and result. In contrast, program control is more focused on direction and delivery of strategy (Best Management Practice, 2011) to achieve those goals (Prevaas, 2018). On program level, goals are set up in a more overall process way (Prevaas, 2018). Prevaas (2018) describes also that the difference lies in the way control on goals has been executed: the unpredictability, uncertainty, and ambiguity are higher in the program, and that ends in control that is more focused on influencing than dominating. It is important to note that project management and program management are interconnected. Shehu and Akintoye (2009) describe this as follows, on multiple known definitions, "where program management cannot do without project management and the existence of the former improves the latter." So, project management is executed on the project level and focuses on output delivery. In contrast, program management covers a group of projects and focuses on the strategy's direction and delivery.

Difference with Portfolio Management

The distinction between program management and portfolio management can also shed light on program management's accurate understanding. To understand program management more accurately, explaining the distinction between portfolio and program management is necessary. The difference seems more clear in the business environment than in the construction industry.

Within the business environment, there is a clear demarcation between portfolio and program management. Portfolios are a set of projects and cover the integrity of the entire business performance in the scope, while program management will be within the program boundary defined by the program's projects (Best Management Practice, 2011). So, within portfolio management all organizational benefits that affect all areas and linked to organizational goals managed at the corporate level will be taken into account, whereas a programs scope does not consider an entire organization's vision . (Best Management Practice, 2011). Portfolio management centres its strategy on leadership, alignment and a corporate (Best Management Practice, 2011), also, it is relatively fixed and incessant (Thiry, 2002). Program management, however, has a more dynamic appearance (Thiry, 2002). Based on the available examination on the management level, a distinction noted is that program management is on the cohesion of activities. In contrast, the activities in portfolios do not fundamentally have anything to do with each other (Prevaas, 2018). This also implies that programs do have a definite starting and endpoint, while portfolios tend to be continue (Prevaas, 2018). A portfolio is *a deliberately chosen, cyclically changed set of projects, programs, and other major change initiatives selected to establish its strategic goals.* (Prevaas, 2018)

Within the construction industry, a less sharp distinction is observed. Sometimes, the portfolio's interpretation within the business industry is adopted in the same way in the construction industry. Often a portfolio has been used as an equivalent of a group of projects (Ferns, 1991; Rayner & Reiss, 2012; Shehu & Akintoye, 2009). However, portfolio management has also been applied as a term that includes directing and

gaining benefit from the collective approach (Erzaij et al., 2020), which contrasts with the description of program management. Although the term portfolio management has provoked some confusion, in studies on program management in the construction industry, portfolio management is most regularly used to bundle projects, without any specific content or sharing of resources Shehu and Akintoye, 2010, with no clear end. This research's interpretation takes a portfolio, as a synonym for a group of projects, into consideration.

Thus, a program differs from a portfolio; a portfolio is a combination of projects bundled randomly without a clear end. In contrast, a program has strategic goals, and once the strategic goals have been achieved, the program ceases to exist.

Difference with Multi-Project Management

Prevaas (2018) state multi-project management as *controlling and deciding on a large number of projects simultaneously.* The main difference compared to program management is that the projects that form a multi-project do not have to be related content-wise. Those projects do, however, share the same owner and, with that, the same resources. Therefore, the management of multi-projects is on the coordination of resources and the prioritization among the projects. Nevertheless, program management coordinates take the coherence among the projects into account. Pellegrinelli (1997) agrees that program management is much more than usual resource management and points out that the focus lies upon technical and planning aspects rather than generative and organizational elements. Although there might be a theoretical contrast between the two concepts, multi-project management has been used as a synonym for program management in practice (Abdullah & Vicridge, 1999; Flyvbjerg, 2011). However, the interpretation for this research will take the distinction found in the literature into account.

Thus, multi-projects are collections of projects but do not necessarily accord the same content, whereas programs do.

3.1.1. Analysis of the characteristics of program management

Program management characteristics will be discovered to understand program management and describe the actual value of this concept. This is done based upon three information sources. First of all, the definition of program management will provide information on program management characteristics. Secondly, the comparison with project, portfolio and multi-project management, as conducted in previous paragraph, will be input. Lastly, literature will provide some more information on the characteristics of program management. This information will be gathered and merged to define the main characteristics of program management.

This paragraph dives into how literature determines this subject to analyze the characteristics of program management. Researches of (Martinelli et al., 2014) and Prevaas (2018) are taken into account because those are leading. Characteristics found in the literature will be merged, and overlapping aspects will be assembled. The results are shown in Table 3.1 Program management characteristics below.

Martinelli et al., 2014 Distinguishes four core tenets: benefits management, coordinated management, interdependent projects, and finite period of time. Benefits management means in this context the characteristic of achieving business goals as the main objective of a program. Coordinated management, or cross-functional management, stands for a general program framework that is indispensable for every project within a program; it assemblies each project's activities and outcomes. The third characteristic (Martinelli et al., 2014) describes is interdependent projects, which indicates that projects within a program be conditional on one another; the output of one project can be the input of another, and resources can be shared, which makes them dependent. Furthermore, a program is defined as temporary; it has a set starting and endpoint.

Prevaas (2018) acknowledged these three tenets. However, he used different expressions for the benefit and coordinated management, respectively, goal-oriented and coherent. Furthermore, Prevaas (2018) adds: unique, complex, a change, and limited. Unique can be understood broadly; it can be a one-off exercise or performed together for the first time. The goals can also be new or how the activities are addressed and managed. Just like the circumstances under which the assignment is being worked on. A program is limited, also called scoping, based on content and resources. A change corresponds to the characteristic of a program that aims to bring changes (Prevaas, 2018). This is found in different literature studies and mostly refers to an organizational change (Pellegrinelli, 1997; Rayner & Reiss, 2012; Thiry, 2002).

So, information is gathered on the characteristics of program management in a view different ways. In Table

3.1 Program management characteristics an overview is created of the characteristics of program management.

Program management characteristics		
Definition	Comparison project/ portfolio/ multi project	Literature
Group of projects	Programs management higher level	Goal oriented/benefits management
Management coordinated	Delivery of strategy	Temporary
Synergy	Programs have clear end	Unique
-	Project in programs share the same resources	Complex
-	Projects in programs have same content	Coherent/coordinated management
-	-	A change
-	-	Limited/Scoping
-	-	Interdependent projects

Table 3.1: Program management characteristics

3.2. Synergy of program management

Programs have the outstanding opportunity to utilize synergy ("achieving benefits that are not possible when projects are managed individually"), because of its coordination and alignments of a group of related projects. Moreover, synergy could be a motivation to apply the program management approach, since a focus on program management can increase efficiency and effectiveness and can overcome failure to achieve success (Lycett et al., 2004).

Synergy manifests itself in programs in various ways. To be more specific, collectively managing projects results in different types of synergy. In a way, those different types of synergy are benefits of program management. An essential remark is that those benefits occur because of collectively organizing projects. In upcoming paragraph those types of synergy are clarified substantiated with literature.

Firstly, Best Management Practice (2011) and Murray-Webster and Thiry (2000) point out that the alignment of projects within a program enables to set out a proper strategy. They describe programs as "the missing link" between a strategy and projects. This corresponds with the statement of implementing the program approach beyond a single asset's boundaries because it enables to realize strategic and tactical goals (Shehu & Akintoye, 2009; Thiry, 2002). As Prevaas (2018) describes, an incentive for a program could be wanting to pursue specific, complex goals. So, programs could be used as a vehicle aligning projects, to implement strategy (Morris & Pinto, 2007). To be more specific, the strategy aims to add value (Ferns, 1991). The alignment of projects is facilitated by the inter-organizational communication and processes (Asgarpour & Neef, 2019). To conclude, due to the alignment of projects within a program, facilitated by inter-organizational communication and processes, strategies that aim to add value can be achieved. In line with this type of synergy, the program management approach enables to focus more on long-term goals and developments (Pellegrinelli, 1997)

Secondly, the fact that projects within a program share the same resources has some positive effects. Sharing resources through different projects comes with the advantage of continued quality, guarantee a stable supply of workforce, and a more successful way of knowledge management (Lycett et al., 2004; Shehu & Akintoye, 2009). In addition, this can save money (Ferns, 1991; Pellegrinelli, 1997; Shehu & Akintoye, 2009). Lastly, sharing the same resources will assist enhancing accuracy and efficiency of performing projects, since resources are knowledgeable of the goals and nature of the projects (Shehu & Akintoye, 2009).

Furthermore, collectively managing projects has a positive effect on budget and planning because no re-employing and/or training new resources is needed (Olomolaiye, 2007). Ferns (1991) research results seem to be consistent with this positive effect on budget by describing that no "climbing unnecessary learning curves for new procedures and tools" will occur. The positive effects on a budget can also be clarified with a decrease in total costs because of economies of scale (Asgarpour & Neef, 2019; Morris & Pinto, 2007). The improvement in planning is in line with Pellegrinelli (1997) research that illustrate this by the fact that backlogs and duplication of works are reduced.

Additionally, an increase in efficiency and integral way of working results in an improved alignment with other projects and less competition or conflicts (Pellegrinelli, 1997). On top of these types of synergy, organizational learning benefits come forward because of the repetition of projects within a program (Asgarpour & Neef, 2019). This makes a program-oriented approach more effective than an individual project approach. Efficiency can also be increased through the projects' predictability and uniformity as happened in the Dutch program on sluices (Willems et al., 2016).

To sum up, synergy manifests itself in programs in various ways. A type of synergy is that the alignment of projects within a program induces the opportunity of setting up long-term, value-adding strategies. Furthermore, sharing the same resources results in among other things continual quality, stable supply workforce and saving budget. Collectively organizing planning and budget comes with positive effects as well. So, program management includes synergy in different forms.

3.3. Control over program goals

To a great extent, program management benefits from the advantages discussed in previous paragraphs. To ensure this, control over a program is essential. A program's success largely depends on understanding the program's goals thoroughly and choosing effective efforts to achieve the program's goals. This section will discuss the definition of control since many programs do not pursue success because of insufficient preparation (Prevaas, 2018). Shaping the control approach will be paid attention to. Then, the way control on program goals can be gained will be discussed, which will result in the description of useful control mechanisms.

Definition of control

The control function is described in Project Management for Business, Engineering and Technology as: *"monitoring work performance concerning the goal and taking necessary action whenever work begins to deviate from the goal"* (Nicholas & Steyn, 2012). Control can be interpreted as all activities aimed at planning the program, assuming the progress, comparing this with the last applicable plan, and taking measures to keep the program on track or get on track. This gives you grip on progress in the light of ambition, goals, and constantly changing circumstances (Prevaas, 2018).

Program life cycle

Having control over a program will require a program management team to go through several stages. Lycett et al. (2004) concludes that the stages of the life cycle of a program that are generic to most approaches are: identification, definition, execution, and closure. This is to the utmost extent in line with the orientation, build-up, implementation, and dismantling stage distinguished by Prevaas (2018). Also, the way Thiry (2007) sets up the program life cycle is comparable, except for the fact that they differentiate five stages; the appraisal stage is separately instead of part of the execution or implementation stage defined by Lycett et al. (2004) and Prevaas (2018), respectively.

Analysis has been done on the different researches focused on the different stages in the program life cycle. Studying the differences and similarities can yield an overall program life cycle used in this research. The results are shown in figure 3.1 below. An extensive analysis on the various processes within those phases are elaborated on in Appendix A Control on a Program.

The first phase of the program life cycle consists of deciding upon a program management approach and its purposes and objectives. This starting point is in accordance with most researches on the subject of program management. The second stage, shaping the control approach, dives into how to program could be organized, including developing program goals, support structures required to facilitate the program's management, strategic level planning, and selection of actions. Then, realizing the program will be addressed. This stage, gaining control, contains the execution of the action, monitoring, and controlling. This incorporates assessing risks, reporting on progress, and taking control measures. Lastly, closing off the program is the last stage of the life cycle and is hopefully because of successfully finishing it.

Although the different researches show many similarities, there is a striking difference. Whereas Lycett et al. (2004) describes the program life cycle as a linear process, Thiry (2007) explains the power of the iterative process of the program life-cycle by "including periods of stability, where benefits can impact the organization and therefore be measured; and have a systems perspective." Prevaas (2018) also states that downplaying the more linear approach in a program context is wise to do.

Based upon the different stages of the program life cycle and the demarcation of this research, the focus will lay upon the stages after chosen for a program management approach and goals are set up, as described earlier. For this reason, this research undertakes the stage of shaping the control approach and gaining control. Even parts of shaping the control approach will not be included for the same reasons.

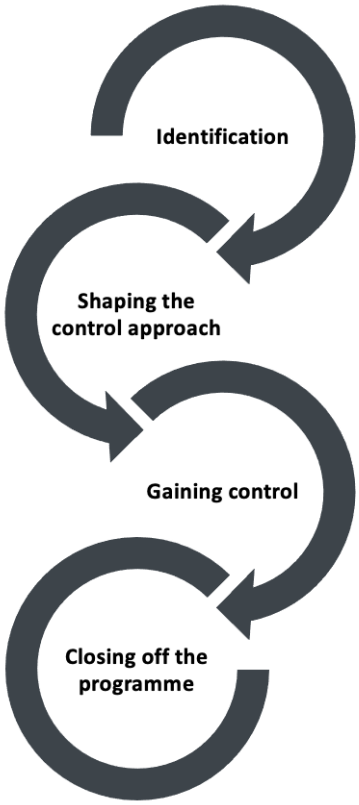

Figure 3.1: Program control life cycle

3.3.1. Shaping the control approach

The upcoming paragraphs will concentrate on how to arrange control on the goals on a program level. Shaping the control approach will be part of the preparation of having control and will highly affect the success of meeting the program's goals. Prevaas (2018) distinguishes seven activities to shape this control approach in his book:

- develop the program vision
- identifying and defining the goals
- develop a credible and feasible strategy
- translating the goals into benefits
- defines the efforts, results, resources, and conditions
- determining the robustness/solidness of the program
- structuring the program.

Since this research's scope focuses on a program where goals have already been identified, this theory's starting point will be "translating goals into benefits." Lycett et al. (2004) do mention the first two activities and add focusing on the program organization and establishment of the processes and support structures that are not part of the scope of this research. Thiry (2007) mentions in their organizational stage the strategical plan, including a communication, resource, program pacing, and change management plan. Also, they set up the way selection of actions in a program should be done.

3.3.2. Gaining control

Now that a control approach has been shaped, it is essential to determine how control can actually be gained during the program. Control over programs is not micro-management of the projects within it but is the

overall management of goals on the program level (Best Management Practice, 2011). Thiry (2007) agrees upon this by mentioning that program control is not on an operational level, but rather a continuous re-evaluation process of the program, considering the achievement of organizational benefits; an 'inductive' (based on emergent inputs) and 'formative' (improvement perspective) type of control.

Prevaas (2018) distinguishes seven activities to gain control on a program, summarized in figure 3.2 Control cycle by Prevaas (2018);

- Define requirements for controlling
- Plan the program
- Monitor the progress
- Compare, assess and report
- Propose and choose measures
- Taking control measures
- Evaluate and update

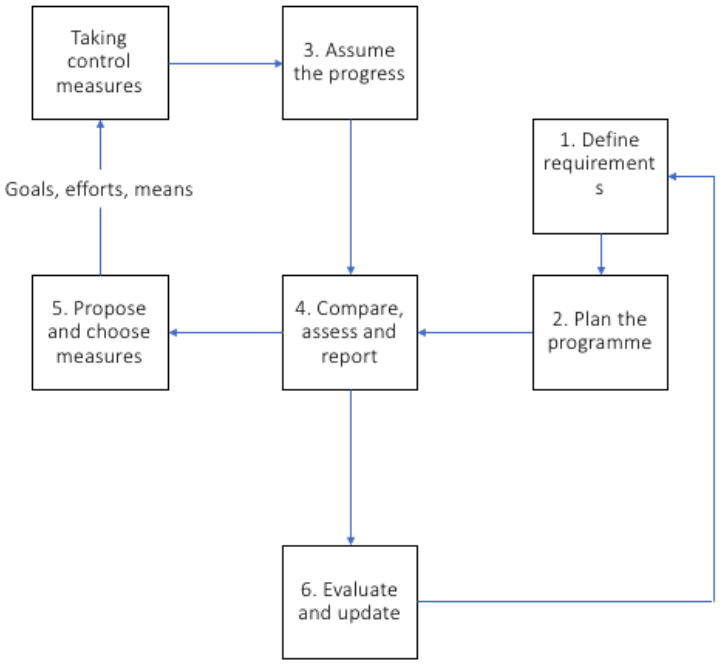

Figure 3.2: Control cycle by Prevaas (2018)

To gain control of a program, Prevaas (2018) determines five control criteria that function as a tool for the program manager to take into your own hands. These criteria are pace, feasibility, efficiency, flexibility, and effectiveness and further described in the table below.

Control Criteria	
Control criteria	Explanation
Pace	The speed at which goals are set up, effort should be executed, and means should be available.
Feasibility	The probability chance goals and efforts can be achieved and mean becoming available and usable.
Efficiency	To what extent goals add value, the efforts are viable, and the means used.
Flexibility	To what extent can goals be adjusted, efforts can be adapted, and different means can be used.
Effectiveness	To what extent goals and benefits contribute to the program's ambitions, and in which the efforts contribute to the goals and the benefits to the efforts.

Table 3.2: Control Criteria

Prevaas (2018) also sets up "supporting aspects" that require attention within a program. To handle the program and to give rise to take measures on the control criteria. Those supporting aspects are risks, issues, information, quality and securing, organization and collaboration, and communication.

3.3.3. Closing of the program

The essential objective of this stage is that the program realizes the planned benefits and goals (Lycett et al., 2004). All projects in the program should be finalized to finish up the program. Other reasons for closing off the program is when the cost of the program is greater than the benefits it is bringing to the organization. Furthermore, when the environment or context have changed, and the benefits that the program was seeking to achieve are no longer required, is a reason to close off the program. Lastly, the program comes to an end when the implementation of the first cycle(s) has demonstrated that the program's ultimate purpose cannot be achieved (Thiry, 2007).

3.4. Existing Barriers

The benefits of program management over project management, multi-project management, or portfolio management are only experienced when proper program management is implemented. However, barriers appear while controlling goals on program level. Additionally, barriers related to utilizing synergy are described. Research has been done on some major challenges that are observed within programs and those will be presented in upcoming paragraphs. These barriers will be compared to barriers observed in empirical research presented in Part II: Literature Review.

First, the poor performance of program control can be clarified with the difficulty of coordinating information during the program life cycle (Denicol et al., 2020). The overall program can contain hundreds of projects, and generating data to reflect all of the projects is not straightforward. Firstly, an appropriate way to measure the right data might be a challenge (Shehu & Akintoye, 2010). Furthermore, making decisions based on these measurement requires an organization to deliver human and financial resources to interpreter the data correctly (Shehu & Akintoye, 2010). In addition, Prevaas (2018) describes a pitfall that the focus lays on measuring and monitoring and this takes away the energy for the content. Also, when interpreting the progress, there is no room for opinions, only for facts (Prevaas, 2018).

Also, goals are mostly set up in an abstract way, and indicators are not always obvious (Murray-Webster & Thiry, 2000). Besides, because goals are mostly set up abstractly (Murray-Webster & Thiry, 2000), it can be a barrier for the program management. Best Management Practice (2011) describes this as a pitfall as well; programs often unsuccessfully define or unsuccessfully communicate their vision.

On top of this, project management processes cannot always be applied to program management, so a different way of working should be used (Thiry, 2007). For instance, if projects are too unrelated (Ferns, 1991; Shehu & Akintoye, 2010). This can have several reasons, as described by Ferns (1991) such as "skills are unique to projects and not transferable, no technical commonality or few technical or management interfaces".

Besides this, alignment of projects to a strategy has been a barrier in program management (Best Management Practice, 2011; Blomquist & Muller, 2006; Shehu & Akintoye, 2010). Particularly in a program, it is essential to align, plan, and coordinate projects properly since projects are dependent (Shehu & Akintoye, 2010; Williams & Parr, 2004). Due to the domino effect that occurs, a change in one project can impact the whole program (Blomquist & Muller, 2006). Getting the projects aligned with the program goals is an ongoing task that needs to be maintained during the program (Best Management Practice, 2011). The alignment of projects is correlated to the lack of cross-functional working, that has been observed as an obstacle (Shehu & Akintoye, 2010; Williams & Parr, 2004). This is in line with Lycett et al. (2004), who reports "facilitating genuinely effective co-operation between project managers as a missed opportunity".

Prevaas (2018) draws also attention to the complexity of the program's goals. There can be many different goals, and they can even be conflicting. This calls for a well thought-out approach that does justice to all those goals. In addition, managing cohesion is more difficult, as internal tensions can arise (Prevaas, 2018).

The major challenge that Shehu and Akintoye (2010) describes in his research on challenges to the successful implementation and practice of program management in the construction environment, is the lack of commitment and support from leaders. Commitment in this context is described in this context as the willingness on the part of individuals to contribute much more to the program organization than their formal contractual obligation (Shehu & Akintoye, 2010). This may result in a priority on activities that are not promising for the program. Moreover, this commitment is essential for a program's success (Fowler & Walsh,

1999; Shehu & Akintoye, 2010; Williams & Parr, 2004).

Furtermore, a barrier lies in the program management's synergistic characteristic; real-time proactive planning is a requirement but a difficulty (Martinelli et al., 2014; Shehu & Akintoye, 2010). A solution is "to cultivate planning and support their managers to ensure the effective delivery of programmes". Raising knowledge on this can be achieved by training or workshops (Shehu & Akintoye, 2010).

Lastly, difficulties can arise when the span of control of the project organization mismatches with the complexity of a project (Leijten, 2017). Another barrier within program control is that it can lead to immoderate bureaucracy levels, if it is executed with a high level of detail, which is inefficient for the program (Lycett et al., 2004; Westerveld & Hertogh, 2010). Moreover, this can lead to conflict between the management on the program level and the management on the project level because of fading goals (Lycett et al., 2004). If control is executed without any form of detail, the distance between program and projects will enlarge. This might hamper control, because of a lack of interconnected. Precisely the characteristic of flexibility needed in a program is clashing with these aspects of control and bureaucracy (Pellegrinelli, 2002). Furthermore, determining the system boundary of the program is related to the span of control of a program. This is because the more it is engaged into the scope, the wider the span of control could get. Defining this system boundary is marked as a barrier (Prevaas, 2018).

To sum up, literature presents many barriers on program level. Those barriers will be compared to barriers experienced in practice in Chapter 7 Case Analysis: Control on Infrastructure Renovation Program Goals and Chapter 8 Case Analysis: Synergy within IRP.

3.5. Conclusion

This literature study has been conducted to provide insight into program management, program synergies, and barriers experienced. It answers the following sub-question:

> *What is program management, what forms of synergy can it utilize and what barriers can be experienced in applying this management?*

First, program management is reviewed. Although program, project, portfolio, and multi-project management have been used inconsistently in practice, some theory has shown clearance. The differences between those forms of management in the construction industry have led to program management characteristics. To conclude, all characteristics of program management found in the analysis are summarized in Table 3.1 Program management characteristics.

Also, the synergy of programs has been investigated. Programs have the outstanding opportunity to utilize synergy because of their coordination and alignments of a group of related projects. Synergy manifests itself in programs in various ways. A type of synergy is that the alignment of projects within a program induces the opportunity of setting up long-term and value-adding strategies. Furthermore, sharing the same resources results in, among other things, continual quality, stable supply workforce, and saving budget. Collectively organizing planning and budget come with positive effects as well. Hence, program management induces synergy benefits in different forms. The program's synergy described in the literature will be input for the synthesis conducted in Part III: Empirical Research. By comparing synergies found in literature and experienced in practice, either an addition to scientific knowledge or practical knowledge can be found. Additionally, synergies found in the literature can be confirmed by practical knowledge.

Control over program management can be achieved by running through the four stages of the program control life cycle; identification, shaping the control approach, gaining control, and closing off the program. However, barriers appear in the process of controlling program management goals. Those are:

- Goals are set up in a broad way
- Indicators are not obvious
- Generating all data
- Goals are conflicting
- Commitment for the approach is missing
- Real-time proactive planning difficult
- Coordination of information
- Alignment of projects

- Span of control

Those barriers will be input for Part III: Empirical Research, in the same way as described for synergies. A comparison between literature and practical knowledge gives insight into how program management can be improved to control program goals and utilize synergy.

4

Infrastructure Renovation Programs

The relevance of renovation projects in the Netherlands is explained in 1.1 Research context. Renovating existing infrastructure assets focuses on public organizations in the upcoming years, because the end of the life cycle of infrastructure assets is reached, little effort is put into renovating, and replacement costs are high.

This chapter begins by interpreting infrastructure renovation programs, including the definition, motivation, and characteristics of this concept. After this, the goals of infrastructure renovation programs will be pointed out. Lastly, the sub-question *What characterizes infrastructure renovation programs and what goals are commonly defined for those?* will be answered.

4.1. Interpretation infrastructure renovation programs

Definition of renovation

The importance of defining renovation in this research can be clarified by showing the difference in the term's use. Although some researchers use the term renovation to indicate a minimum of interventions (Ebbert, 2010), other researchers use it to indicate more consistent upgrading (Douglas, 2006).

When the end of an asset lifetime is reached, there are only a few options to consider. Hertogh et al. (2018) differentiates maintenance, renewal and replacement. Renovation is a synonym for renewal and is in contrast to building a new construction (Shami, 2004). So categorizing the intervention measures in two aspects can be chosen for as well. Thomsen and Van Der Flier (2009) makes a distinction between two options to choose from regarding a certain intervention measure: replacement (demolition and building a new construction) and life cycle extension (renovation, refurbishment, alterations, etc.). Also, van den Boomen et al. (2019) uses the terminology of replacement and life cycle extension, whereas lifetime-extending maintenance includes renovation and major overhauls.

Synonyms used for renovation in several scientific types of research are renewal, alteration, adaption, rehabilitation, retrofitting, and upgrading(Thuvander et al., 2012). The clarification for the many synonyms used in research is the varied type and scale of construction actions and the variety of motivations for doing these (Thuvander et al., 2012). To give clearance, renovation in this research is defined as:

> *"any construction that has to be done to an existing facility to maintain or modify its characteristics in aspects such as functionality, performance, capacity, safety, quality, social and aesthetic values."* (Shami, 2004)

To get grip on this definition, some examples are mentioned. Also, the responsibility of renovating is pointed out. Examples of different renovation projects can be modernization, remodeling, major rehabilitation, upgrading, expansion, historical preservation, major repair and maintenance, reconstruction, and conversion (Shami, 2004). Large infrastructure renovation projects in the Netherlands are initiated, and the responsibility, of asset owners. In the Netherlands, this is could, for instance, be the Ministry of Infrastructure and Water Management, local municipalities, the provincial government, and water authorities. Success depends on the public party, who is project-owner, and on a private party, the project executor (contractor, for instance). L. Koops et al. (2017) researched this success in the public sector and figured out that Dutch public project managers have clear priority by budget and time and less by quality. Also, in line with Hertogh and Westerveld (2010), L. Koops et al. (2017) conclude that project-specific political or social factors is exceptionally valuable.

Characteristics of renovation

Characteristics of renovation will give clearance throughout this research.

Firstly, renovation is about extending the life cycle of an asset. It upgrades the asset functions to the required standards, which can be rapidly advancing nowadays (Frangopol & Liu, 2007). Renovation projects are mostly planned and carried out in a term period of 1 to 5 years, and often annual budget has been set aside for this (Schraven et al., 2011).

Also, a characteristic of a renovation project or program is that it interferes with facility operations, safety, security, regulations, and others (Shami, 2004).

Furthermore, many phases in the process of new construction are in line with the process of a renovation project. However, in contrast to new construction projects, renovation projects emphasize preparing and investigating in terms of time and resources (Karydas & Gifun, 2006). This can be clarified by the highly complex characteristic of renovation projects; it has to do with "complex structural systems with all related uncertainties of the mechanical behavior of materials. "(Casciati & Lagorio, 1996). Many researchers concur on the high complexity of renovation projects (Reyers & Mansfield, 2001; Thuvander et al., 2012). The specification, as the shortfalls and qualities, of the existing building is required, and a lack of this knowledge can result in loss of value (Thuvander et al., 2012). Additionally, renovation projects frequently kick off with poor documentation of building conditions (Thuvander et al., 2012), which are essential.

The reason to renovate infrastructure

First, the reason to renovate projects instead of replacing an asset will be discussed. Then, reason for bundling these infrastructure renovation projects into a program is elaborated. This will give more context on the subject.

The trade-off between either a renovation project or a replacement project has to do with several aspects. Firstly, the effect the different intervention measures have on the state of assets differs; a replacement has the most effect, then renewal and lastly maintenance (Hertogh et al., 2018). To be more specific, the end of an infrastructure asset's life cycle can be reached because of its technical, economic, or functional lifespan. Degradation can lead to the end of the technical lifespan (Bakker et al., 2016). The economic lifespan ends once maintenance and renovation are not an option anymore from a financial point of view, so that that replacement will be preferable. The functional lifespan is over when functionalities are limited due to external changes, more intense use, heavier loads, climate change, new regulations, etc. Life cycle management (LCM) has as a goal to choose wisely from a range of possibilities to generate an optimal value for society over the life cycle of infrastructure (Bakker et al., 2016).

Also, decision-makers take into account future uncertainties and changing requirements by deciding upon interventions (Schraven et al., 2011). Besides this, the infrastructure asset's objective is leading by the intervention that will be chosen for (Schraven et al., 2011).

Furthermore, a trend observed by KPMG (2016) shows that public sector owners become more sophisticated towards their assets because the productivity of the existing assets is key. In compliance with the sustainability trend that has been going on in recent years, the renovation has gained some attention to reduce total energy use (Thuvander et al., 2012). Also, in terms of resource management, renovation is preferable over the replacement of civil structures (Thomsen & Van Der Flier, 2009). Hertogh et al. (2018) came up with a life cycle management approach that includes four perspectives on deciding on renovating or replacing.

- Broadening towards a network approach as an opportunity for redesign
- Developing innovations for increasing requirements and budget restrictions
- Realizing adaptive networks to cope with future challenges
- Combining functionalities to increase the added value

So, the extent to which the asset requires effect on its state, uncertainties, changing requirements, the objective of the infrastructure asset, and sustainability goals influences the choice of renovating.

The program-oriented approach is often observed within the renovation. As mentioned in 3 Program Management and its Synergy, programs have many advantages. In this paragraph, the motivation to work with programs in the infrastructure renovation sector is discovered.

Because infrastructure renovation projects influence one another, a joint approach such as a program is an opportunity in this case (Asgarpour & Neef, 2019). This influence could, for instance, be geographically or functional. For example, renovating a bridge can improve the vertical clearance for boats as they upgrade the road network for cars. This renovation influences both hydraulic infrastructure, such as embankment, as road infrastructure.

Furthermore, bundling the projects in a program is relevant in the infrastructure renovation industry because it allows using existing infrastructure efficiently. Also, traffic disruption during construction could be minimized, and an effective way of anticipating future traffic demand is possible (Asgarpour & Neef, 2019).

Also, the program approach could be implemented to realize strategic and tactical goals (Shehu & Akintoye, 2009; Thiry, 2002). programs aim to add value (Ferns, 1991). This argumentation for using a program management approach has been observed within infrastructure renovation, because this is relevant. To be more specific, besides the functional aspect of renovating when the construction is at the end of the life cycle, infrastructure renovation programs can have a broader functional scope and be put in a wider perspective. Instead of a policy that focuses on just the assets, policy can be focused more and more on a region, including mobility, economy, spatial planning, utility, energy and water elements (Spijkerbroer et al., 2015). This will be further discussed in 4.2 Infrastructure renovation programs goals.

Renovating existing infrastructure assets will focus on the upcoming year because the end of the life cycle of many infrastructure assets is reached, (R. Koops, 2020; Rijkswaterstaat, 2020), little effort is put into renovating (R. Koops, 2020; Westenberg & Bleijenberg, 2020) and replacement costs are high (van den Boomen et al., 2019). This problem results in a major task to guarantee safety in a relatively short amount of time (Gemeente Amsterdam, 2019). A program management approach suits this assignment.

Lastly, a renovation infrastructure project could be the same operation, only differing geographically. For instance, the flood protection program from Rijkswaterstaat and the regional water authorities will reconstruct 1300 kilometer dikes and 500 sluices and pumping stations (HWBP, 2019). By repetition projects within a program, the benefits of organizational learning come forward (Asgarpour & Neef, 2019). Because of this repetition, a collective approach is efficient and effective (McKinsey & Company, 2019).

To sum up, because of the influence infrastructure renovation projects have on one another and the opportunity to use existing infrastructure efficiently, the program management approach fits within the infrastructure renovation sector. Also, realizing strategic and tactical goals and solving the existing, deferred maintenance suits bundling projects in a program.

4.2. Infrastructure renovation programs goals

An infrastructure renovation program allows focusing on the whole network instead of just the assets (Hertogh et al., 2018). To be more specific, besides the functional aspect of renovating when the construction is at the end of the life cycle, infrastructure renovation programs can have a broader functional scope and be put in a wider perspective. Instead of a policy that focuses on just the assets, the policy can focus on a region, including mobility, economy, spatial planning, utility, energy, and water elements (Spijkerbroer et al., 2015). This trend of broadening the scope of infrastructure renovation programs is a trend observed by Vlist et al. (2016).

Primary functional goals

Infrastructure renovation programs include at least a goal specifically on the function of the assets that will be renovated. The flood protection program from Rijkswaterstaat and the regional water authorities have as main goal to make sure that all dikes, sluices, and pumping stations in the Netherlands are safe by 2050; this results in reconstructing 1300 kilometer dikes and 500 sluices and pumping stations (HWBP, 2019). Amsterdam's municipality has a functional goal for their program, guaranteeing the quality and safety of all bridges and quay walls in the center of Amsterdam (Gemeente Amsterdam, 2019). The program road tunnels in Amsterdam have main functional goals on the program level: comply with legislation in the short term and create a robust fundamental for future proof management and maintenance of concerned assets (Gemeente Amsterdam, 2018). Lastly, the replacement and renovation program of Rijkswaterstaat has the primary goal of the extension of the life cycle of infrastructures (Rijkswaterstaat, 2018). Hence, infrastructure renovation programs define in every instance goals that focus on the primary reason to execute construction. This primary functional goals concentrate on the original reason for the renovations to extend an asset's life cycle or comply with a new legislation.

Secondary value-adding goals and secondary conditional goals

Besides primary functional goals, more secondary goals are set up as well. Those do not focus on the function of the assets, but concerns different aspects that the programs wants to achieve. In this paragraph, the trend of setting up more secondary goals is illustrated. Also, a distinction is made between two kind of secondary goals.

A trend observed within infrastructure renovation programs is broadening the scope of the program and defining this as program goals. The cause of a broader scope is often by social-cultural and climatic developments or goals of the environment (Vlist et al., 2016). An example is the weirs, built in the 1920s and 1930s, on the Maas that regulate the water and made shipping possible. Rijkswaterstaat should for instance take the shipping capacity, recreation, and other environment developments into account with the extending the life cycle of of these constructions, that will be executed in the upcoming decade (Vlist et al., 2016). This corresponds with the observed trend by Spijkerbroer et al. (2015) of an increase in focus on sustainability in policy, taking into account the use, experience and future value of developments. With the use of good program management, the opportunity of broadening the scope can be used.

This is also observed for the program examples mentioned in 4.2 Primary functional goals. The flood protection program from Rijkswaterstaat and the regional water authorities has the main goal of preventing the Netherlands from floods by strengthening 1300 kilometers of dikes and 500 locks and pumping stations in the upcoming 30 years (HWBP, 2019). Besides these functional goals, they set up more environmental and process-related goals as well. For instance, the sub-goals such as the focus on sustainability and spatial quality. An example is the emergency dikes together with the wire that is built in 1993 and 1995. The location of those constructions is near residential area, so the decisions made for this project should take the environment into account and not only the asset with his initial function (HWBP, 2019). The replacement and renovation program of Rijkswaterstaat would like to achieve, besides the functional goals, to use new innovative tools successfully, prevent malfunctions, and make sure constructions and installations are future-proof (Rijkswaterstaat, 2018).

Now that the reasoning behind more secondary goals is clear, the distinction between secondary conditional goals and secondary value-adding goals can be pointed out. The similarity is that both kind of goals do not focus on the function of the asset. The distinction is essential in this research, since the approach of controlling these kind of goals may be differing as well.

Secondary value-adding goals are focused on infusing value with the primary functional goals. Goals that stimulate adding value can be broadly interpreted since there are many possibilities, such as spatial planning, sustainability, uniformity of all projects and stimulating innovation. Those goal do not necessarily have to be taken into account to achieve the primary functional goal.

Secondary conditional goals do not centralize on the function of an asset, however, do focus on the primary functional goal. This type of goal functions as precondition. In other world, those are defined as goals separately, but are necessary to achieve in order to realize the primary functional goal. For example, a realizable programming could be set up as a goal, however, is a condition. Innovation can be a secondary conditional goal as well. This is the case when, for instance, innovations help to guarantee the efficiency and affordability needed to prevent costs overrun and delays.

4.3. Conclusion

The sub-question answered in this chapter will be:

> *What characterizes infrastructure renovation programs and what goals are commonly defined for those?*

Characteristics of infrastructure renovation programs are: extending the life cycle of assets, governmental organizations as the responsible party, the complexity and a planned term of 1 to 5 years. It interferes with facility operations, safety, security, and regulations.

Renovation is one of the intervention measures when an asset lifetime is reached; it upgrades the asset functions to the required standards. A program-oriented approach is used to bundle infrastructure renovation projects together. Firstly, because they influence one another, geographically and functionally. Also, existing infrastructure can be used efficiently with this collective way of working. Strategic and tactical goals that are often relevant within infrastructure renovation will be encouraged by using a program. Furthermore, since renovating existing infrastructure assets will be the point of attention in the upcoming years, these significant tasks will fit with a program. Lastly, because infrastructure renovation projects could be reasonably the same operation, a collective approach is efficient and effective.

Infrastructure renovation programs often include at least a goal specifically on the function of the assets that will be renovated. A trend observed is that not only primary functional goals are set up, but also goals fo-

cusing on broadening the scope of an infrastructure renovation program. Those secondary goals can be distinguished into conditional and value-adding goals. Focus on sustainability, spatial quality, innovations, and the process are examples of secondary value-adding goals. Secondary conditional goals function as a precondition for primary functional goals.

III

Empirical Research

This section presents the empirical research that has been conducted. Chapter 5 Methodology In-Depth Case Studies starts with elaborating on the methodology used. All three cases will be hierarchically and individually presented in Chapter 6 Case Studies through the information gained from both program-related documents and the interviews. A case analysis on control on program goals will be launched in Chapter 7 Case Analysis: Control on Infrastructure Renovation Program Goals, followed by an analysis on program synergy in Chatper 8 Case Analysis: Synergy within IRP. Lastly, Chapter 9 Validation Expert Session shows the expert meeting as validation of the results.

In this section, the empirical research strategy for arriving at the answers of these questions is explained in a structured way in this section.The research questions that will be answered in this part are:

3. *Which improvements contribute to control infrastructure renovation program goals?*
4. *Which improvements contribute to utilizing synergy in infrastructure renovation programs?*

(Lousberg,

5

Methodology In-Depth Case Studies

As expound in Chapter 2 Methodology, this practice-oriented research will have an in-depth, qualitative, and empirical character. This will be realized by performing a case study with a comparative nature. The case studies will be conducted by practicing the hierarchical method (Verschuren & Doorewaard, 2010). Cases will be independently observed and analyzed. Systematic differences in the manner of control have been found, and barriers that should be overcome are intended to be found by comparing several cases. Data collection will be done by examining documents related to the case and by conducting semi-structured interviews. Paragraph 5.1 will refine the method applied for data collection. In the upcoming paragraph, this particular approach will be explained in more detail.

5.1. Substantiation of chosen case-study approach

This empirical part of the research aims to gain more insight into IRP phenomena, the approach of primary functional and secondary program goals in IRP, how synergy is utilized, and barriers experienced within those two aspects. To avoid the risk of deductive theory confirmation and generalizing observations (Yin, 2017), a minimum of two comparative case studies is preferred. The number of cases analyzed was determined based on the purpose and credibility of the study. As indicated before, the study focuses on an "in-depth" analysis rather than a broad, generalized idea. Therefore, three cases were selected for this research. The limited amount of time available for performing this research is considered.

5.2. Case Selection criteria

The objective is to conclude how controlling both primary functional, secondary value-adding and secondary conditional goals can be improved. In order to generalize this conclusion for all public authorities within the infrastructure renovation it is necessary to pick the cases wisely (Flyvbjerg, 2006). To make sure that comparison among these cases is valuable, this has been done based on several criteria. The selection of case studies is made based on the following criteria:

1. The case study must match the criteria of a program

As explained in the literature study, the difference between a program, project, portfolio, and multi-project management is not always defined. The difference between those forms of management in the construction industry has been explored, which has led to certain program management characteristics, determined in chapter 3 Program Management and its Synergy. Since this research focuses on finding a strategy for controlling goals at a program level, the case studies must match the program's definition. The three Dutch infrastructure renovation programs used as cases will be assessed to the program management characteristics to make sure that the case studies meet those characteristics. Table 5.1 Program characteristics of selected case studies describes this assessment.

2. The program are focused on Infrastructure Renovation and represent a variety of types and sizes

All case studies must be an infrastructure renovation program since this is what the research scope is focused on. This limits the search space, since a great deal of these specific programs can be found within public organizations. A variety of types of infrastructure renovation programs have been chosen so that the outcome of this research will apply to infrastructure renovation programs in general.

3. The program have been started and should not yet be completed
Prevaas (2018) distinguishes four various stages within the life cycle of a program management approach. At first, during the orientation stage, whether a program management approach will be operated in the first place will be decided. Then, during the edify stage, the program will be shaped and formalized with a program plan as a result. During the execution phase, the focus will lie upon realizing the program, which includes monitoring and criticizing the goals' progress. Lastly, the phasing down stage will encompass finalizing the program. The scope of this research focuses on programs that have already been set up. So, the orientation stage will already have been executed; there will have been chosen for a program management approach. Furthermore, program goals will have been defined already. Programs that will be most valuable for this research will be in their execution phase; focus will lay upon realizing the program, which includes monitoring and criticizing the goals' progress. Furthermore, the program should not be completed yet in order to obtain the required information for the research on an up-to-date basis. Besides, in this way, moments are recorded during the process of gaining valuable control. An evaluation at the end of the program could show a different picture than when capturing information during the process itself. In this study, the focus was laid on how control is organized during the process.

4. The programs must have both primary functional and secondary goals
Since this research focuses on finding an applicable approach for achieving IRP goals chosen cases are required to contain both primary functional and secondary kinds of goals. In addition to what was stated in 4 Infrastructure Renovation Programs, secondary goals are distinguished in goals with a focus on adding value and goals with a focus on conditions.

Primary functional goals concentrate on the original reason for the renovations to extend an asset's life cycle or comply with a new legislation. The secondary value-adding goals are not functional but center on adding value to the program, so those goals add extra value. Goals that stimulate adding value can be broadly interpreted since there are many possibilities to add value to a program, such as spatial planning, sustainability, uniformity of all projects and stimulating innovation. The secondary conditional goals function as conditional for the primary goal. This distinguishing is relevant to find out more about the instruments used for functional oriented goals and goals focused on adding value.

5.3. Cases selected

Based on the criteria that have been drawn up, three different Dutch infrastructure renovation programs have been selected for this case-study. Namely, the Road Tunnels program (Road Tunnel Program (RTP)), the Flood Protection Program Flood Protection Program (FPP), and the Bridges and Quay Walls Program (Bridges and Quay Walls Program (BQWP). In table 5.1 the characteristics of the selected programs are displayed. Per case the criteria of the selection procedure is explained in upcoming paragraphs, corresponding to the information presented in 5.1.

Most criteria shown in Table 5.1 Program characteristics of selected case studies are clear for all cases and do not need further explanation. However, some of them are not and are clarified.
"Unique" as a characteristic for a program can be understood broadly, such as performing something for the first time or performing something as a one-time exercise. The goals or how the activities are addressed and managed can also be new, just like the circumstances under which the project is being executed. For all three cases, this is the situation.

"A change" corresponds to the characteristic of a program that aims to bring changes (Prevaas, 2018). This is found in various literature and mostly refers to an organizational change (Pellegrinelli, 1997; Rayner & Reiss, 2012; Thiry, 2002). The RTP and FPP is a change in terms of complying to legislation again. Lastly, the BQWP is a change because of guaranteeing safety and functionalities of assets again.

Programs have interdependent projects, which indicates that projects within a program be conditional on one another; the output of one project can be the input of another, and resources can be shared, which make them dependent (Martinelli et al., 2014). In case of the RTP, the integrated road tunnel system is only a success if all projects comply on its requirements, so the projects are interdependent in terms of achieving this goal. Furthermore, the safety of the Netherlands is only reached when all projects within the FPP are a success, what indicates projects' interdependence. Lastly, the bridges and quay walls in Amsterdam are interdependent because the safety legislation's can only be reached in collaboration.

Criteria	Road tunnels program (Municipality of Amsterdam)	Flood protection program (Water authorities & Rijkswaterstaat)	Bridges and Quay Walls program (Municipality of Amsterdam)
1. The case study must match the criteria of a program			
Management coordinated, limited and goal oriented	Yes	Yes	Yes
Synergy	Comply legislation, An efficient and uniform basis for future-proof management and maintenance	Safety of NL only reached by the success of all projects	Opportunity for incorporating other ambitions (urban logistics, sustainability, and waste collection)
Temporary	2018-2025 [7 years]	2020-2050 [30 years]	2019-2039 [20 years]
Unique	Performed together as an integrated system for the first time	The largest dike reinforcement operation of the Netherlands, integrating sustainability	Maintenance in such extent performed together for the first time
Complex	Time pressure due to legislation, uniformity of the whole system	Many stakeholders, different water authorities	Guarantee accessibility city, in the middle of a city
A change	Legislation	Legislation	An increase in knowledge on the condition and more appropriate use of the area
Interdependent projects	Integrated road tunnel system as a strategic asset	Safety of NL only reached by the success of all projects	Only together can goals be achieved
2. Infrastructure renovation program and represent a variety of types and sizes			
Renovation and Infrastructure	Renovating road tunnels	Renovating hydraulic assets	Renovating bridges and quay walls
Size	Five assets	1300 km dike/dam/dune and 500 assets	Around 200 km quay walls and 830 bridges
3. The program has been started and should not yet been completed			
Started and not yet completed	2018-2025 [7 years]	2020-2050 [30 years]	2019-2039 [20 years]
4. The program must have both primary functional and secondary goals			
Primary functional goals	Comply with tunnel legislation	Safe dikes, dams, and dunes	Guaranteeing safety and functionalities of assets
Secondary conditional goals	Nuisance reduction	Focus on product and process innovations to guarantee the efficiency and affordability of the FPP.	Functioning city during construction. Optimization and innovation of processes and method: accelerating the construction in order to guarantee safety and functionality
Secondary adding value goals	Future-proof management and maintenance	Realizing additional social goals, such as spatial quality and sustainability.	Functioning city during construction: low traffic, urban logistics. Optimization and innovation of processes and method: Contributing to knowledge in the field

Table 5.1: Program characteristics of selected case studies

5.4. Data retrieving process

To retrieve data, both program-related documents are analyzed, and semi-structured interviews with involved persons are conducted. Using multiple input sources in a case study allows addressing a broader interpretation (Yin, 2003). Also, findings and conclusions in a case study are likely to be much more powerful and accurate if they are based on multiple sources of information (Yin, 2003).

5.4.1. Interview set up

There has been chosen for semi-structured interviews rather than structured or non-structured interviews because this way of interviewing has the potential to reveal more detailed information. This approach allows the researcher to keep asking questions on a particular subject. Given this research's explorative in-depth character, getting detailed information and discussing this with program-involved persons will be exciting and valuable. The correct number of interviewees is not fixed and hard to determine (Kvale, 2011). A minimum of four interviews per case is conducted in this research to obtain information and increase continuity per case.

The semi-structured interviews will be conducted with employees in different positions in the program to illuminate all aspects of the way control is organized in IRP. Although all programs do not have identical management structures, based on the predominant part, the same kind of positions within a program will be interviewed. The program director and the primary person responsible for controlling the program goals will be interviewed to get a good overview of how the control process is going. Also, someone mostly responsible for secondary goals, and someone mostly responsible for primary functional goals will be interviewed to get more insight into the differences between the approach of achieving both type of goals. Interviewing those four positions will give a broad overview of the way control is organized in IRP. The respondents are coded with a program abbreviation, followed by a number that corresponds to the program's respondents' position. For example, the program director receives a "1", the respondent responsible for the department control gets a "2", the respondent responsible for primary functional goals gets a "3". The respondent responsible for more secondary goals receives a "4". Appendix B.3 Information interview respondents shows information of the interviewees.

An introduction document, shown in Appendix B.2, is shared with the respondents beforehand to inform the respondents about this research's subject; this is shown in 7.1 Interview information. This information made them aware and prepared, which positively influenced understanding the research they participated in. It did not give any direction or opinion because that could affect their answers. Due to the lockdown caused by the corona crisis that the Netherlands is currently in, all interviews took place via Microsoft Teams. Lastly, interviews were recorded (with permission) to make it easier for the researcher to focus on having a conversation with the respondent and get the correct information. This recording also allowed re-listening relevant parts of the interview to make sure valuable information was interpreted in the correct manner. Appendix B.4 shows the interview protocol, containting of three sections, been used to set up the semi-structured interviews. This protocol is established based on the literature findings. The first section is the introduction section and is designed to find out more about someone's current function within the program and respondents' responsibilities. Since it has been unclear from literature if a different approach for primary functionals goals and secondary goals have been employed before, and if this is desirable, interview questions on the current way of working are initiated. This is because studies have been on the program level's barriers, but not yet specifically on IRP. This resulted in the second section of the interview protocol. Here, participants are asked about the way goals on the program level were controlling, including the three distinct phases that are distinguished. Once this was covered, the barriers experienced in this process were discussed. Furthermore, as is concluded from literature, synergy is one of the program management approach's beneficial characteristics. Different ways of synergy that could be utilized at the program level were found. However, it is unclear if those synergies are consciously recognized and utilized and what barriers potentially benefit oneself. This is of scientific added value to find out. So, the interview protocol contains questions on the synergy as characteristic of a program and the barriers that arise. Finally, the interviews are wrapped up by asking if everything was covered. All questions were open-ended questions.

5.4.2. Program-related documents

The information from the interviews is supplemented by documents related to the cases. This information is mainly exerted for mapping out the approach of controlling program goals. All program-related documents used in this study are presented in Appendix B.1.

6
Case Studies

After conducting the interviews, the gathered data of every case is extensively analyzed. In this chapter, the most important findings of these analysis are summarized. The absolute outcome of this comprehensive analysis per case can be found in Appendices C, E and D. First of all, an introduction to the program will be presented, including the goals, the way the program is organized and the scope. Then a review of the approach of controlling different kind of program goals and barriers experienced that come with this are presented. In addition, synergy and related barriers per case have been assessed.

6.1. Case 1: Bridges and Quay Walls Program

Amsterdam has a total of approximately 1800 bridges and 600 kilometres of quays, banks, and slopes. They are all at the end of their life cycle and are in urgent need for renovations. Because of the necessity to prioritize, the Bridges and Quay Walls Program focuses on objects with a relatively high-risk profile. These are essential objects for the city's functioning or that have a high risk of safety problems. This program focuses on the 829 road bridges and approximately 205 kilometers of quay walls. Table 6.1 shows an overview of information about this program. Within this scope, the program investigates the structures, keeping them safe and renewing them when necessary, with great attention to accessibility and quality of life in the city. The Bridges and Quay Walls program (BQWP) is more than the sum of the implementation of many measures. The efforts made, such as research, monitoring, limiting, strengthening, and renewing, are carried out in mutual cohesion and contribute to preserving the historic city. The program management is responsible and has decision-making authority over the entire assignment and manages the program goals integrally. An assigned program director leads the program.

Bridges and quay wall program in Amsterdam	
Organization	Municipality of Amsterdam
Duration	2019-2039 [20 years]
Budget	47,50 million Euro
Assets	829 bridges and 205-kilometer quay walls
Mission	A functioning city with safe and future-proof bridges and quay walls for current and future generations.
Primary functional goals	Guaranteeing safety and functionalities of the bridges and quay walls in Amsterdam Realizable programming
Secondary conditional goals	Functioning city during construction. Optimization and innovation of processes and method aimed at accelerating the construction in order to guarantee safety and functionality
Secondary value-adding goals	Functioning city during construction: low traffic, urban logistics. Optimization and innovation of processes and method aimed at contributing to knowledge in the field

Table 6.1: General information Bridges and Quay Walls Program

6.1.1. Differences in the approach of controlling primary and secondary program goals

Within the organization, carrying out innovation is separated from the responsibility of renovating the bridges and quay walls. Many instruments implemented for controlling both primary and secondary program goals are the same. However, the following differences have been noted:

- Primary functional goals are more quantitatively defined. Secondary conditional goals are set up both qualitative as quantitative. Lastly, secondary value-adding goals are set up quantitative, however, those do not necessarily reflect success or progress of goals.
- The primary functional goal's programming input is based upon quantitative input. The input used to control the more secondary goal of stimulating gaining knowledge and implementing innovations is an agenda that has been used as a checklist. The conditional secondary goal might be controlled by the proper programming method for the primary goals, since these are related.
- Primary functional goals are reported more quantitatively, while secondary goals are reported more qualitatively, and that is why control is sometimes based on a gut feeling. It can be observed that specific instruments are used for the secondary goals, such as "Digital map with all safety measures" and "A multi-year knowledge and innovation agenda". No specific instrument is used for the secondary value-adding goal "Functioning city during construction".
- External stakeholders are involved in the contradiction meetings that focus on detecting blind spots and unfounded assumptions. The difference in the meetings is that the result meeting focused on "knowledge and innovation" is only informative, whereas the other result meetings are decisive.

6.1.2. Perceived barriers to control program goals

The barriers experienced by controlling both kinds of goals are mentioned below. The numbers refer to table **?? ??**. Some barriers do have a proposed solution, some do not.

- Drawing up goals and their key performance indicators [1]
- Getting program goals in balance (by more collective thinking) [2]
- The program's size [3]
- Fit organization with program goals [4]
- Determine the scope of the program [5]
- Taking action is problematic when monitoring is not done structured yet. [6]
- Commitment to the program management approach [7] by culture change process including lunch lectures and week start meetings

6.1.3. Synergy utilized in practice and experienced barriers to utilize synergy

Sharing knowledge, bundling complex matters, causing political urgency, obtaining resources, offering financial opportunities and dealing with risks are ways of synergies that have been recognized and utilized. Although all forms of synergy experienced in the program are utilized, still barriers (presented in table **??**) can be observed that sabotage utilizing the synergy. These include:

- Retaining the knowledge collected within the program is a difficulty. [1]
- The collective approach that characterizes the program needs to be carried out with everyone within the program organization to utilize synergy. The solution proposed focuses on a culture change procedure including lunch lectures and week start meetings. [2]
- Getting innovation practice-oriented. Involving market parties and knowledge institutions can be useful. [3]

6.2. Case 2: Road Tunnel Program

The municipality of Amsterdam is facing the task that its tunnels must comply with tunnel legislation. The Amsterdam Road Tunnels Program (RTP), part of the Metro and Tram organization, covers the entire road tunnel area from integrality and uniformity. The road tunnel area of the municipality of Amsterdam consists of the following components: five road tunnels, a traffic control centre and a transmission network.

Integrality and uniformity are of great importance throughout the entire lifespan of this area. After all, differences between the parts in the area pose a risk of increasing maintenance costs and lack of clarity in operation and monitoring, resulting in lower availability or even less safety. The pursuit of uniformity, integrity in use, as well as management and maintenance, is responsibility of the Road Tunnel Program. The (future) uniform operational processes and procedures for asset and traffic management also determine how the projects are defined and implemented. Simultaneously, the time pressure to comply with the legislation cannot be ignored, and therefore, projects are already underway to be executed.

The Road Tunnels program director is ultimately responsible for the Amsterdam Road Tunnels program. For all projects defined within the Amsterdam Road Tunnels program, a project framework and a project plan are drawn up that are in line with the program plan. Controlling the uniformity, the secondary value-adding

goal, is done by involving the specialists that were responsible for the design in the process of executing the projects. In this way, the right design will be carried out in the right way. Table 6.2 shows an overview of information about this program.

Road tunnels in Amsterdam	
Organization	Municipality of Amsterdam
Duration	2018-2025
Budget	46,9 million Euro
Assets	Five road tunnels, one traffic control center and transmission network to connect those
Mission	Create a robust basis, so that the future-proof management and maintenance of the integrated road tunnel system can be implemented efficiently and uniformly as a strategic asset of the municipality of Amsterdam, so that the safety and availability thereof can also be demonstrably guaranteed in the future.
Primary functional goals	Comply with legislation with the entire tunnel system as soon as possible, so that safety and availability are demonstrably guaranteed.
Secondary conditional goals	Reduction of nuisance
Secondary value-adding goals	Future-proof management and maintenance

Table 6.2: General information Road Tunnel Program

6.2.1. Differences in the approach of controlling primary and secondary program goal

Task-oriented working is central to the program organization. The managers of the task areas of integral design, implementation, commissioning, and environment and communication have a role in guaranteeing integrality of their task field on the program level. This way of working results is a shared responsibility for both kinds of goals.

Looking into the differences of instruments applied, both kinds of goals do have their specific instruments to gain control. Even though specific instruments are practiced for the secondary goals, respondents indicate that there is benefit to be made in gaining control over secondary goals. The cause is that secondary goals are less tangible and, therefore, less easy to control. The main difference in controlling goals in this case are:

- The primary functional goals' performance indicators are indicated quantitatively, whereas the secondary goals are indicated more qualitatively.
- The difference in reporting is based on the qualitative and qualitative of the indication of the goals.
- No specific difference is mentioned, based on programming, in the interviews.
- The difference in meetings on the different kind of goals lies within the fact that stakeholders are engaged in the secondary conditional goal; reduction of the nuisance.

6.2.2. Perceived barriers to control program goals

The barriers related to controlling goals in RTP case are presented in Table **??** , and summarized as:

- Designating all goals quantitatively is something that is indicated as valuable, and at the same time, a barrier. No applied solution has been determined and applied yet. [1]
- Making sure goals are balanced rather than one goal is prioritized over the other is a difficulty. Solutions that have been applied are exhibiting objectives simultaneously, tackling goals integrally and not sticking to the goals' numbering. Also, dedication and support from everyone in the organization seem like an answer to the barrier. [2]
- Introducing too many goals is considered undesirable, which is easily solved by defining a limited number of program goals. [3]
- Another barrier mentioned in the interviews is the difficulty of controlling caused by projects that are in the same phase. This brings about many variation and complexity. However, the fact that projects are in different phases also enables the learning synergy. [4]
- The size of the program makes coordination of the program complicated. Much alignment and integration is required to achieve program control on different goals. No particular solutions have been proposed or applied. [5]

- Commitment to the program management approach of the whole organization is indispensable. The task-oriented way of working applied in this program could facilitate the organization's commitment. No particular solution has been mentioned. Overcoming this barrier will have a positive effect on barrier [2]. [6]

6.2.3. Synergy utilized in practice and experienced barriers to utilize synergy

Synergy is utilized in this case by sharing knowledge to learn from project to project. This is utilized through meetings. Also, matrix organization facilitates, in this case sharing knowledge, together with an auditable system that is established to collect working methods. Another synergy is that broad goals can be set up, what has been utilized. Forms of synergy and how they are utilized in RTP are presented in table **??**.

Two barriers experienced in this case are described in detail in table **??**. Those two barriers are briefly:

- Commitment to the whole organization's program management approach is required to benefit from the synergy and be seen as a limitation. Hypothetically, the task-oriented way of working could help to aid to propagate this mindset within the program.
- Coordinating projects within the program requires too many actions to align, tune, adapt.

6.3. Case 3: Flood Protection Program

The Flood Protection Program (FPP) is a water safety program in which the central government and water boards work together to protect the Netherlands against flooding. The FPP organization is responsible for setting up the program and starting with the reinforcements task. The central government and the water boards jointly bear responsibility and contribute to the financial costs. The FPP strives for projects carried out soberly and effectively and facilitates the water authorities by granting subsidies and providing knowledge. Also, they stimulate innovation and sustainability. The water boards are themselves responsible for the projects' execution, including time, budget and scope.

The FPP program organization consists of the Program Board, the Management Team represented by the program directors, supplemented by the water authorities that realize the FPP projects and the advisory organizations. Support teams have been set up to intensify the cooperation between projects and the program. They aim to guarantee mutual interaction, integrality, and consistency of the information provision and decision-making within the primary process. They focus on the two kinds of secondary goals. Table 6.3 shows an overview of information about this program.

Flood Protection Program	
Organization	Rijkswaterstaat & water authorities
Duration	2020-2050 [30 years]
Budget	Around 380 million Euro per year
Assets	1300 km dike/dam/dune & 500 sluices/weir/pumping stations
Mission	By 2050, all primary flood defenses will meet the applicable standards. This is done by strengthening barriers and structures, where possible in combination with the realization of additional social goals, such as spatial quality and sustainability.
Primary functional goals	Safe dikes, dams and dunes
Secondary conditional goals	Focus on product and process innovations to guarantee the efficiency and affordability of the FPP.
Secondary value-adding goals:	Realizing additional social goals, such as spatial quality and sustainability.

Table 6.3: General information Flood Protection Program

6.3.1. Differences in the approach of controlling primary and secondary program goals

The difference between the primary functional goals and the secondary goals is that the risk of execution lies with the water authorities. The risk of the secondary goal, sharing knowledge and being innovate, lies with the alliance. This provides an incentive to get started with the secondary objective for the FPP program board. The support groups that are set up focus on the two secondary goals.

- Primary functional goals and secondary conditional goals have quantitative performance indicators. Secondary value-adding goals are not identified.

- A difference that is observed is the fact that subsidies for innovation and sustainability are available for 100%, based on recalculation and low-threshold criterion, whereas subsidies for primary functional goals are not. Furthermore, there is a yearly budget available for knowledge and innovation efforts, and the result of these efforts are 'paid back' by the cheaper renovation projects.
- No specific difference in reporting of the goals is mentioned.
- The responsibility of secondary value-adding goal is less in the hand of the program, so different way of monitoring is chosen for. Also, the difference in the various kind of goals on the meetings is that reporting to the minister focuses on the primary functional goal.

6.3.2. Perceived barriers to control program goals

The barriers experienced by controlling both kinds of goals (presented in table **??**) are:

- The tension between project and program interest is experienced because of a lack of commitment to the program management approach and collective interests by the whole organization. The applied solutions are setting up work processes jointly, discussing the balance, making people ultimately responsible for both, and focusing on transparency in the organization. [1]
- Because of the facilitating and controlling role of the program management board, different kind of relationships will need to be maintained with the water authorities. This could be tackled by the support team established to intensify the cooperation between projects and the program. [2]
- Another barrier mentioned is that the Union of water authorities is the representative for this audience. However, they are not seen as representative. [3]
- Much coordination is needed because of the size of the program. This requirement should be taken into account setting up the program organization. [4]
- A barrier specifically on how the program is organized is brought up; the alliance reduces the program management team's power since this is not an organization where management can act top-down. [5]
- Within a program, individuals and their attitude can be deciding what is experienced as a barrier. [6]
- Structuring the information to monitor data has been found difficult since different systems are used to gain information. One leading database would ease this process. [7]
- It is unknown what level of taking action will be adequate. The difficulty lies mainly on what level a solution will be implemented, so on what agenda the problem should be put. [9]
- If action is taken, it is found hard when evaluating those action should be taken since a program is complex and has a long duration time. [8]

6.3.3. Synergy utilized in practice and experienced barriers to utilize synergy

Synergy is experienced in different ways and is all utilized in the form of way. Learning through knowledge sharing is extensively utilized by a procedure that has been set up. Trends can be observed, strategic choices can be made, tasks can be bundled, and finance and planning can be approached collectively, all because the projects are organized in a program. Those synergy and the way they are utilized are shown in table **??**. The barriers (shown in in table **??**) experienced in utilizing synergy are:

- Stimulating to share knowledge is difficult, which might be caused by rivalry. A solution for this is stimulating sharing knowledge by social media and setting up communities of practices. Also, employees are deployed to disseminate knowledge actively. [1]
- The risks or the low priority of innovating could be an obstacle. However, this could be solved by shifting the risk from the one executing the innovation to the overarching organization, such as the alliance. Besides, only innovations that can grant benefit should be on the agenda, which will lead to lower risk. To overcome this barrier, innovating should be a requirement to automatically achieve the goal to increase priority. Also, granting subsidy might shift innovating from low priority to higher priority. [2]
- The fact that five-year planning on innovations will need to be made is a barrier. A solution raised is a yearly portfolio of subjects, which makes it easier to manage. [3]
- Getting the innovation developments application-oriented and applied has been found hard. This is trying to be solved by obliging the explanation of not using an innovation that has been offered. Also, ongoing innovation is connected to the project in the program to make them practice-oriented. [4]
- Organization of collectively addressing things not fully implemented in organization. However, this is vital in utilizing synergy. No specific solution has been suggested. [5]
- Commitment to the program approach is required. The applied solutions are setting up work processes jointly, discussing the balance, making people ultimately responsible for both, and focusing on transparency in the organization. [6]

7

Case Analysis: Control on Infrastructure Renovation Program Goals

The cases will be analyzed by comparing the outcomes related to control on program goals presented in Chapter 6 Case Studies. Firstly, the differences between cases in the approach on primary functional, secondary conditional and secondary value-adding goals (explained in 4.2 Infrastructure renovation programs goals) will be described in 7.1. This will be done based on the criteria that has been shown in Chapter 6 Case Studies: governance, performance indicators, programming, reporting and meetings.

Then, barriers experienced in the cases are compared to determine what benefit can be gained in terms of controlling both primary functional and secondary goals within IRP. This comparison together with input of 7.1. lead to the underlying causes leading to these barriers. Paragraph 7.2 shows this analysis.

Lastly, an analysis has been conducted to see how these barriers experienced in practice can be placed in context of existing literature, presented in 3.4. Existing Barriers. In addition, based on applied solutions in practice and literature, improvement to overcome the barriers will be presented.

The research question that will be answered in this chapter is: *Which improvements can be made to control goals on program level in IRP?*

7.1. Difference in approach in primary and secondary goals

The difference in several criteria of the three different cases might be interesting input for clarifying the barriers that will be discussed in 7.2. Based upon the criteria considered in chapter 6, those differences are outlined in upcoming paragraphs. Table 7.1 gives an overview of this information. As explained in paragraph 5.2 Case Selection criteria and Chapter 4 Infrastructure Renovation Programs, a distinction is made between primary functional, secondary conditional and secondary value-adding goals.

7.1.1. Governance

Within the BQWP organization, carrying out innovation is separated from renovating within the bridges and quay walls program. Within the control department, control over planning, risk and budget is separated from control over information and quality.

Within the RTP, the matrix organization is central, with on one axis the task and on the other axis the project. The managers of the task areas of integral design, implementation, commissioning, and environment, and communication have a role in guaranteeing their task field's integrality on the program level. They deliver someone from their task field to participate on the project level, which results in a matrix organization. This way of working results is a separated responsibility for both kinds of goals; however, a more integral way of working is central because of the matrix organization.

FPP applies again another way of organizing the program. The difference between the primary functional goals and the secondary goals in this program is that the risk of execution, so the primary functional goal lies with the water authorities. However, the program organization still controls the primary functional goal since they facilitate and have the responsibility that the program will be executed. The risk and responsibility of the secondary goal, sharing knowledge and innovation, lies with the program. This provides an incentive to get started with the secondary objective for the FPP program board. Besides, the secondary goal focused on adding value is set up by the program organization, however, the initiative to work on this goal lies by the water authorities.

Lastly, loads of program employees are busy on gaining control. Both RTP and FPP respond to the lack of grip on secondary goals by additionally implementing an instrument to monitor the progress of secondary

goals. They involve specialist that actively monitor the uniformity of the design and the consistency of the information provision. Those processes correlated to the secondary goals. So, program employees are specifically engaged, on top of the control already actively employed, to monitor secondary goals.

So, the main difference between controlling primary functional goals and secondary goals is how the responsibility is organized. In all three cases the responsibility of the primary functional goals is in different hands that the responsibility of the secondary goals. However, BQWP separated the responsibility over different people but within the same department. RTP separated the responsibility over different departments, but matrix organization stimulated integral way of working. Besides, FPP outsourced the risks of the primary functional goal and secondary value-adding goal, but not the complete responsibility, to another organization. On top of this, program employees are specifically engaged in RTP and FPP to monitor secondary goals.

7.1.2. Performance indicators

RTP indicate performance indicators of secondary goals only qualitatively, whereas primary functional goals are indicated quantitatively. BQWP indicate performance indicators of secondary goals both qualitative as quantitative, however, it can be questioned if the quantitative indicators gain reflect the success of the program goals. FPP did find quantitative performance indicators to indicate the progress of the secondary conditional goal. However, FPP did not define performance indicators for secondary value-adding goals at all.

The reason why FPP was able to quantify those indicators is because of the approach they use. As described in the program plan, indicators have been drawn up based on the program goals, which will initially form the basis for measuring and monitoring. Where necessary, these are sharpened or complemented. Initially, the development of the indicators will be monitored. Based on experience, it will be determined whether and for which indicators a target value will be established. Any target values will be determined annually and adjusted if necessary, as part of the annual plans. If the development of an indicator so requires, a further analysis of the underlying causes is made. Examples of the innovation indicators, related to the conditional secondary goal, are “investments as % program budget”, “Realized cost savings” and “% improvement actions realized on time”. Those indicators are focused on the process of getting to an end result, instead of the end result itself.

Thus, FPP did initially focus on the development of a goal, so on the process of achieving the goal, instead of focusing on the end product as a result. This enabled them to draw up quantitative indicators that help controlling the goals. Especially secondary goals turn out to be difficult to get grip on, so a way of improving this is highly demanded.

So, identifying performance indicators of primary functional goals is done quantitatively in all three cases. Performance indicators for secondary conditional goals were only in one case quantitatively defined. Lastly, performance indicators for secondary value-adding goals were either not defined at all or not defined quantitatively. The approach FPP uses for performance indicators differs from the other two cases; focus lies upon development and process, instead of target values and the end product.

7.1.3. Programming

Programming the budget and planning of a program is integrally done for all cases. FPP has both for budgeting as for planning specific tools for secondary goals, namely the knowledge and innovation agenda for planning and a different subsidies regulation for budgeting. The other cases less anticipate in implementing tools for programming secondary goals. They either did not find it necessary, or they could not come up with something. Respondents did mention that control over budget and planning of more secondary goals could use some improvements.

7.1.4. Reporting

As shown in table 7.1, primary functional goals are more quantitatively reported than both secondary goals in two cases. The third case does not recognize this difference: both primary functional goals as secondary conditional goals are reported quantitatively. However, no instruments are applied in the FPP case on the secondary value-adding goal.

So, a difference in reporting of the progress of primary functional goals, secondary conditional goals and secondary value-adding goals has been noticed. The primary functional goals are reported more quantitatively, whereas both secondary goals are defined qualitatively.

7.1.5. Meetings

In the FPP case, the responsibility of secondary value-adding goal is less in the hand of the program, so different way of monitoring is chosen for. Also, the difference in the various kind of goals on the meetings is that reporting to the minister focuses on the primary functional goal. The difference in meetings in BQWP case on the different kind of goals lies within the fact that stakeholders are engaged in the secondary conditional goal; reduction of the nuisance. Lastly, external stakeholders are involved in the contradiction meetings that focus on detecting blind spots and unfounded assumptions. The difference in the meetings is that the result meeting focused on "knowledge and innovation" is only informative, whereas the other result meetings are decisive. So, it is a possibility to involve (external) stakeholders in meeting regarding secondary value-adding goals, while this is not obvious for goals related to the function of the asset. However, those meeting are not necessarily decisive, but rather informative.

Criteria	Difference in control on various goals
Governance	The responsibility of controlling primary functional goals and secondary goals is organized differently.
Performance indicators	Identifying performance indicators of: primary functional goals is done quantitatively, secondary conditional goals were only in one case quantitatively defined, in two cases qualitatively. Lastly, secondary value-adding goals were either not defined at all or defined qualitatively. The approach of one case focuses on development and process, instead of target values and the end product.
Programming (budget & time)	Programming the budget and planning of a program is integrally done. FPP has both for budgeting as for planning specific tools for secondary goals, the other cases less anticipate in implementing tools for programming secondary goals
Reporting	The primary functional goals are reported more quantitatively, whereas both secondary goals are defined qualitatively.
Meetings	It is a possibility to involve (external) stakeholders in meeting regarding secondary value-adding goals, while this is not obvious for goals related to the function of the asset. However, those meeting are not necessarily decisive, but rather informative.

Table 7.1: Difference in control approach on various goals

7.2. Barriers and its clarification

Table 7.2 summarizes the barriers that are discovered by conducting the interviews. A categorization is applied to interpreter the results: barriers focused on (monitoring) goals and barriers focused on organization.

All barriers are analyzed separately, and this is done using the same structure. Each barrier is coded with the abbreviation BC (*barriers correlated to controlling program goals*, followed by a number to order the barriers in text. Firstly, the barrier is described and possible causes, linkages to other barriers and clarifications are given. This together with an own interpretation of the researcher and input of 7.1 Difference in approach in primary and secondary goals leads to the underlying problem of each barrier. This enables to come up with ways to overcome these barriers effectively and efficiently, which is done in 7.3 Barriers in context of literature and suggested solutions.

Barriers removed from this set of data are the ones that are mentioned by one respondent and are not repeated by other cases. Those are interpreted as subjective. Also, those could be interpreted as less relevant.

7.2.1. Barriers focused on (monitoring) goals

[BC1] Drawing up goals and its KPI, preferably quantitatively

The difference observed in performance indicators described in 7.1 Difference in approach in primary and secondary goals and the organization's difference provides helpful information for interpreting this barrier. The difference observed in the use of performance indicators is that two of the three cases indicate performance indicators of secondary goals only qualitatively, whereas primary functional goals are indicated quantitatively. Those two cases describe drawing up goals and their Key Performance Indicator (KPI)s as a barrier, and the respondents mention that defining goals would preferably be done quantitatively. The FPP case did come up with quantitative performance indicators for the secondary conditional goal. However, they did not define performance indicators for adding value at all. It could be explainable that they did not mention barrier [BC1]. Firstly, because they did not come up with quantitative performance indicators since this goal's

responsibility is not entirely in the program management's hands, as is found and explained in 7.1 Difference in approach in primary and secondary goals. Secondly, because they us a different approach indicating performance indicators. As described in 7.1 Difference in approach in primary and secondary goals, FPP did initially focus on the development of a goal, so on the process of achieving the goal, instead of focusing on the end product as a result. This enabled them to draw up quantitative indicators that help controlling the goals.

So, control on the secondary goals, especially the secondary value-adding goal, is lacking. It is often stated in interviews that quantitative performance indicators are a must to control program goals. So, finding a way performance indicator of secondary value-adding goals can be defined quantitatively is a solution. However, it could be questioned if this is the right way to overcome this barrier. In other words, if quantitative performance indicators are necessary to be in control of program goals. This barrier's underlying problem might be that a lack of control tends to prefer quantitative performance indicators. In contrast, the solution to this lack of control might lie somewhere else than defining secondary (value-adding) goals in quantitative performance indicators. This should be taken into account considering the improvement. The underlying problem of this barrier is that focus lays on trying to define the performance or end results of the secondary goals quantitatively, while gaining control on those goals potentially should not focus on defining indicators of performance.

[BC2] Taking action is hard to when monitoring is not done structured yet
The barrier of "taking action is hard to when monitoring is not done structured yet" implies that available information on the progress of the goals is not yet put together in a way it can function as intended. This is striking, since all three cases have a dashboard or report that focuses on the progress of all program goals. Partly the cause could be that a barrier observed is that performance indicators are not drawn up successfully [BC1]. That would make it hard to structure the information to monitor. Furthermore, the difference in meetings and reporting discussed in 7.1 has to do with this barrier. The primary functional goals are reported more quantitatively, whereas both secondary goals are defined qualitatively. Also, many different reporting systems are practiced presenting the progress, such as a digital map, an online portal, an auditable system and a knowledge and innovation agenda. Even though all three cases implemented a dashboard with the progress of all program goals, the input for this dashboard comes from various reporting systems. Besides, many meetings are organized what can all potentially be input for the dashboard. Structuring all data might be the underlying problem of this barrier, because the input comes from too many sources with insufficient analysis prior to reporting. Also, the underlying problem lays in the fact that in the database usually just data is available. Giving an understanding and a meaning to data in order to interpreter it, is something different.

[BC3] Getting program goals in balance
The barrier of getting program goals in balance is experienced in both BQWP as RTP. FPP did not mention this barrier, what can be clarified by the difference in organization described in 7.1 The FPP organization does not carry the ultimate responsibility of the secondary goals, what explains that they are not responsible for balancing goals.
To be more specific, this barrier signifies that a program goal can prioritize another program goal, and it is unclear how this should be managed. As mentioned in the interviews, the cause for this is a lack of commitment to the program management approach [BC7], one of the barriers also experienced. Furthermore, the barrier described earlier [BC1], drawing up goals and their KPI's influences this barrier. Once a program management team has control over all goals, the balance could more easily be succeeded. Lastly, when all available data on the progress of the program goals are structured [BC2], monitoring will be done possible what makes provision for taking action. So, the underlying problems of this barrier lays in others.

7.2.2. Barriers focused on organization

Five barriers could be linked to the category "organization". This shows improvement in the way program management is organized would be valuable.

[BC4] Much coordination is needed because of the size of the program
Two out of six barriers are experienced by all three cases, and one of these is "Much coordination is needed because of the program's size". The organization must be set up in a way that the program's coordination can be taken into account. This is missing in all three cases since all cases have mentioned this in the inter-

views. Striking is that all three cases do use a slightly different way of organizing. So, despite different ways of organizing the program, the efforts to coordinate are experienced as too high.

An underlying problem of this barrier might be that program management is not only focused on program coordination but focuses much on coordination that is a projects responsibility, as well. This expands the coordination and forms an obstacle.

[BC5] Mismatch between organizational plan and control on program goals
Two barriers, barrier [BC5] and [BC6], are only mentioned by the BQWP case. It would be interesting to find out why only this case experiences those barriers. Furthermore, BQWP did not yet implement supporting groups that actively monitor and control secondary goals. The barrier of "Mismatch between organizational plan and control on program goals" is mentioned. On the one hand, making a department responsible for a goal might work, since this creates clarity. On the other hand, goals are intertwined and dependent, so working together on goals is preferable. This balance is hard to find. Currently a mismatch between program goals and organization of the program is experienced.

Looking into the difference in governance presented in table 7.1, the responsibility of controlling primary functional goals and secondary goals is organized differently. Within the BQWP organization, carrying out innovation is separated from renovating within the bridges and quay walls program. Within the control department, control over planning, risk and budget is recently separated from control over information and quality. This recent implementation is essential to take into account when analyzing improvement possibilities. Furthermore, the other two cases specifically engaged employees, on top of the control already actively employed, to monitor secondary goals.

[C6] Determine the scope of the program
The sixth barrier, "determine the scope of the program", is again only mentioned in the BQWP case. This barrier can be clarified by the fact that this case is executed in the middle of a city. So, many stakeholders are involved, what results in many aspects that can make it to the scope of the program. This is an opportunity; broadening the scope, enables adding value to the program. However, enlarging the scope deviates the program from the initial primary functional objective of renovating the assets. Because of the opportunity it enables and on the other side the attention and coordination that it requires, a balance between enlarging the scope and sticking to the initial scope is hard to determine.

The other two cases, RTP and FPP made use of an integral change management procedure. RTP defined the scope of the entire program in the program plan. This provides the opportunity to formally determine changes to the program scope on the basis of the "request for change" procedure. FPP set up an Integral Change Management procedure, that aims to safeguard the integrality and consistency between scope, time, budget, and risks from the baselines and the changes to both the individual projects and the program as a whole.

In addition, when programming described in 7.1 is not successfully done for both primary functional and secondary goals, the scope will be triggered to extend. To be more specific, if it is unclear what should be done to achieve a goal in accordance with budget and time, actions might not be effective and efficient. Enlarging the scope will be the result. This might be desirable, but yet it is unknown, and therefore not in control. This interpretation can also be inferred from the information given in 7.1 on programming. BQWP is the only case that brought up barrier [BC6]. They are the case that did not specify "functioning city during construction". To overcome this, programming should be done properly for all kind of goals.

In short, the underlying problem of this barrier is that clarity of the effect of a change in scope on all program goals is essential. In addition, programming should be executed properly.

[BC7] Lack of commitment of program management approach
"Tension between project and program interests because of a lack of commitment of program management approach and collective interests by the whole organization" is one of the two barriers that has been experienced by all three cases. The commitment to the program management approach is lacking, what means that not every program's employee is aware and act according to the collective attitude chosen by entering a program. So, everyone working in the program should not only take their own interest, such as project interests, into account but should consider the program's interests as well. It is the program managements responsibility to enlighten this. So, improving the awareness of the program management approach is essential in controlling both kind of program goals. Also, stimulating working together has a positive impact on the

commitment of program management approach.

[BC8] The alliance reduces the power of the program management team
One barrier is only mentioned by the FPP case. The barrier “the alliance reduces the power of the program management team” corresponds directly to the way the program is organized. Shifting the responsibility of the secondary value-adding goal to other parties does come with the disadvantage of a reduction of power. This barrier is too specific on one case. Since this research aims for recommendation for IRP, this barrier will not be taken into further consideration.

7.3. Barriers in context of literature and suggested solutions

Upcoming paragraph places the barriers experienced in practice in context of literature. In addition, improvements to overcome those barriers are presented with the input of literature, and applied solutions in practice.

This study confirms several barriers described in the literature, presented in the literature study in chapter 3.4 Existing Barriers. Barriers that correspond to one another are labelled as relevant and validated. Barriers only mentioned in literature, indicated with abbreviation BCL, will need to be validated if applicable in IRP during the expert meeting. Barriers only mentioned in empirical research are an addition to scientific knowledge.

Firstly, every barrier (and underlying problem of the barrier found in 7.1) is mentioned and compared to excising literature. In order to come to a solution to overcome those barriers, applied solutions in practice are considered together with input of literature. The result will be a suggested solution per barrier.

[BC1] Drawing up goals and its KPI, preferably quantitatively
The result of drawing up goals and its KPI’s as a barrier corroborate the findings of a great deal of the previous work of Murray-Webster and Thiry (2000). Nonetheless, in empirical research, the emphasis lay upon defining the KPI’s, preferably quantitatively, of the program goals as a barrier extensively, while literature does not elaborate this in more detail.

The underlying problem of this barrier is that focus lays on trying to define the performance or end results of the (secondary) goals quantitatively, while gaining control on those goals potentially should not focus on defining indicators of performance.

Solutions applied and mentioned in interviews not yet cover the barrier. Trying to qualify the goals is mainly tried to implement and done by SMART goals. Also, using traffic lights (red/orange/green) to indicate progress are applied to get a grip on the secondary goals.

A solution to get control on the secondary value-adding goal might be to focus on the process instead of the product as a result. This means that KPIs are defined on how to achieve the goals, instead of the performance that should be delivered in the end. To be more specific, KPIs are not always tangible and this can be overcome by setting up process indicators that determine the program’s success. By doing so, the opportunity arises to break down the goals in manageable parts that are more tangible. This is favourable over using KPIs that are hard to approach and access.

This solution based on the approach applied by FPP, and they did not mention [BC1] as a barrier what might show the potentiality of this approach. This solution is also corresponding to literature. Thiry (2002) work states that the current program management model is “strictly performance based” and it appears necessary to include a learning process in the management of programmes.

This solution can be clarified with an example. As doing innovation might be one of the secondary goals, coming up with performance indicators seems difficult. However, a focus on the process of achieving this goal can help. Instead of setting up performance indicators as "spending xx budget yearly on innovation" and "increase pace of execution of the program because of implementing new innovations", indicators focused on the process of achieving the goal gives perspective. For instance, "creating overview of potential innovation in the field" and "desired afford of innovation" will give direction in the first phase of the program. In a later stadium, process related indicators can for instance be "implementing a try-out of the innovation". So, KPIs should not only focus on the performance of a goal that should be delivered, but also focus on the process of how to achieve the goals. This enables to have control on program goals by the use of more tangible indicators.

[BC2] Taking action is hard to when monitoring is not done structured yet
Consistent with the literature, this research found that structuring all data of a program to take action is difficult (Shehu & Akintoye, 2010). In his research, Shehu and Akintoye (2010) describes both the complication of measuring the right data and the requirement to deliver human and financial resources to interpreter the data correctly. In addition, Prevaas (2018) describe a pitfall that the focus lays on measuring and monitoring and this takes away the energy for the content. Also, when interpreting the progress, there is no room for opinions, only for facts (Prevaas, 2018). This is in line with the underlying problem described in 7.3; giving an understanding to data to be able to interpretate it, is lacking. This research adds to those complications that structuring all data is difficult because the input comes from too many sources with insufficient analysis prior to reporting, as described as underlying problem described in **??**.

The applied solution in practice for these problems are to gather all data and present it in one leading database, in order to structure data. This is a potential solution; however, it requires that barrier [BC1] is tackled.

To tackle above mentioned barriers, a suggestion is to focus on the transition of measured data to interpretable information. By extensively emphasize on the method going from data to information, measuring the right data, structuring it and deliver the right human and financial resources can be achieved.

[BC3] Getting program goals in balance
Prevaas (2018) points out that there can be many different program goals, and those can be even conflicting. Managing cohesion between those goals is a challenge. This accords with empirical observations, which showed that getting program goals in balance is a barrier.

The applied solutions for this barrier are to set up work processes jointly. This could be associated with the commitment to a program management approach, since setting up work processes jointly stimulate the awareness of the collective approach. Also, discussing the balance with employees is suggested as solution, what can be linked to the commitment of the program management approach. So, the applied solution are examples of how substance can be given to the commitment to the program management approach.

Once the commitment to the program management approach [BC7] and control over the secondary (value-adding) goals are achieved, getting program goals in balance will potentially get easier. Once drawing up goals and its KPIs is accomplished [BC1], balancing the program goals would get less challenging. Lastly, when available information is structured [BC2], monitoring can be done correctly, balancing the program goals will get less demanding. To sum up, if barrier [BC1], [BC2] and [BC7] are solved, getting program goals in balance [BC3] will be less complicated.

[BC4] Much coordination is needed because of the size of the program
The barriers of "much coordination are needed because of the program's size" broadly supports the work of the other studies in this area (Best Management Practice, 2011; Blomquist & Muller, 2006; Shehu & Akintoye, 2010). The size of the program requires much alignment and coordination. The alignment of projects is correlated to the lack of cross-functional working, which has been observed as an obstacle (Shehu & Akintoye, 2010; Williams & Parr, 2004).

An underlying problem of this barrier might be that program management is not only focused on program coordination but focuses much on coordination that is a projects responsibility, as well. This expands the coordination and forms an obstacle. No particular solution for this barrier is applied, except for the fact that it should be taken into consideration by setting up the organization of an IRP.

To overcome this barrier, the organization of a program should prioritize what needs to be coordinated on program level. This should be clearly translated in the organization plan and should actively be reflected upon. Also, make sure roles and responsibilities of the key team members are defined in such a way the program can rely on the various underlying teams.

[BC5] Mismatch between organizational plan and control on program goals
The mismatch between the organization and program goals has been observed as a barrier in practice. However, it is not described in literature before. This is an addition to scientific knowledge.

Within all three cases responsibility for control on primary functional goals is separated from the responsibility for control on secondary goals. The case that experienced BC5 recently adjusted their approach to this way of working. This implementation of splitting up the responsibility might already overcome the barrier. This impression is raised because of two out of three cases did not mention this barrier and also applied a

separate responsibility for the goals.

Furthermore, the other two cases specifically engaged employees, on top of the control already actively employed, to monitor secondary goals. This could be a suggestion to overcome this barrier.

[BC6] Determine the scope of the program
A barrier disclosed by literature that has to do with program control is that if it is executed on a high level of detail, it can lead to immoderate bureaucracy levels, which is inefficient for the program (Lycett et al., 2004; Westerveld & Hertogh, 2010). Moreover, this can lead to conflict between the management on the program level and the management on the project level because of fading goals (Lycett et al., 2004). On the other hand, control with too little detail might result in a disconnected program and projects relation, which hampers control. The barrier of determining the system boundary (Prevaas, 2018)does influence the span of control. This study supports evidence from these previous observations (Lycett et al., 2004; Prevaas, 2018; Westerveld & Hertogh, 2010) since determining the program's scope is reported as a barrier in empirical research. Adding too much to the scope complicates having control, while value can be added by involving more aspects into the program's scope.

The solution applied, of outsourcing some tasks, did not fully overcome the barrier. The counter side of outsourcing tasks comes with potential delays and more coordination, what is not desirable, as mentioned in barrier [BC5].

The underlying problem of this barrier is that clarity of the effect of a change in scope on all program goals is essential. In addition, programming should be executed properly. A solution to overcome this barrier is to implement a change management procedure where the effect of the change for all program goals is described. It is therefore required to set up baselines for all program goals in order to be able to measure potential deviation. The effect is in term of probability and impact. In this way, it is explicit when a scope change helps in achieving program goals and the right balance can be found to overcome barrier [BC6]. This solution is based on the applied approach of cases.

[BC7] Lack of commitment on program management approach
Shehu and Akintoye (2010) describes a lack of business leaders' commitment, which is essential for a program's success, as a major challenge in his research. Commitment in this context is described in this context as the willingness on the part of individuals to contribute much more to the program organization than their formal contractual obligation (Shehu & Akintoye, 2010). This barrier is in a certain way found in empirical research. However, while literature focuses on leaders' commitment, empirical research shows a barrier of a lack of commitment of all employees in the program.

Examples of applied solutions are setting up work processes jointly and transparency in the organization. Communication through the whole program organization can be stimulated to increase the collective approach by lunch lectures, week start meetings and discussions. This will enable employees to see all interests of the program instead of focusing on their own tasks only. By showing the beneficial character of a program, balancing out the goals might get easier.

A set of solutions should be implemented in order to overcome this barrier. Firstly, stimulating working together on tasks should be implemented in the program organization. For example, creating a matrix organization, meeting with responsible employees for all kind of goals and implementing support teams. Secondly, creating awareness of the beneficial collective program approach will overcome this barrier and can be done through communicating this through lunch lectures, week start meetings and discussions.

[BCL1] programs often unsuccessfully define or unsuccessfully communicate their vision
Best Management Practice (2011) and Murray-Webster and Thiry (2000) describe a pitfall: programs often unsuccessfully define or unsuccessfully communicate their vision. Nonetheless, in empirical research, this has not been found as a barrier.

[BCL2] Real time proactive planning is difficult
This study did not demonstrate that real-time proactive planning is difficult on program level (Shehu & Akintoye, 2010).

7.4. Conclusion

The research question that will be answered in this chapter is: *Which improvements can be made to control goals on program level in IRP?*

As presented in Table 7.2, many barriers are observed in both literature and practice what indicates a confirmation of literature presented in 3.4. Improvements to control program goals in IRP will contribute to gain control. The barrier of the mismatch between the organization plan of a program and control on program goals is only found in empirical research. The suggests that this barrier is an addition to scientific knowledge. However, the validation session will confirm this.

Two barriers are only found in literature, but are not acknowledged in the empirical study. Those ("goals are set up in a broad way" and "real time proactive planning is difficult") will need to be validated if applicable in IRP during the expert meeting.

Furthermore, four barriers are related to the category of monitoring goals, whereas five barriers are related to the category of organization. This suggests that in both those categories benefit can be gained.

Lastly, only the first barrier "drawing up goals and its KPI's is directly related to secondary goals. It was indicated that especially secondary value-adding goals were hard to indicate, particularly because the preference was to draw up its indicators quantitatively. To respond to the trend, as described in 4.2 Secondary value-adding goals and secondary conditional goals, this barrier is essential to tackle.

Barrier category	Barriers: control on program goals	Suggested improvement
Barriers corresponding to literature and empirical research		
Monitoring goals	[BC1] Drawing up goals and its KPIs, preferably quantitatively / Indicators are not obvious	Focus on process instead of performance
Monitoring goals	[BC2] Taking action is hard to when monitoring is not done structured yet / Coordination of information, Generating all data	Focus on the method going from data to information
Monitoring goals	[BC3] Getting program goals in balance / Goals are conflicting	Focus on overcoming [BC1], [BC2] and [BC7]. In addition, by setting up work processes jointly and discussing the balance between the different kind of goals.
Organization	[BC4] Much coordination is needed because of the size of the program / Alignment of projects	The organization of a program should prioritize what needs to be coordinated on program level. Also, make sure roles and responsibilities of the key team members are defined in such a way the program can rely on the various underlying teams.
Organization	[BC6] Determine the scope of the program / Span of control	Implement a change management procedure where the effect of the change for all program goals is described. In this way, it is explicit when a scope change helps in achieving program goals and the right balance can be found to overcome barrier [BC3]
Organization	[BC7] Lack of commitment on program management approach / Commitment for approach is missing	Stimulating working together on tasks by matrix organization, meeting with responsible employees for all kind of goals and implementing support teams. Creating awareness of the beneficial collective program approach through lunch lectures, week start meetings and discussions.
Barriers found in literature		
Monitoring goals	[BCL1] Goals are set up in a broad way	
Organization	[BCL2] Real time proactive planning difficult	
Barriers found in empirical research		
Organization	[BC5] Mismatch between organizational plan and control on program goals	Separate responsibility for control on the different goals. Specifically engaged employees, on top of the control already actively employed, to monitor secondary goals

Table 7.2: Barriers related to controlling IRP goals with a distinction of source (literature/empirical research)

8

Case Analysis: Synergy within IRP

The synergy experienced in the cases will be presented in 8.1 Synergy recognized and utilized in practice in IRP. Then, those synergies will be placed in context of literature, presented in 3.2 Synergy of program management. Also, barriers recognized in practice within utilizing synergy will be discussed together with its clarification in 8.3. Additionally, an overview of what kind of synergy is sabotages due to these barriers is given. In 8.4, synergy will be put into the context of existing literature and improvements will be presented, based on comparing applied solutions and literature. The research question answered in this chapter is: *Which improvements contribute to utilizing synergy in infrastructure renovation programs?*

8.1. Synergy recognized and utilized in practice in IRP

Synergy has been recognized within every case. Respondents agreed with this beneficial character of programs. All forms of synergy mentioned are summarized in Table 8.1 and coded with S, followed by a number.

To create a realistic overview on the synergies experienced in practice, subjective data is undesirable. Forms of synergy mentioned by only one respondent in one case is interpreted as subjective. No synergies were mentioned by only one out of twelve respondents.

Four forms of synergy were recognized by all three cases: the financial opportunities it offers [S2], the collective approach of managing risks [S10], the opportunity of giving more content and solidity [S5] and the repetitive nature that enables knowledge sharing [S1].

Synergy code	Case code	Synergy
S1	FPP, RTP, BQWP	The repetitive nature of projects enables knowledge sharing, what allows learning
S2	FPP, RTP, BQWP	Offers financial opportunities: compensating of gains and losses, and to economize
S3	FPP, BQWP	Removes obstacle of doing research
S4	FPP, RTP	Strategic choices, linkage opportunities
S5	RTP, BQWP, FPP	Opportunity of giving more content and solidity; political urgency
S6	FPP, BQWP	Collectively organizing planning to streamline and simplify processes
S7	BQWP	Easy handling and obtaining of resources
S8	FPP, RTP	Program approach gives the opportunity to look further into the future; trend can be observed
S9	BQWP	Collectively taking decisions based upon more knowledge available than when only knowledge of a single project is available
S10	RTP, BQWP, FPP	Collectively approach for risks enables overall overview

Table 8.1: Synergy recognized and utilized in practice in IRP

8.2. Synergy in context of literature

A reflection with literature shows the context of this study's findings. The results of this study will be certified with knowledge already available. Upcoming paragraph will place each form in synergy, presented in Table 8.1, in context of literature. Table 8.2 shows the result of this.

First, synergy found in this study that corresponds to literature are relevant, utilized and validated, are described. Then, an explanation is given of the synergy that only comes forward in literature and not deliberately utilized in the IRP cases observed. Last, the synergy that appears in this study, but has not been mentioned in the literature, is an addition to scientific knowledge, and elaborated on.

Most of the synergies recognized in practice do come forward in literature. First of all, the repetition of projects within a program as an advantage is in line with the literature (Asgarpour & Neef, 2019) [S1]. It enables knowledge gaining and knowledge sharing within a program, which allows learning. This increases effectiveness and efficiency.
Furthermore, the result of offering financial opportunities as synergy [S2] is in accord with recent studies indicating that programs advantage of economies of scale. Where literature points out that no re-employing or training new resources is necessary as an advantage (Olomolaiye, 2007), empirical research states the possibility of compensating of gains and losses as a benefit. Both literature as empirical research recognize the decrease in total costs because of economies of scale (Asgarpour & Neef, 2019; Morris & Pinto, 2007).
In addition, this study confirms that a synergy utilized in IRP is that strategies, that add value, can be achieved [S4]. The literature explains this synergy by pointing out that the alignment of projects within a program, facilitated by inter-organizational communication and processes, comes with the opportunity of setting up strategies (Best Management Practice, 2011; Murray-Webster & Thiry, 2000). In practice, this has been confirmed by setting up more secondary goals and linking opportunities.
Also, the synergy of improvement in planning [S6] is in agreement with Olomolaiye (2007) findings which showed that a program's planning is profitable because of less re-employing or training new resources. Additionally, in the empirical research conducted, planning improvement is noticed because collectively coordinating the planning results in streamlining and simplifying processes.
Furthermore, consistent with the literature, this research found that IRP utilizes the opportunity of sharing the same resources [S7].
The result of a more long-term focus as synergy [S8] corroborates the findings of a great deal of the previous work of Pellegrinelli (1997). He describes that program management enables focus on more long-term goals and developments. Empirical research underlines this by identifying the opportunity of being able to observe trends and look for possibilities in the future.

One form of synergy is found in literature but is not mentioned in the interviews that has been conducted. Although Pellegrinelli (1997) states that the integral way of working in a program results in less competition or conflict, this study did not demonstrate that.

Four forms of synergy found by the empirical research are not mentioned in previous studies. Those are an addition to scientific knowledge. Firstly, the repetitive nature of projects within a program and the augment of available resources removes the obstacle of doing research [S3]. Furthermore, program management gives the opportunity of giving more content and solidity, which empowers political urgency [S5]. Also, decisions can be based upon more knowledge available because of the program's size compared to projects [S9]. Lastly, the collective approach that characterizes a program allows forming a clear overview of risks [S10].

Synergy literature	Synergy empirical research
Synergies corresponding to literature and empirical research	
Repetitive character increase effectiveness and efficiency. Also enables continual quality, stable supply of workforce, and successful knowledge management	The repetitive nature of projects enables knowledge sharing, what allows learning
Sharing the same resources increase effectiveness and efficiency	Easy handling and obtaining of resources
Economies of scale	Offers financial opportunities: compensating of gains and losses, and to economize
Improvement in planning	Collectively organizing planning to streamline and simplify processes
Strategies that aim to add value can be achieved	Strategic choices, linkage opportunities
The program management approach enables it to focus on more long-term goals and developments.	Program approach gives the opportunity to look further into the future; trend can be observed
Synergies only mentioned in literature	
Less competing or conflicting between projects	-
Synergies only mentioned in empirical research	
-	Removes obstacle of doing research
-	Opportunity of giving more content and solidity; political urgency
-	Collectively taking decisions based upon more knowledge available than when only knowledge of a single project is available
-	Collectively approach for risks enables overall overview

Table 8.2: Synergy recognized in practice and in literature

8.3. Barriers linked to forms of synergy

Figure 8.1 shows in the red boxes all barriers experienced in utilizing synergy in practice. This is the result of combining all barriers presented per case in 6. Barriers removed from this set of data are the ones that are mentioned by one respondent and are not repeated in any of the other cases. Those are interpreted as subjective. In this case, "long term planning of innovation is hard to predict" is a barrier that is only mentioned by FPP and does not appear in one of the other cases.

All barriers are discussed and coded with the abbreviation BS (*barrier corresponding to utilizing program synergy*), followed by. a number to order the barriers in text. Firstly, the underlying problem of the barriers is pointed out. Secondly, it is interesting to see how the cases' barriers can be linked to the synergies mentioned. In this way, conclusions can be drawn on what forms of synergy are being utilized and what forms of synergy need some improvements to optimally take advantage of the synergy forms that program management offers. Figure 8.1 Barriers linked to synergy visualizes this. Barriers (red) disturb the utilization of synergies (green). By implementing the improvements (blue), the barriers can be overcome, and synergies can be utilized. Linking the barriers to the forms of synergies are mostly done based on the interviews.

Three forms of synergy are not linked with any of the barriers, which indicates that those synergies are optimally utilized and do not encounter any obstacles. Those synergies are the opportunity of making strategic choices, creating more content and solidity and observing trend to look further into the future. The synergy that has been observed in literature, but is not mentioned in empirical research, will be added to this overview. In this way, barriers experienced in practice could clarify why this synergy is not mentioned and/or experienced in practice.

8.3.1. Improvements focused on organization

As can be observed in figure 8.1, many forms of synergies are influenced by the barriers experienced in practice. In other words, many forms of synergy are not fully exploited because of the barriers. Particularly the barriers have to do with the organization of a program. So, improvement on this has the potential to utilize forms of synergy.

[BS1] Stimulate knowledge sharing is hard, sometimes rivalry
The rivalry between projects is a barrier observed and can be categorized under the barrier of a lack of commitment to the program management approach [S4]. Experiencing rivalry contradicts to the commitment to the program management approach since rivalry does not imply an open mindset to collaborate. This barrier will be discussed in further detail and linked synergies will be subject.

[BS2] Coordinating projects within the program requires too many actions to align, tune, adapting.
A barrier experienced in practice is the fact that a program requires many actions to align, tune and adapt. This barrier is also mentioned in chapter 7 and numbered as barrier [BC4]. As explained, an underlying problem of this barrier might be that program management is not only focused on program coordination but focuses much on coordination that is a projects responsibility, as well. This expands the coordination and forms an obstacle.

It is of great importance to overcome this barrier, since many forms of synergy can be linked to this barrier. When the coordination of projects, so the cross-functional working between projects, within the program does not go smoothly, a program cannot make the most of it. If projects are properly aligned, collectively organizing budget, planning, resources and risks reach achieve synergy when projects are coordinated properly. In addition, coordinating projects generates more available data than when projects are individually approached, and this enables knowledge sharing and taking decision on more data. Lastly, because of the collective approach, the obstacle of doing research is removed.

[BS3] Organization of collectively addressing things not fully implemented in organization.
Addressing things collectively is not yet fully implemented in the organization. However, this is a requirement for taking advantages of forms of synergy. To be more specific, collectively tackling certain tasks is central to the program management approach and leads to its beneficial character.

The barrier might be caused by the fact that the program is split up in different departments, described in the paragraph on governance in 7.1. Those departments are set up to make the program manageable. It is advantageous if the departments operate quiet independently. However, to be able to utilize synergy, working collectively is key. So, a balance should be found between making the program manageable and utilizing synergy by a collective approach. This barrier affects knowledge sharing [BQWP1, BQWP3, BQWP4].

[BS4] Commitment to the program management approach of the whole organization is required
This barrier is also mentioned in chapter 7 and numbered as barrier [BC7]. The analysis concludes that improving the awareness of the program management approach is essential in overcoming this barrier.

The lack of commitment to the program management approach can be linked to the synergy of stimulating knowledge [FPP1, FPP2, FPP4] [BQWP1, BQWP2, BQW3, BQWP4]. Lastly, this barrier influences the synergy that is only recognized in literature. When commitment to the program management approach is lacking, the project are sooner in conflict, since they are less dedicated to the collective way of working and the benefits that come with this approach. The organizational improvements will potentially bring into play the synergies.

8.3.2. Improvements focused on innovation

Besides the organizational improvements that will be beneficial, improvements focused on innovation will be useful. It will enable programs to benefit from the synergy of removing the obstacle of doing research. This form of synergy is not described in literature and thus an addition to scientific knowledge. Consequently, barriers related to this synergy are not recognized in literature as well.

[BS5] Getting the innovation developments application-oriented and used
The barrier of getting the innovation developments application-oriented and used refers to the return on investment a program would like to see. When innovations the program invests in will become applicable, the result of this efforts are ‘paid back’ by the cheaper renovation projects.

Getting the innovation developments application-oriented and utilized is a barrier that directly influences the synergy of doing researchers more efficiently in a program approach. Both FPP and BQWP mention this barrier. RTP did not have innovating as one of the program goals, focusing on this form of synergy. Additionally, RTP did not mention and thus recognized this form of synergy in their program.

[BS6] Innovation is not forthcoming, because of low priority or high risks
Another issue that is raised is that of the low priority or high risks that come with focusing on innovation. Those statements are based on interviews with FPP1 and FPP3. Overcoming those two barriers would contribute to utilizing the synergy of collectively researching a program. In order to do so, improvements should focus on organizing risks and priority of research wisely.

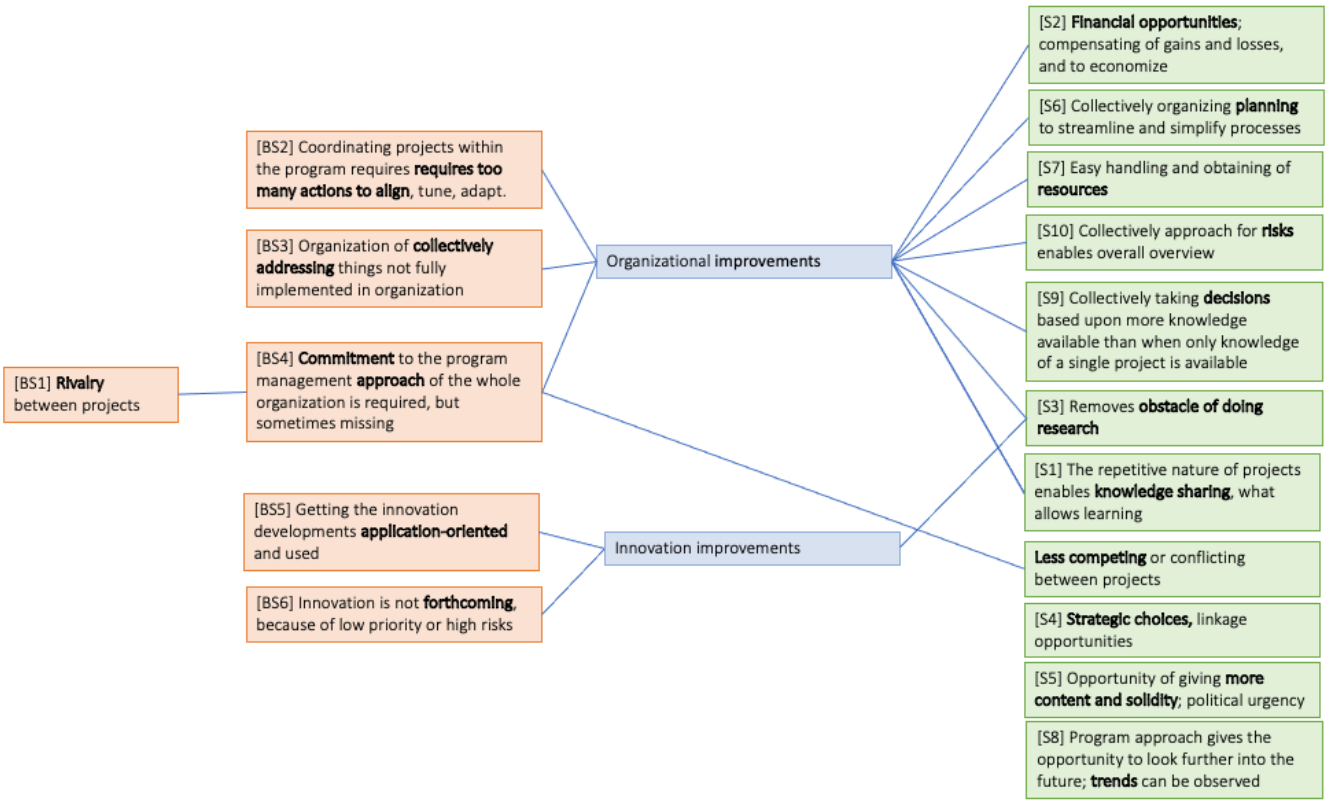

Figure 8.1: Barriers linked to synergy

So, in order to benefit from the synergies that program management has to offer, both organizational and innovation improvements should be implemented. All barriers with proposed potential solutions are shown in table 8.3.

8.4. Barriers in context of literature and suggested improvements

Upcoming paragraph places the barriers experienced in practice in context of literature. In addition, improvements to overcome those barriers are presented with the input of literature, and applied solutions in practice. The result will be a suggested solution per barrier.

[BS1] Stimulate knowledge sharing hard; sometimes rivalry
This barrier has not previously been described in literature. By overcoming barrier [BS4], barrier [BS1] will be tackled as well.

[BS2] Coordinating projects within the program requires too many actions to align, tune, adapting.
As described in the paragraph on [C4] in 7.3, this barrier broadly supports the work of the other studies in this area (Best Management Practice, 2011; Blomquist & Muller, 2006; Shehu & Akintoye, 2010)

To overcome this barrier, the organization of a program should prioritize what needs to be coordinated on program level. Also, make sure roles and responsibilities of the key team members are defined in such a way the program can rely on the various underlying teams.

[BS3] Organization of collectively addressing things not fully implemented in organization.
A balance should be found between making the program manageable and utilizing synergy by a collective approach. This barrier is not demonstrated in literature.

A combination of both working in departments on tasks, and still practice an integral way of working can create this balance. The integral way of working can be stimulated through meetings, and through overcoming barrier [S4].

[BS4] Commitment to the program management approach of the whole organization is required
As described in the paragraph on [BC7] in 7.3, this barrier is in a certain way found in literature (Shehu & Akintoye, 2010). However, while literature focuses on leaders' commitment, empirical research shows a barrier of a lack of commitment of employees in the program.

A set of solutions should be implemented in order to overcome this barrier. Firstly, stimulating working together on tasks should be implemented in the program organization. For example, creating a matrix organization, meeting with responsible employees for all kind of goals and implementing support teams. Secondly, creating awareness of the beneficial collective program approach will overcome this barrier and can be done through communicating this through lunch lectures, week start meetings and discussions.

[BS5] Getting the innovation developments application-oriented and used
The barrier of getting the innovation developments application-oriented and used refers to the return on investment a program would like to see.

The FPP set up a thorough approach of doing research adequately and did focus on cultivating application-oriented innovation. Securing and practicing the developed knowledge can be done in multiple ways and in line with the goal. Explicit knowledge can be found in reports/tests/protocols. Establishing a learning community or offering knowledge workshops can bring about knowledge transfer in practice. The effects of the innovation project are appraised based on the Technology Readiness Level. The BQWP set up a track to develop, validate and apply fundamental innovations with market parties, government, and knowledge institutions. The collaboration (triple helix) encourages collecting, sharing, and applying knowledge to appropriate the potential for innovation and economic development appropriately. Knowledge institutions cooperate with Amsterdam's municipality based on a multi-year knowledge and innovation agenda aligned with the formulated objectives. Similarly, innovation partnerships are set up and tendering procedures to develop and purchase innovations from market parties.

An inherent resolution for subduing this barrier is focusing on the above-suggested solutions. Firstly, associating the innovation directly to the goals of the program is a way to incite applicableness. Additionally, including knowledge institutions guides innovation that will probably be helpful considering they have a distinct overview of potential.

[BS6] Innovation is not forthcoming, because of low priority or high risks
Another issue that is raised is that of the low priority or high risks that come with focusing on innovation.

Priority can be mapped out by a knowledge and innovation agenda. This starts with putting a specific knowledge question on the agenda. This knowledge question is tackled and further developed within research projects. The results are - where possible - recorded in technical guidelines, software and guidelines. Describing application examples is an essential part of this. In this way, priority can be created. To lower the risks of doing research, BQWP focuses partly on innovation with parties already under contract with the program, and those innovations focus on a high Technical Readiness Level. In this way, there is a higher success ratio and, therefore, fewer risks.

So, risks can be lowered by focusing on innovations with a high Technical Readiness Level. Additionally, setting up a knowledge and innovation agenda properly can prioritize doing research.

8.5. Conclusion

This chapter gave answer to the following sub-research question: *Which improvements contribute to utilizing synergy in infrastructure renovation programs?*

Table 8.2 Synergy recognized in practice and in literature shows an overview of synergy in literature, as described in 3.2 Synergy of program management, compared to synergy recognized in practice.Some synergies discovered in practice are mentioned in literature, as well as in the empirical study. It can be concluded that those are present and should be overcome. The synergy of "less competing or conflicting between projects" is found in literature study, however, not discovered in the empirical research. This implicates that IRP partly or fully not optimally utilize this synergy. Validation session will confirm if this synergy is not utilized in practice. Four forms of synergies are only discovered in the empirical research, and not found in literature what results an addition to scientific knowledge.

The same observation can be done on the barriers related to utilizing synergy presented in table 8.3 Barriers related to utilizing synergy IRP with a distinction of source (literature/empirical research). While two barriers found in literature are confirmed by this empirical research, four barriers related to utilizing synergy in IRP are new. This addition to scientific knowledge is interesting and important to overcome. Since the synergy of simplifying doing innovation in a program was not indicated as a synergy in practice yet, as a logical consequences the barriers related to this synergy were not either. To utilize this synergy, those two barriers [BS5] and [BS6] should be overcome. Additionally, empirical research showed the barrier of rivalry between projects, whereas literature define less competing or conflicting between projects as synergy. This contrast should be presented to experts in order to validate. Lastly, it seems like addressing matters collectively in the program organization is difficult. This barrier is essential to overcome since it effects many forms of synergy.

Barrier category	**Barrier synergy**	**Suggested improvement**
Barriers corresponding to literature and empirical research		
Organization	[BS2] Coordinating projects within the program requires too many actions to align, tune, adapting.	Prioritize what needs to be coordinated on program level
Organization	[BS4] Commitment to the program management approach of the whole organization is required	Overcoming [S3] and creating awareness of the beneficial collective program approach will overcome this barrier and can be done through communicating this through lunch lectures, week start meetings and discussions.
Barriers found in empirical research		
Organization	[BS1] Sometimes rivalry between projects	Overcoming barrier [BS4]
Organization	[BS3] Organization of collectively addressing things not fully implemented in organization.	A balance should be found between making the program manageable and utilizing synergy by a collective approach. A combination of both working in departments on tasks, and still practice an integral way of working can create this balance. The integral way of working can be stimulated through meetings, and through overcoming barrier [BS4].
Innovation	[BS5] Getting the innovation developments application-oriented and used	Associating the innovation directly to the goals of the program is a way to incite applicableness. Additionally, including knowledge institutions guides innovation that will probably be helpful considering they have a distinct overview of potential.
Innovation	[BS6] Innovation is not forthcoming, because of low priority or high risks	To lower the risks of doing research, BQWP focuses partly on innovation with parties already under contract with the program, and those innovations focus on a high Technical Readiness Level. In this way, there is a higher success ratio and, therefore, fewer risks.

Table 8.3: Barriers related to utilizing synergy IRP with a distinction of source (literature/empirical research)

9
Validation Expert Session

Results of Chapter 7 Case Analysis: Control on Infrastructure Renovation Program Goals and Chapter 8 Case Analysis: Synergy within IRP is validated through an expert session. This chapter describes the validation methodology, strategy during the meeting and eventually the outcome of the expert session.

9.1. Method description

Respondents were chosen on the basis of different roles within a program. In this way, a broad and complete picture has been obtained on the way goals are controlled, synergy is utilized and what barriers are experienced within this. This has resulted in barriers and potential solutions presented in table 8.3 and table 7.2. Those solutions are either applied in practice or described in literature, however, are only suggestion of potential solution. In order to reflect on its reasonableness and effectiveness, validation of the suggested solutions is valuable.

In order to validate those results, experts are brought together in a focus group meeting to give their opinion and thoughts on a certain topic, which is a qualitative research methodology (Morgan, 1997). Experts could deliver a “unique source” of in-depth information on present occurrence of phenomena in the field (Dorussen et al., 2005; Rubin & Rubin, 2005). Alternatives for discussing research results with experts are the Delphi method and a ‘normal’ group meeting discussion (Gordon, 1994). The advantage of a focus group, over expert interviews or the Delphi method, is that it provides the opportunity of discussion between participants (Morgan, 1997). This increases the validity of the outcome. Furthermore, the difference of a focus group and a ‘normal’ group meeting is that there is ”a clear plan; use of a structured process to collect and interpret data and participants selected based on characteristics they share” (Larson et al., 2004). This way of collecting data in a structured way is seen as suitable, because it enables retrieving data efficiently and effectively.

Although the group size highly depends on the subject of discussion, generally six to ten experts participate (Morgan, 1997). Seven experts will participate in this focus session. All experts are, or have been, active in the field of program management.The experts are a combination of respondents in the cases and consultants at AT Osborne. Participants from different organizations enable a “rich” discussion, because of various field of visions (Kitzinger, 1994). Due to the corona measures, the focus session will be performed via Teams. An online tool (AhaSlides) is used. Before the expert meetings, respondents will receive an introduction to program management shown in Appendix F F, to align their interpretations on these subjects.

9.2. Expert session strategy

Firstly, all barriers correlated to controlling program goals (both case studies and literature) will be presented. Respondents answer per barrier if they recognize it and to what degree. Answers could individually be submitted by a survey through phone during the meeting. In this way, the weighting on the barriers will prioritize the barriers, making improvement more effective. Also, barriers from the literature that were not mentioned in interviews are checked upon if experienced in practice. This is valuable since it gives insights if the barrier mentioned in literature still occurs. Although the subject has been discussed in interviews, those barriers could still occur, since respondents could have forgotten to mentioned it.

Secondly, based upon the weighting that has been given, the most essential three or four barriers are picked out, and the corresponding solutions described in chapter 7 will be presented. Hereby, barriers related to controlling goals and utilizing synergy are put together. Experts may criticize if those solutions have potential in IRP. Also, possible solutions that have been applied successfully by experts may be proposed. The discussion will result in a validated set of solutions that should be implemented in IRP to overcome barriers.

9.3. Outcome expert session

9.3.1. Additional barriers

During the focus meeting with experts, barriers that the researcher did not present were pointed out. Discussion delivered potential solutions. These were:

- Goals on the project level and program can differ, which can lead to conflicting interests. Although the solution is not straightforward and is situation dependent, setting up governance at program level that focuses on jointly controlling could be a solution. In this way, the various stakeholders of a program can be involved in determining scope and goals.
- Within a program, control is approached as it is done in a project, what may result in an approach that is too detailed and with little flexibility. Flexibility can be created by dynamically acquire control instead of entrenching time, budget and scope.
- Project and program control must be in line with each other. The program success is not only dependent on the possible available means to speed up and realize a certain renewal or renovation. It also requires development on project level, for instance, to implement a new working method, new service contracts or a new way of working.
- The outside world of a program must be stable, because of the great influence it has on a program. As people's interest may change, budget can flow elsewhere. Therefore, it is important to keep the surroundings on track.

9.3.2. Main barriers (based on weighting) and potential solutions

In Appendix F Expert session the outcome of the weighting process is shown. In this section, the four obstacles with the highest weighting are interpreted as essential. Overcoming those barriers will, therefore, potentially have the most effect. The addressed barriers are mentioned including its weighting, briefly description of the solution and the opinion of those present concerning the potential of the solution. Then, a summary of valuable contributions, as result of the discussion between experts, are given. Those are remarks or additions, and will be taken into further consideration in the conclusion and are remarks.

Taking action is problematic when monitoring is not done structured yet

- Weighting: (4/5)
- Presented solution in short: focus on the method that translates data into useful, interpretable information
- Opinion of those present concerning the potential of the solution: Yes (7/7)

The solution is marked as a potential way to overcome the barrier and some additional comments were made to confirm this. First, a practical example of one of the experts showed the importance. It is a requirement that a good picture is created on the content that will be controlled. However, this can be tricky because information collectors and users can be widely separated. Although it takes a long time to connect those, it is beneficial and worth the time. This connection can be achieved by entering the conversation. Furthermore, the solution was referred to as prolonged regarding the solution of *Drawing up goals and their KPIs, preferably quantitatively*. Both solutions focus on the process. It is essential to keep the approach dynamic and alive.

Drawing up goals and their KPIs, preferably quantitatively

- Weighting: (3.3 / 5)
- Presented solution in short: focus on the process rather than the end result
- Opinion of those present concerning the potential of the solution: Yes (7/7)

During the expert session, the presented solution was entitled as a potential solution for the barrier. It was mentioned that the process-oriented approach is specifically suited to programs, and less to portfolio or multi-project management. The argument complemented to this statement was the goal-oriented character of programs. Furthermore, the remark was made that the solution does not function as a replacement but as an addition to KPI's focused on the performance as end result.

Not only outlining goals and its KPIs is relevant for the success of this solution, but in addition, it is necessary to monitor the KPIs dynamically. So, indicators are tracked iterative to keep an eye on the progress of the particular goal.

Lastly, keep goals and their indicators active is remarked as essential. So, beside monitoring KPIs dynamically, it is important to continuously develop the set of KPIs. This means that goals and indicators cannot be settled down since they will not be representative through-how the whole execution of the program. The process of constantly assessing goals, KPIs and its work-ability can be done by entering into the conversation with program employees, perhaps by scheduling meetings. This allows evaluating and questioning if the goals and KPIs are still helpful and applicable. So, not only defining goals and its KPIs wisely, the process of continuously assessing goals and its KPIs is essential as well.

Determine the scope of the program
- Weighting: (3.3/5)
- Presented solution in short: Program-level coordination—less on the project.
- Opinion of those present concerning the potential of the solution: Yes (5/7)

Some remarks were detected. For instance, it was noted that ensuring focus and clear allocation of responsibilities is essential. Furthermore, this potential of the solution is program dependent. Also, guaranteeing uniformity and also facilitating projects can be done by "Organize centrally what has to be done, and locally in projects what is possible" Lastly, it is remarked to be aware of centralizing on the program; do not get “too far away” from projects what results in a lack of understanding

Lack of commitment to the collective interests of the program
- Weighting: (3.4/5)
- Presented solution in short: Stimulation of collaboration and awareness
- Opinion of those present concerning the potential of the solution: Yes (7/7)

Although the solution is marked as a potential way to overcome the barrier, side notes were mentioned. First, not only the program organization will need to be aware of the shared collective interests, but even outside the program, this awareness is necessary. Furthermore, it was mentioned that the success to create this awareness lies in organizing cohesion by letting employees work on “the other side” they are not used to. In this way, employees recognize each other’s interests. Lastly, awareness is not only achieved by communication. Additionally actively controlling that the collective interests are priority is required.

9.4. Conclusion

The expert session took results of Chapter 7 and Chapter 8 into account. First, additional barriers that did not came along in literature neither in the case studies were mentioned. Those are:
- Goals on the project and program level can differ.
- Within a program, control is approached as it is done in a project, what may result in an approach that is too detailed and with little flexibility.
- Project and program control must be in line with each other.
- The outside world of a program must be stable, because of the great influence it has on a program.

Also, weighting was given to all proposed barriers in Chapter 7 and Chapter 8. This resulted in prioritization of barriers what gave direction to the improvements. The proposed solutions in Chapter 6 and Chapter 7 for the four barriers with high weighting were validated in the expert meeting. Besides validation, the discussion gave additional contribution to those solutions. The barriers discussed and important remarks are:
- *Taking action is problematic when monitoring is not done structured yet*:
  A good picture should be created on the content that will be controlled. In addition, it is beneficial to focus on the connection between information collectors and the ones interpreting the information.
- *Drawing up goals and their KPIs, preferably quantitatively*:
  The solution should not be seen as replacement of indicators focused on the performance, but as an addition. Also, monitoring, assessing and developing the KPI’s dynamically is key.
- *Determine the scope of the program*:
  It was noted that ensuring focus and clear allocation of responsibilities is essential. Also, guaranteeing uniformity and also facilitating projects can be done by organizing centrally what has been done and locally in projects what is possible.
- *Lack of commitment to the collective interests of the program*:
  The world outside the program should be taken into account as well. Besides, organizing cohesion can help create the awareness suggested. Also, not only communication should be suggested as a solution, but actively controlling on the commitment to the program approach is essential

IV

Discussion and Conclusion

The fourth and final part of this research is focused on a synthesis of all information gained. Part II: Literature Study provided a literature overview of IRP. With the use of this knowledge, Part III: Empirical Research dived into how control is gained and synergy utilized, and what barriers come with those processes, in IRP. Comparison of cases, literature input and a validation session resulted in improvements that contribute to control on IRP goals and to utilize synergy.

The discussion focuses on interpreting and describing the significance of the results in light of what is described in existing literature. Fresh insights about problems and its potential solutions are discussed. The conclusion answers the main question of this research: *How can future infrastructure renovation programs improve to gain control over program goals and utilize program's synergy?*
From there it is possible to suggest recommendations.

(HWBP, 2018)

10 Discussion

The first paragraph of this chapter (10.1) presents the the contribution of this research to move the field of study forward. The importance of the study and how it may be able to contribute to existing literature is performed. This is done based upon describing, based on literature and own findings, observed balances between aspects in program management. In addition, this study offers potential solutions. The second section (10.2) aims to point out some fresh insights to consider which cannot be ignored in the context of this study, but is not shed light on, yet. Limitations of this research will be presented in 10.3 considering the research methodology, obtained data and generalization of results.

10.1. Implications

This research contributes to both practical knowledge as scientific knowledge in the construction industry. The research findings show the balance between the advantages program management has to offer in IRP, versus the difficulties that come with operating it. The implications are assessed in the light of three different dilemmas observed in literature.

10.1.1. Synergy versus manageability

In accordance with the presented results, previous studies have demonstrated that a program utilizes synergy (Asgarpour & Neef, 2019; Best Management Practice, 2011; Ferns, 1991; Lycett et al., 2004; Morris & Pinto, 2007; Murray-Webster & Thiry, 2000; Olomolaiye, 2007; Pellegrinelli, 1997; Prevaas, 2018; Shehu & Akintoye, 2009; Thiry, 2002). However, the result of this study adds forms of synergy to already existing literature. It indicates the opportunity of giving more content and solidity because of the size of a program which results in more politic urgency. Furthermore, the collective program approach removes an obstacle to do research. Also, it gives the possibility to collectively take decisions based upon more knowledge available when only knowledge of a single project is available. Lastly, collectively approaching risks enable a comprehensive overview therefore, showing more advantages observed in in this study than already acknowledged.

To utilize synergy, collectively addressing matters such as resources, planning and budget is a requirement however, coordinating all this information is a difficulty (Denicol et al., 2020). This research explains the underlying problems of this difficulty and more importantly suggests a solution. The reason behind the difficulty of collectively addressing those matters is that the program size requires to demerge in order to be manageable. A balance should be found between making the program manageable and utilizing synergy by a collective approach. A combination of working in departments on tasks and still practicing in an integral way of working can create this balance. The integral way of working can be stimulated by focusing on the commitment of the program management approach in the whole organization.

10.1.2. Flexible/general control versus fixed/elaborated control

Consistent with the literature, this research found that it is challenging to balance excessive control and insufficient control on program level (Lycett et al., 2004; Partington, 1996). Concluding that excessive control is elaborated in detail and insufficient control is too general and flexible.

Diving into the research on the excessive way of controlling on program level, negative consequences are observed in literature. Several reports have shown that it causes “inflexibility and bureaucratic overheads of reporting requirements” (Gray & Bamford, 1999; Platje & Seidel, 1994). Furthermore, too much detail induces the risk of identifying real issues that arise (Lycett et al., 2004). Lastly, worsening the relationship between project and program and deviating energy to add value are other negative impacts of excessive control. As

Thiry (2002) describes, excessive bureaucracy and control is stimulated in programs by the available program management software.

This study is in accord with recent studies indicating that the balance between elaborated control and general control is hard to find on program level. Contrary to existing literature, this research gives insight into finding the right balance by proposing potential solutions for overcoming specific barriers in line with this struggle.

This study acknowledges the negative impact of this dilemma by pointing out the difficulty that arises by setting goals and key performance indicators. Although, it brings clarity and control by setting fixed goals and critical performance indicators and even more so when the KPI's can be established quantitatively and are based on performance. However, this study shows that this fixed way of working does not pay off. In addition, secondary goals, such as sustainability or innovation, that cannot be quantitatively defined causes dissatisfaction. A solution that has been presented is defining KPIs focused on the process rather than focused on the performance only. Keeping goals and their indicators alive and active is the outcome of the validation session that offers a possibility to overcome this.

Furthermore, this research confirms the issue of finding this balance by underlying the barrier of monitoring the progress of program goals. As Lycett et al. (2004) described, by focusing on an inappropriate level of detail, more significant issues that arise, might get lost in the excessive amount of information available. This could downgrade program management to little more than a process for reporting (Gray & Bamford, 1999; Lycett et al., 2004; Platje & Seidel, 1994). This study supports evidence from previous observations and finds the underlying problem it causes. Measuring all kinds of facts that have something to do with the program, which is done in practice, brings about an excessive amount of information. However, this elaborated way of controlling does provide interpretable data used to control programs progress. Focusing on the method that translates data into useful, interpretable information will help. In this way, a good overview of the content that gives insight in the progress will be created. Entering the conversation between information collectors and users takes time but will eventually pay off. By focusing on the process and keeping the method dynamic is critical. Therefore, instead of measuring data elaborately and fixed, a shift to a more flexible way of working will help.

To conclude, this study confirms the difficulty of finding a balance on program level between flexible/general control and fixed/elaborated control. Furthermore, this study adds knowledge on how balance can be found by offering potential solutions for several barriers in line with this struggle.

10.1.3. Project versus program

The findings in this study support the ideas of Lycett et al. (2004) and Buuren et al. (2010), who observed the tension between project and programs. A balance between projects that conduct decisive action on single-value issues and the program that enables synergy and coherence is necessary (Buuren et al., 2010). While too much program management can diminish the capability of projects, the same applies when there is too much project management, this balance is underlined in this research constructively. There are tensions between the project and the program, which control mechanisms are present and who is responsible for controlling which aspect.

This study shows similar findings and emulates a great deal of the previous work (Best Management Practice, 2011; Blomquist & Muller, 2006; Shehu & Akintoye, 2010) by stating a lot of coordination is needed on the program level. Current research states that this project's alignment is correlated to the lack of cross-functional working which has been observed as an obstacle (Shehu & Akintoye, 2010; Williams & Parr, 2004). However, this study shows that the difficulty in practice of too much coordination is because control is done as it is a project, which results in the control being too detailed, as stated in the expert session. If the program management focuses more flexibility and sticks to its purposes, the balance can be recovered.

Finding the balance between project and program management also focuses on the commitment to the approach. (Shehu & Akintoye, 2010) showed that commitment to the program approach of leaders is lacking, whereby commitment is the willingness on the part of individuals to contribute much more to the program organization than their formal contractual obligation. This differs from the findings presented in this study as it points out that the commitment of employees within the program is deficient. The expert in the validation session adds to this suggesting that there could be particular conflicting interests between projects and program, which do not relate to the commitment to the program. They also stated that project and program control must be in line with each other. The program success is not only dependent on the possible available means to speed up and realize a certain renewal or renovation, it also requires development on project level, such as implementing a new working method, new service contracts or a new way of working. Stimu-

lating working together on tasks should be implemented in the program organization. Furthermore, creating awareness on the benefits of the joint program approach will overcome this barrier.

Moreover, the current study's findings do not entirely support the previous findings of Lycett et al. (2004) and Eskerod (1996)who stated that the competition between projects manifests itself. Although this barrier is mentioned in this research, the validation session resulted in the lowest rating out of all barriers.

10.2. Food for thought

Although this this research answered the main research questions, it also gave some interesting new information to consider. Upcoming paragraphs will provide some food for thought concerning the subject of this study.

10.2.1. Competition between projects

The study's findings contradict the previous findings stating that the competition between projects manifests itself. Although this barrier is mentioned in one of the interviews, the validation session resulted in the lowest rating out of all barriers what implicates that this barrier might not express itself. Less competition and conflict between projects within a program might be clarified by the integral way of working in a program. Alignment of interests, benefits, and strategy helps to avoid conflict between different projects. Program managements stimulates and enables intercommunication what contributes to cooperation. This might indicate that multi-project managements, whereby this alignment is not addressed, do experience competition between projects.

10.2.2. Project management and its similarities to program management

While this research indicates the difference between project and program management, some essential similarities have been observed. Due to a high degree of uncertainty and complexity in projects, the traditional, linear life cycle of a project makes room for a more iterative process. This trend has been given a prominent place for the first time in the latest edition of the body of knowledge of project management. When going through a linear process, the scope, implementation, resources (budget and time) are fixed. While with such an iterative process it is exactly the other way around: the scope adapts to the resources (budget and time) available. This trend corresponds with the outcome of this study. The experts in the validation session indicate that a more iterative process is better suited to achieving program goals than the traditional linear approach. While this research examines many of the differences between project and program management, it is interesting to observe a similar trend between project and program management.

Literature showed that commitment to the program approach of leaders is lacking (Shehu & Akintoye, 2010). Commitment in this context is described as the willingness of individuals to contribute much more to the program organization than their formal contractual obligation (Shehu & Akintoye, 2010). This slightly differs from the findings presented in this study as it points out that the commitment of employees within the program is deficient. A clarification for this difference might lie in the fact that the lack of commitment of employees in a program is caused by the lack of commitment of leaders in the case of a top-down management approach. If the program leaders do not initiate an appropriate organizational policy, it will most likely not be taken on by program employees in the organization. It is interesting to find out more about these particular barriers and the way they are correlated.

10.2.3. Jointly control programs

The result of this study shows an overview of improvements in managing infrastructure renovation programs and does not contain a detailed explanation about the cooperation between programs. However, Bleijenberg (2021) recommends to jointly control programs to improve knowledge development and innovation. This is based on a recent study that provides, despite the many uncertainties, a forecast for the replacement and renovation of the entire civil engineering infrastructure in the Netherlands.

It is interesting to consider the outcome of this MSc thesis combined with the recommendation provided by Bleijenberg (2021). It seems like responding to the great effort of renovating infrastructure assets that need to be delivered by the Dutch government is twofold. While this study shows that jointly organize knowledge development and innovation between projects within a program is beneficial, a recent study indicate that jointly control programs has potential as well. Those two recommendations are an extension of one another.

10.3. Limitations

Several limitations should be considered in interpretation of the results of this study. These are discussed in upcoming sections.

10.3.1. Limitations as research methodology

There has been chosen for a multiple case study over a single case study to avoid the risk of deductive theory confirmation and generalizing observations. However, with the small sample size of three cases, caution must be applied, as the finding might not be completely external valid. Besides, four interviews per case have been executed. Keeping the study's credibility in mind, taking more interviews into account will decrease the change of subjectivity. Although the external validity of the results is pressured, the quality of the research is appropriate because of the significant involvement of experts.

Furthermore, in observational studies, there is a potential for interpretation bias of the researcher. This affects the validation of observations. However, this has been limited by validating the results in an expert session.

10.3.2. Limitations of obtained data

In terms of the limitation of obtained data, Dorussen et al. (2005) points out the importance of the quality of experts considering the validity of the information collected through interviews. However, this research (Dorussen et al., 2005) also mentioned that expert's interviews could obtain high-quality data, but only if the experts are willing to go along. Since finding the experts for both the interviews as the validation session was easy, it is stated that experts were willing to collaborate, which assumes the possibility of obtaining high-quality data. Furthermore, there is no direct reason to assume the strategic behaviour of experts. However, strategic behaviour is surprising and unpredictable (ten Heuvelhof et al., 2009).

Research participation might come with the Hawthorne effect, which means that the awareness of being studies has a possible impact on behaviour (McCambridge et al., 2014). In this study, there has been actively asked if barriers are experienced. Questioning if barriers occur in practice might affect participants' response; they might eventually come up with barriers, even though those do not (dominantly) come to pass. On the other hand, it is assumed that respondents do not devise barriers. In that case, the Hawthorne effect might indicate that no weighting can be marked upon the barriers mention in interviews.

Also, looking critically towards the method of interviewing, open questions have been asked, and a respondent could forget to mention something they do experience. In order to filter out subjective barriers and be sure of more reliable barriers, a validation in a form of an expert session is done.

Furthermore, the average weighting given to the barriers in the expert meeting is taken into account. However, the average may not be representative when half of the respondents experience the barrier slightly (a weighting of 1) while the other half experience the barrier fully (a weighting of 5).

Lastly, social desirability bias indicates that information is disclosed in an interview. However, since no sensitive topics are drawn attention to, this form of bias is limited.

10.3.3. Limitations of generalization of results

The representation of cases may somewhat limit the findings of this research. Three cases do not fully represent the extensive diversity of IRP in Holland. Analyzing different cases would not naturally conduct the same findings.

This research focuses on Dutch infrastructure renovation construction programs. Limitation on the ability to generalize results either internationally or on construction programs in general because of only emphasizing on these programs.

11

Conclusion and recommendations

11.1. Answering the main research question

In this section, the main question will be answered:

> *How can infrastructure renovation programs in the future gain more control of their program goals and utilize the potential program synergy?*

Answering the main research question considers three sections. First, the contribution of the improvements to literature is outlined to indicate how future infrastructure renovation programs improvements relates to its context (11.1.1). Then, the improvements suggested in this research are presented based upon the analysis and validation described in previous chapters, both on control over IRP goals (11.1.2) and utilizing synergy (11.1.3).

11.1.1. Contribution of improvements

This study confirms the difficulty for program managers of finding a balance on program level between flexible/general control and fixed/elaborated control. This study adds knowledge on how balance can be found by offering potential solutions for several barriers in line with this struggle. Furthermore, a balance should be found between making the program manageable and utilizing synergy by a collective approach. The study shows that a combination of working in departments on tasks and simultaneously practicing an integral way of working can create this balance. The integral way of working can be stimulated by focusing on the commitment to the program management approach in the whole organization. Moreover, the current study's findings do not entirely support existing findings that state that the competition between projects manifests itself. Although this barrier is recognized by the program managers investigated in this research, the validation session showed that this barrier had the lowest rating out of all barriers.

11.1.2. Control over IRP goals

Based on the findings of this research, several conclusions can be drawn on what is needed to gain more control over program goals. The barriers observed are twofold. Firstly, improvements in monitoring the program goals are suggested. Secondly, improvements within the program organization are proposed.

Improvements of monitoring the program goals

When researching the improvements of monitoring the program goals, two key barriers were observed. Firstly, drawing up goals and defining the key performance indicators can be challenging, especially for secondary program goals. In order to control goals of IRP, including secondary goals, focus should be extended on the control of the process instead of the control of the performance. To be more specific, key performance indicators are not always tangible and this can be overcome by setting up process indicators that determine the program's success. Instead of setting up performance indicators as "spending xx budget on innovation yearly ", indicators focused on the process of achieving the goal gives perspective. For instance, "creating an overview of potential innovations in the field" will guide program managers on what process actions are needed to achieve the goals. However, not only the way goals and its KPIs are outlined is relevant for the success of this solution, but in addition, it is necessary to monitor the KPIs continuously. Indicators should be tracked iteratively to keep an eye on the progress of the particular goal. This is beneficial over a more linear, static approach. Moreover, instead of setting down goals and its indicators, it is important to continuously develop the set of KPIs, since they will not be representative throughout the whole execution of the program.

So, key performance indicators are not always tangible and this can be overcome by setting up extra indicators: process indicators (focused on how to realize program goals) that determine the program's success. In addition, monitoring and developing the KPIs should be done continuously.
Secondly, although a considerable amount of data is measured to facilitate gaining control, interpretable information to control is lacking. With regard to obtaining interpretable information, careful and constant attention of the connection between the essential content and the method in which it is acquired is key. Therefore, focusing on the process can give guidance and can be crucial to the overall success. Within this way of working, keeping goals and indicators current is key. An iterative approach helps in this case to continuously assess and develop. Since the people who collect information and the people who interpret the information might be different, it is useful to pay extra attention to this step, although this might take a lot of time. Stimulating collaboration and conversation will smoothen the process of transferring the desired data into useful information.

Improvements program organization
In relation to the improvements related to the program organization, three implementations are suggested. Firstly, stimulating working together on tasks and creating awareness of the beneficial collective program management approach is essential to respond to the lack of commitment to this approach, whereby commitment is the willingness on the part of individuals to contribute much more to the program organization than their formal contractual obligation. Working in a program comes with the responsibility of propagating the program goals, interests and strategy, what sometimes might not be in line with the project main interests. It is essential that the program employees are committed to the collective interests in order to benefit from a programs potential.
Working together to stimulate the collective approach means in this case that program employees that have a focus on their own, or project, interest above the program interest work together with employees that do recognize and convey the program interests. Implementing working together is program-specific, but a possibility is to let employees of different departments define the program strategy and policy in collaboration. In this way, commitment to and support of the program strategy and policy can be obtained. Awareness can be created by devoting attention to informing the program employees on these benefits and communicating effectively through, for instance, lunch lectures, week start meetings and discussions. It is key to not only use communicate as a means to create awareness but also actively control if commitment is achieved.

Secondly, to safeguard undesired changes to both the individual projects and the program as a whole, a change management procedure might be implemented. If a change of scope is suggested, the change management procedure is taken into account. In this procedure, an estimate of the effect of a change on all ultimate program goals and possible achievement to get there should be elaborated. It is therefore required to set up baselines for all program goals in order to be able to measure potential deviation. The effect is in term of probability and impact. In doing so, it is made explicit when a scope change aids in achieving program goals.

Lastly, the organization of a program should prioritize what needs to be coordinated on program level, and not confuse this with project responsibilities. This should be clearly translated in the organization plan and should actively be reflected upon. Also, it is important that the roles and responsibilities of the key team members are clearly defined, this will ensure that the program can rely on the various tasks of underlying team.

11.1.3. Synergy utilized in IRP
Although existing literature suggests the presence of synergy in program management, this study shows additional forms of synergy that can be obtained. Firstly, bundling projects within a program enables to give more body and solidity to renovating infrastructure. In other words, the increase in size of individual projects to a program comes with more body, power and urgency. Furthermore, the collective program approach removes an obstacle in doing research, because of the increase in resources, economizing and the more knowledge and content it has.

Additionally, it gives the possibility to collectively make decisions based upon further knowledge available opposed to when only knowledge of a single project is available. Lastly, the collective approach enables a comprehensive risk overview rather than risks only defined per project what gives less. Therefore, there are greater advantages observed in practice than are acknowledged in literature.

Improvements program organization
The barrier of finding the balance between making the program manageable and utilizing synergy by a collective approach is required to ensure that it is possible utilize all forms of synergy. The reason behind the difficulty of collectively addressing areas is that the program size requires to demerge in order to be manageable. A balance between making the program manageable and utilizing synergy by a collective approach is needed. A combination of working in departments on tasks and still practicing an integral way of working can create this balance. The integral way of working can be stimulated by focusing on the commitment of the program management approach in the whole organization.

Improvements innovation
In order to benefit from the obstacle of enabling research, getting the innovation developments application-oriented and used should be the main focus. Associating the innovation directly to the goals of the program is a way to incite applicableness. Additionally, including knowledge institutions could generate innovation and therefore, could be helpful considering they have a distinct overview of the potential benefits. Knowledge institutions committed to a certain subject, such as Deltares to the water sector, can subscribe to the applicability of researching and innovating.

11.2. Recommendations for program managers

Some major recommendations are essential to the plans presented in previous paragraph. These recommendations will give program managers guidance in controlling program goals and utilizing synergy. All recommendations are visualised in Figure 11.1.

11.2.1. Be aware of the potential synergy in practice

Both literature and this research show the synergy of program management and its great potential. A convenient and obvious road-map on utilizing each form of synergy might not be available because every program is unique. In order to utilize the program's potential, it is recommended to program managers to notice and understand the forms of synergy accessible by consulting literature and previous program plans. Reflecting their own program on the theoretical potential will help examine the possibilities. Once a program management team is aware of the opportunities for synergy, decisions can be made on the programming, planning, budgeting and organization. It is essential to develop, prior to the program, an organizational plan that suits the implementation of the forms of synergy. This requires to take into account the balance that should be found between collective addressing matters and keeping it manageable in a program. Setting up specific responsibilities and workforces will help to succeed in this implementation. In this way, a unique and applicable road-map can be created on how to utilize each form of synergy.

11.2.2. Be aware of the tension between project and program management

The findings in this study support the ideas of previous research that show the tension between project and programs. Conflicting interests between projects and program makes program management difficult. While too much program management can diminish the capability of projects, the same applies when there is too much project management. While looking for this balance, being aware of this tension is essential, however, dissipating this tension is not crucial. The tension between projects and the program seems healthy and even stimulate constant vigilance. It is recommended for the program management team to be aware of this tension and make sure it is in proportion and healthy. Taken this into account in the organization plan of a program is wise. Furthermore, iterative and dynamically reflect on this tension by setting up meetings between project and program employees is recommended.

11.2.3. Pro-active attitude towards the program approach

This research has shown the importance of the attitude of the program team towards the collective program approach. It is recommended to practically translate this into a program organization by devoting attention to informing the program employees on the collective approach. This can be done by communicating effectively on fixed moments through, for instance, lunch lectures, week start meetings and discussions. The program management team should consider what means of communicating are effective in their program and the participants. Furthermore, it is recommended to stimulate the pro-active attitude towards the program approach by working together. Shared responsibility and teaming up provides recognition of the collective way of working. Lastly, setting up a suitable organizational policy that every employee in the program

acknowledges contributes to encouraging a pro-active attitude.

11.2.4. Short term actions: reflect and analyse

The numerous improvements presented in this study may be a little great in amount to all implement in the near future. Upcoming paragraphs gives footing on what steps a program managers should take on the short term to improve controlling program goals and utilize synergy.

First of all, it is recommended that program managers reflect and analyse constantly on the program failure and difficulties during the program in order to improve those processes. Program managers should describe what current way of controlling they use and what barriers are recognized in their own program. This can be done by looking into program reports and checking upon deviations of the desired. Interviewing employees is also a way to explore barriers. Thereafter program managers can analyse the underlying problem, what benefit is desirable and has most potential. Identify the barrier and desired situation will be the starting point. Then, the program management team should appoint someone in the organization responsible for the implementation of the solution. If barrier(s) that should be tackled are likewise as the one mentioned in this study, suggested solutions might be implemented, what might bring them back to steps taken during the "shaping the program" phase and "gaining control" phase. How to implement the suggested solutions are presented in 11.1. Recommendation is given in 11.2.6 how these solutions are related to the "shaping control" and "gaining control" phase.

Reflection is also key after the implementation of a potential solution to check whether the implementation had the effect as desired. This can be done by compare data to predictions and examine learning. According to the previous step, changes to be made and questioning how to improve next time should take place.

11.2.5. Enable to power of an iterative process

It is recommended for program managers to enable an iterative process, which is in line with previous recommendation that point out to continuously reflect and analyse on difficulties. The iterative process comes forward in the solutions suggested in 11.1, such as setting up KPI's and assessing those. Furthermore, the transformation from data to interpretable information requires an iterative process.

Allowing an iterative way of working in a program enables improvement on controlling program goals and utilizing synergy. In addition, it allows flexibility that is beneficial. Moreover, to find a balance between flexible/general and fixed/elaborated control, implementing iterative reflection can give footing. This could practically be translated into a program organization by actively making room, at a fixed moment, for meetings and discussions for reflection. Also, besides time, resources such as people and budget should be made available to work on the iterative process.

11.2.6. Align the implementation of solutions with program phases

The present study raises numerous improvements to implement in IRP. Since the broad and extensive information might be overwhelming, a more concrete and doable action plan might give footing. It is recommended to structure the improvements in the light of the program management cycle, since this might provide to keep grip. However, every program is unique and therefore every program will slightly derogate from the program management cycle described in 3.3.

Upcoming enumeration describes the phases a program passes and indicates how these are in relation with implementing suggested solution presented in 11.1. This MSc thesis focuses mostly on the "shaping the program" and "gaining the control" phase. Implementing suggested solution described in detail in 11.1 can be aligned with the phases a program passes. A set-up for this alignment is given and shown in Figure 11.1.

- *Identification:*
  The first phase of the program life cycle consists of deciding upon a program management approach and its purposes and objectives.

- *Shaping the program:*
  It is crucial and valuable to implement some solutions for barriers and think them through in an early stage of the program, since it is harder to undo or requires more effort to reverse once arrived in a later stage of the program. Following suggested solution should be taken into account in this phase. The way those solutions should be implemented is presented in 11.1. The iterative process of this phase is visualised in 11.1.

(A) Process indicators
(B) Commitment of collective approach
(C) Prioritize coordination
(D) Applicableness of innovation

- *Gaining control:*
  This phase of the program determines how control can actually be gained during the program. This includes for instance assessing and reporting of the indicators. Also, taking control measures and reflecting on those is part of this phase. Following solutions should be implemented in this phase and are described in detail in 11.1.The iterative process of this phase is visualised in 11.1.

  (E) Transferring data to information
  (F) Change management procedure

- *Closing off the program:*
  Lastly, closing off the program is the last stage of the life cycle and is hopefully because of successfully finishing it.

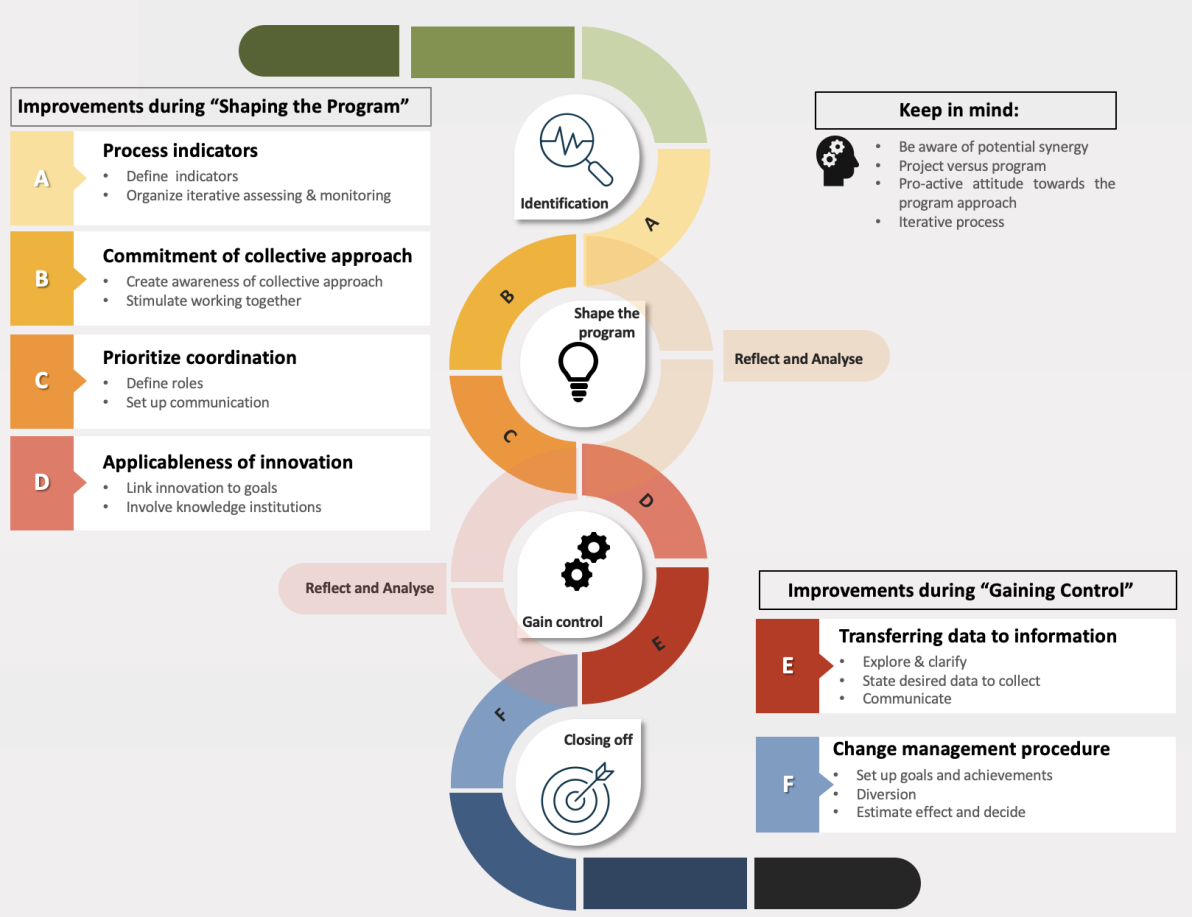

Figure 11.1: Recommendation for program managers to improve to gain control over program goals and utilize synergy

11.3. Suggestions for further research

With respect to further, future, research the following consideration can be taken into account.

- There is abundant room for further progress in determining the sample size. Keeping the study's credibility in mind, taking more interviews and cases into account will be even more insightful.
- This research is addressed within the settings the infrastructure renovation context. It would be interest to investigate the same research problem in a different setting. For instance, other types of construc-

tion programs or other types of program management industries as setting will enable comparison of results. Furthermore, comparing results internationally could be interesting.

- This study took mainly literature on program management in general into account. Mostly because this literature was available and literature specific on program management within the construction industry is not comprehensively available. However, this might increase the quality and validity of the research. A further study with more focus on program management within the construction industry is therefore suggested.
- In future investigations, it might be possible to include the success a certain approach of a case achieves. In this study, this has not been taken into account extensively.
- This study focused on programs that were not been finished yet. In future research, it might be possible to use programs that have been finalized, in order to gain entire insight on the approach to control program goals. This is an important issue for future research.
- Furthermore, studies examining occurring barriers in a quantitative manner might need to be undertaken.
- Future research may address unanswered aspects of this research problem. To develop a full picture of barriers experienced in IRP, additional studies will be needed that dives into the difference barriers experienced in different roles of the program.
- Despite these promising results, questions remain on the exact way of implementing the recommendation of improvements. For example, the way a more process way of controlling
- Further research should be undertaken to investigate the barrier of “real time proactive planning difficult”. This barrier did not occur in the case studies; however, existing literature did mention this as a barrier. On top of this, during the validation session the barrier scored relatively high.
- This study shows additional forms of synergy in practice that were not noticed in literature before, as described in 11.1. Since too little is known on utilizing those forms of synergy and its potential, it is recommended to further elaborate on this.

Bibliography

Abdullah, A., & Vicridge, I. (1999). Best practice for multi project management in the construction industry. *Centre of Research into the Management of Projects*, 169–179.

ANP. (2019). Grote delen van de kaders en oevers in Amsterdam moeten worden gerenoveerd.

Asgarpour, S., & Neef, R. (2019). Op weg naar een responsieve infrastructuur. *NG Infra Magazine*, (June), 43–45. https://www.researchgate.net/publication/335099459_Op_weg_naar_een_responsieve_infrastructuur/link/5d4ec561299bf1995b7403c4/download

Bakker, H., Hertogh, M., & Rijke, J. (2016). Opportunity framing for infrastructure projects. *Cost and Value*, (April), 8–11.

Best Management Practice. (2011). *Managing Successful Programmes* (2011 Editi). The Stationery Office.

Bleijenberg, A. (2021). *Instandhouding civiele infrastructuur. Proeve van landelijk prognoserapport vervanging en renovatie* (tech. rep.). TNO. Delft.

Blomquist, T., & Muller, R. (2006). *Middle managers in program and project portfolio management; practices roles and responsibilities*. Project Management institute.

Buuren, A. v., Buijs, J. M., & Teisman, G. (2010). Program management and the creative art of coopetition: Dealing with potential tensions and synergies between spatial development projects. *International Journal of Project Management*, *28*(7), 672–682. https://doi.org/10.1016/j.ijproman.2009.12.002

Casciati, F., & Lagorio, H. J. (1996). *Urban renewal aspects and technological devices in infrastructure rehabilitation* (A. Baratta & J. Rodellar, Eds.; 12th ed.). World Scientific. https://books.google.nl/books?hl=nl&lr=&id=nPAnDwAAQBAJ&oi=fnd&pg=PA173&dq=Urban+renewal+aspects+and+technological+devices+in+infrastructure+rehabilitation.&ots=rybGTH5Mmb&sig=Zn3i_q2_awcrzIHWYAEYN6Fv3jM#v=onepage&q=Urban%20renewal%20aspects%20and%20technological

Dasgupta, S., & Tam, E. K. (2005). Indicators and framework for assessing sustainable infrastructure. *Canadian Journal of Civil Engineering*, *32*(1). https://doi.org/10.1139/l04-101

Denicol, J., Davies, A., & Krystallis, I. (2020). What Are the Causes and Cures of Poor Megaproject Performance? A Systematic Literature Review and Research Agenda. *Project Management Journal*, *51*(3), 328–345. https://doi.org/10.1177/8756972819896113

Dorussen, H., Lenz, H., & Blavoukos, S. (2005). Assessing the reliability and validity of expert interviews. https://doi.org/10.1177/1465116505054835

Douglas, J. (2006). *Building adaptation, second edition* (2nd Edition). Routledge. https://doi.org/10.4324/9780080458519

Ebbert, T. (2010). *Re-Face. Refurbishment strategies for the technical improvement of office facades* (tech. rep. February). Technical University of Delft. Aachen.

Erzaij, K. R., Hatem, W. A., & Maula, B. H. (2020). Applying Intelligent Portfolio Management to the Evaluation of Stalled Construction Projects. *Open Engineering*, *10*(1), 552–562. https://doi.org/10.1515/eng-2020-0064

Eskerod, P. (1996). *Meaning and action in a multi-project environment* Understanding a multi-project environment by means of metaphors and basic assumptions* (tech. rep. No. 2).

Fernández-Sánchez, G., & Rodríguez-López, F. (2010). A methodology to identify sustainability indicators in construction project management - Application to infrastructure projects in Spain. *Ecological Indicators*, *10*(6), 1193–1201. https://doi.org/10.1016/j.ecolind.2010.04.009

Ferns, D. (1991). Developments in programme management. *International Journal of Project Management*, *9*(3), 148–156. https://doi.org/10.1016/0263-7863(91)90039-X

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, *12*(2). https://doi.org/10.1177/1077800405284363

Flyvbjerg, B. (2011). Characteristics of major projects. *The Oxford Handbook of Project Management*, 321–344. http://ssrn.com/abstract=2278226

Fowler, A., & Walsh, M. (1999). Conflicting perceptions of success in an information systems project. *International Journal of Project Management*, *17*(1), 1–10.

Frangopol, D. M., & Liu, M. (2007). Maintenance and management of civil infrastructure based on condition, safety, optimization, and life-cycle cost. *Structure and Infrastructure Engineering*. https://doi.org/10.1080/15732470500253164

Gemeente Amsterdam. (2018). *Programmaplan Aanpak Wegtunnels Amsterdam* (tech. rep. No. 1). Gemeente Amsterdam. Amsterdam. https://amsterdam.raadsinformatie.nl/document/7413883/1/09012f9782841cdb

Gemeente Amsterdam. (2019). *Actieplan bruggen en kademuren* (tech. rep.). Gemeente Amsterdam. Amsterdam. https://assets.amsterdam.nl/publish/pages/935382/actieplan_programma_bruggen_en_kademuren_juli_2019.pdf

Gordon, T. J. (1994). *THE DELPHI METHOD* (tech. rep.). The Futures Group.

Gray, R. J., & Bamford, P. J. (1999). Issues in programme integration. *International Journal of Project Management*, *17*(6). https://doi.org/10.1016/S0263-7863(98)00056-8

Gray, R. J. (1997). Alternative approaches to programme management. *International Journal of Project Management*, *15*(1), 5–9. https://doi.org/10.1016/S0263-7863(96)00014-2

Hartsema, M. (2018). Hitte en Genua zetten onderhoud en renovatie infrastructuur op de politieke agenda. *Arcadis*. https://www.arcadis.com/nl/nederland/arcadis-blog/marc-hartsema/hitte-en-genua-zetten-onderhoud-en-renovatie-infrastructuur-op-de-politieke-agenda/

Hendiani, S., & Bagherpour, M. (2019). Developing an integrated index to assess social sustainability in construction industry using fuzzy logic. *Journal of Cleaner Production*, *230*. https://doi.org/10.1016/j.jclepro.2019.05.055

Hertogh, M., & Westerveld, E. (2010). Playing With Complexity. Management and Organisation of Large Infrastructure Projects. *World*.

Hertogh, M., Bakker, J., Vlist, M. v. d., & Barneveld, A. (2018). Life cycle management in upgrade and renewal of civil infrastructures. *Organization, Technology and Management in Construction: an International Journal*, *10*(1), 1735–1746. https://doi.org/10.2478/otmcj-2018-0005

HWBP. (2018). Prins Hendrikzanddijk.

HWBP. (2019). Over HWBP. https://www.hoogwaterbeschermingsprogramma.nl/over-hwbp

Karydas, D. M., & Gifun, J. F. (2006). A method for the efficient prioritization of infrastructure renewal projects. *Reliability Engineering and System Safety*. https://doi.org/10.1016/j.ress.2004.11.016

KHN. (2020). Weet je het al? De Amsterdamse tunnels gaan dicht voor onderhoud.

Kitzinger, J. (1994). The methodology of Focus Groups: the importance of interaction between research participants. *Sociology of Health & Illness*, *16*(1), 103–121.

Koops, L., Loenhout, C. v., Bosch-Rekveldt, M., Hertogh, M., & Bakker, H. (2017). Different perspectives of public project managers on project success. *Engineering, Construction and Architectural Management*, *24*(6), 1294–1318. https://doi.org/10.1108/ECAM-01-2015-0007

Koops, R. (2020). Drukt corona het herstel van de kades en bruggen opzij? https://www.parool.nl/amsterdam/drukt-corona-het-herstel-van-de-kades-en-bruggen-opzij~b916affe/

KPMG. (2016). 10 Emerging Infrastructure Trends in 2016. *Foresight: A golab infrastructure perspective*, *1555*(January).

Kvale, S. (2011). Planning An Interview Study. *Doing interviews*. https://doi.org/10.4135/9781849208963.n4

Lam, T. Y. (2020). Driving sustainable construction development through post-contract key performance indicators and drivers. *Smart and Sustainable Built Environment*. https://doi.org/10.1108/SASBE-07-2020-0111

Larson, K., Grudens-Schuck, N., Lundy Allen, B., & Lundy, B. (2004). Methodology Brief: Can You Call It a Focus Group? Recommended Citation. *Extension Community and Economic Development Publications*, *PM19d69a*(11). http://lib.dr.iastate.edu/extension_communities_pubs/11

Leijten, M. (2017). *What lies beneath: Bounded manageability in complex underground infrastructure projet* (tech. rep.). Delft University of Technology. https://doi.org/https://doi.org/10.4233/uuid:82981ce2-e734-440f-91e6-061e568125dc

Lousberg, J. (2015). Dijkversterking in de Hoekse Waard.

Lycett, M., Rassau, A., & Danson, J. (2004). Programme management: A critical review. *International Journal of Project Management*, *22*(4), 289–299. https://doi.org/10.1016/j.ijproman.2003.06.001

Martinelli, R. J., Waddell, J. M., & Rahschulte, T. J. (2014). *Program Management for Improved Business Results* (2nd ed., Vol. 9781118627). John Wiley & Sons, Inc. https://doi.org/10.1002/9781118904367

McCambridge, J., Witton, J., & Elbourne, D. R. (2014). Systematic review of the Hawthorne effect: New concepts are needed to study research participation effects. https://doi.org/10.1016/j.jclinepi.2013.08.015

McKinsey & Company. (2019). *Toekomstige Opgave Rijkswaterstaat: Perspectief op de uitdagingen en verbetermogeljkheden in de GWW sector* (tech. rep.). Rijkswaterstaat.

Miterev, M., Engwall, M., & Jerbrant, A. (2016). Exploring program management competences for various program types. *International Journal of Project Management*, *34*(3), 545–557. https://doi.org/10.1016/j.ijproman.2015.07.006

Morgan, D. L. (1997). Focus Groups as Qualitative Research: PLANNING AND RESEARCH DESIGN FOR FOCUS GROUPS. *Focus Groups as Qualitative Research*.

Morris, P., & Pinto, J. (2007). *The Wiley Guide to Project, Programme and Portfolio Management*. Wiley.

Murray-Webster, R., & Thiry, M. (2000). Managing programmes of projects. *The Gower Handbook of Project Management*, (3rd ed.).

Nicholas, J., & Steyn, H. (2012). *Project Management for Business, Engineering and Technology* (4th editio). Routledge. https://b-ok.cc/book/1174020/d692e4

Olomolaiye, A. (2007). The impact of human resource management on knowledge management for performance improvements in construction organisations. *Built and natural environment*, (Glasgow: PhD Thesis, Glasgow Caledonian University).

Partington, D. (1996). The project management of organizational change. *International Journal of Project Management*, *14*(1). https://doi.org/10.1016/0263-7863(95)00037-2

Pellegrinelli, S. (1997). Programme management: Organising project-based change. *International Journal of Project Management*, *15*(3), 141–149. https://doi.org/10.1016/S0263-7863(96)00063-4

Pellegrinelli, S. (2002). Shaping context: The role and challenge for programmes. *International Journal of Project Management*, *20*(3), 229–233. https://doi.org/10.1016/S0263-7863(01)00073-4

Platje, A., & Seidel, H. (1994). *Project and portfolio planning cycle Project-based management for the multiproject challenge* (tech. rep. No. 2).

Prevaas, B. (2018). *Werken aan programma's* (Versie 2.2). www.werkenaanprogrammas.nl

Project Mangagement Institute. (2001). *A Guide to the Project Management Body of Knowledge* (2000 Edition). Project Management Institute.

Rayner, P., & Reiss, G. (2012). Portfolio and programme management demystified: Managing multiple projects successfully, second edition. *Portfolio and Programme Management Demystified: Managing Multiple Projects Successfully, Second Edition*, 1–322. https://doi.org/10.4324/9780203867730

Reyers, J., & Mansfield, J. (2001). The assessment of risk in conservation refurbishment projects. *Structural Survey*. https://doi.org/10.1108/02630800110412480

Rijkswaterstaat. (2018). Minister Van Nieuwenhuizen geeft aftrap voor grote onderhoudsopgave infrastructuur. https://www.rijkswaterstaat.nl/nieuws/2018/01/minister-van-nieuwenhuizen-geeft-aftrap-voor-grote-onderhoudsopgave-infrastructuur.aspx

Rijkswaterstaat. (2020). Make-over voor bruggen, sluizen, tunnels en viaducten op leeftijd. https://www.rijkswaterstaat.nl/nieuws/2020/05/make-over-voor-bruggen-sluizen-tunnels-en-viaducten-op-leeftijd.aspx

Rubin, H. J., & Rubin, I. S. (2005). (2005): Qualitative Interviewing – The Art of Hearing Data . 2. Edition, Sage Publications, Thousand Oaks, London, New York. Reviewed by. *Qualitative interviewing: The art of hearing data*.

Šaparauskas, J. (2007). The main aspects of sustainability evaluation in construction. *Proc. of the 9th International Conference „Modern Building Materials, Structures and Techniques*.

Schraven, D., Hartmann, A., & Dewulf, G. (2011). Effectiveness of infrastructure asset management: Challenges for public agencies. *Built Environment Project and Asset Management*, *1*(1), 61–74. https://doi.org/10.1108/20441241111143786

Shami, M. (2004). An innovative decision support system for solving the renovation and expansion problems in operational infrastructure systems. *International Journal of Technology Transfer and Commercialisation*, *3*(2), 199. https://doi.org/10.1504/ijttc.2004.004654

Shehu, Z., & Akintoye, A. (2009). Construction programme management theory and practice: Contextual and pragmatic approach. *International Journal of Project Management*, *27*(7), 703–716. https://doi.org/10.1016/j.ijproman.2009.02.005

Shehu, Z., & Akintoye, A. (2010). Major challenges to the successful implementation and practice of programme management in the construction environment: A critical analysis. *International Journal of Project Management*, *28*(1), 26–39. https://doi.org/10.1016/j.ijproman.2009.02.004

Siew, R. Y. J. (2016). Integrating sustainability into construction project portfolio management. *KSCE Journal of Civil Engineering*, *20*(1). https://doi.org/10.1007/s12205-015-0520-z

Spijkerbroer, R., Busscher, T., Zuidema, C., Arts, E., & van Sandick, O. (2015). Trends en opgaven in het ruimtelijk domein ; Een verkenning. *Rijksuniversiteit Groningen, faculteit Ruimtelijke Wetenschappen*, 39.

ten Heuvelhof, E., de Jong, M., Kars, M., & Stout, H. (2009). *Strategic Behaviour in Network Industries: A Multidisciplinary Approach*. Edward Elger Publishing Limited.

Thiry, M. (2002). Combining value and project management into an effective programme management model. *International Journal of Project Management*, *20*(3), 221–227. https://doi.org/10.1016/S0263-7863(01)00072-2

Thiry, M. (2007). *Managing Portfolios of Projects, Gower Handbook of Project Management* (J. Turner, Ed.; Fourth Edi, Vol. 22). Gower. https://doi.org/10.1016/s0263-7863(01)00077-1

Thomsen, A., & Van Der Flier, K. (2009). Replacement or renovation of dwellings: The relevance of a more sustainable approach. *Building Research and Information*, *37*(5-6), 649–659. https://doi.org/10.1080/09613210903189335

Thuvander, L., Femenías, P., Mjörnell, K., & Meiling, P. (2012). Unveiling the Process of Sustainable Renovation. *Sustainability*, *4*(6), 1188–1213. https://doi.org/10.3390/su4061188

van den Boomen, M., van den Berg, P. L., & Wolfert, A. R. M. (2019). A dynamic programming approach for economic optimisation of lifetime-extending maintenance, renovation, and replacement of public infrastructure assets under differential inflation. *Structure and Infrastructure Engineering*, *15*(2), 193–205. https://doi.org/10.1080/15732479.2018.1504803

Verschuren, P., & Doorewaard, H. (2010). *Designing a Research Project: Project Design* (2nd). Eleven International Publishing.

Vlist, M. v. d., Roovers, G., & Barneveld, A. (2016). Vervangingsopgave natte kunstwerken in het hoofdwatersysteem en hoofdvaarwegennet in Nederland. *Water Governance*, *2*(2), 76–83. http://edepot.wur.nl/430752

Vogels, P. (2020). Veiligheid wegen in gevaar door geldgebrek: 'We zijn nog geen België en dat wil ik zo houden'. https://www.bndestem.nl/economie/veiligheid-wegen-in-gevaar-door-geldgebrek-we-zijn-nog-geen-belgie-en-dat-wil-ik-zo-houden~afa0ccc8/?referrer=https%3A%2F%2Fwww.google.com%2F

Wensing, N. (n.d.). Onderhoud infrastructuur - mobiliteit. https://www.bouwendnederland.nl/belangenbehartiging/standpunten/onderhoud-infrastructuur-mobiliteit

Westenberg, F., & Bleijenberg, A. (2020). Kuifje in bruggenland. https://www.verkeerskunde.nl/artikel/kuifje-in-bruggenland-fred-westenberg

Westerveld, E., & Hertogh, M. (2010). Playing With Complexity. Management and Organisation of Large Infrastructure Projects. *World*, 377.

Willems, J., Busscher, T., & Arts, J. (2016). De vervangingsopgave in de Nederlandse vaarwegen : volstaat een smart aanpak ? *Colloquium Vervoersplanologisch Speurwerk 24 en 25 november 2016, Zwolle Samenvatting*, 1–13.

Williams, D., & Parr, T. (2004). *Enterprise Programme Management Delivering Value* (Curran Publishing Services, Ed.; 1st ed.). Palgrave Macmillian. https://doi.org/10.1057/9780230514706

Yin, R. K. (2003). *Case Study Research Design and Methods, Third Edition, Applied Social Research Methods Series* (S. Robinson & G. Dickens, Eds.; 3rd ed.). SAGE Publishers.

Yin, R. K. (2017). *Designing Case Studies* (6th). SAGA Publishing.

A

Control on a Program

A.1. Shaping the control approach

Upcoming paragraphs will explore the relevant activities during the "shaping the control approach" phase described by Prevaas (2018) in more detail. The elements of Thiry (2007) will be addressed upon by explaining the applicable activity.

From goals to benefits

The goals on the program level will need to be translated into a concrete approach to gain control. Especially in a constantly, rapidly changing environment, this is crucial (Prevaas, 2018). This concrete approach can consist of creating benefits, that will make a goal on program level manageable (Prevaas, 2018). Benefits management is also an aspect that is mentioned as effective by Best Management Practice (2011). This paragraph differs from 3.2 Synergy of program management. In this paragraph, benefits on the content of a program are discussed, whether the previous paragraph was on the advantages the program management approach has to offer.

First of all, benefits are "the measurable improvement resulting from an outcome perceived as an advantage by one or more stakeholders, which contributes towards one or more organizational objective(s)" (Best Management Practice, 2011)."

To define benefits, four key aspects are essential. The benefits should be defined with a desirable level, a changing object, the environment, and the lead time (Prevaas, 2018). An example of a benefit is: at least 80 percent [level] of all installations used within the renovation of bridges program in Amsterdam [environment] will be energy efficient [changing object] by 2021 [lead time].

Furthermore, the downsides of a program should be taken into account as well. Also, the number of benefits should be limited and defined realistically. On top of this, to make those benefits more concrete, decomposing could be used. This means that the level of the benefit could be divided into manageable parts and linked to a certain point in time. Decomposing is not only applicable on time but also on categorizing the change objects in manageable parts, including a target audience, or be more specific on the graphical location.

When defining benefits is not possible because the results are not directly measurable or data is not available, it can use indicators to examine progress. A couple of indicators can collectively indicate a benefit.

Using a benefit profile can make tracking a benefit possible. This profile includes a description of the benefit, relationship with the parent goal, any supporting indicators, unit of measure, frequency, method, and the person responsible, start value (zero measurements), and target value with data planning of the realization (possibly separately), key contributing efforts and achievement results, realization budget and beneficial owner. Furthermore, some benefits will need a financial term to represent a goal.

Define your efforts, results, resources, and conditions

To pursue the benefits explained A.1 , the effort to do so would require some attention. This comes with the exact results, available resources, and conditions.

Based upon the theory of Prevaas (2018), firstly, specify the necessary efforts and results. This consists of determining the relationship between organization and program, make choices between different types of efforts, consider using models to support your choices, connect efforts and results to goals, recognize that causality cannot always be proven, take ownership of those who will be doing the work and be aware of what you are "doing" in the meantime.

Thiry (2007) is in his theory more specific about making choices between different types of efforts. In his research, it is pointed out that the selection of actions should take the inter dependability of projects into account, in terms of effects on each other and terms of their collective beneficiation to the overall program. Also, prioritization of actions in the overall program must ensure that benefit delivery is enhanced.

Secondly, focus on the necessary resources and conditions. This means identifying the resources required, pay specific attention to people's ability, accept uncertainty and work with stages and margins, ensure contact and contract with the means, link the resources to the efforts and goals in the DIM, and be concerned about organizational conditions (Prevaas, 2018). Shortly, Thiry (2007) describes the resource management with matching the supply (available resources) and demand (required resources). As explained in the previous chapter, resources within a program are shared. Maximizing resource sharing will encourage organizational learning, efficiency, knowledge sharing, and fluent working (Best Management Practice, 2011). However, sharing of resources increases the chance of bottlenecks occur (Best Management Practice, 2011).

Decide upon the solidness of the program

Now the program approach's content has been set up, it is wise to dive into the program's solidness. To decide upon the program's solidness, it is necessary to compile the business case, ask colleagues for a peer review, identify potential opportunities and threats and investigate potential dysfunctions in your program.

Structuring the program

Creating structure by clustering parts is essential because it will make it easier to control the program. This can be done based upon sequence, market-orientation, object-orientation, geographically, organizational-oriented, process-oriented, financial, or hybrid. During the execution stage, a sequential structure will be necessary. Then, specify the interfaces in and around a program (Prevaas, 2018).

Organizational-wise, the communication channels are important, which indicates "how information should be filtered and sorted to suit different organizational levels and how access to systems should be allowed or restricted. "(Thiry, 2007). Moreover, change management should be included while structuring the program (Thiry, 2007).

A.2. Gaining control

All seven activities of Prevaas (2018) will be worked out to get to know more about how control can be gained on programs. Other researches will be included.

Define requirements for controlling

The activity of defining the requirements for controlling requires considering the following aspects. Prevaas (2018) mentions the nature of the program and the environment, the demands, success criteria, and concerns of decision-makers, and the opportunities and threats to the program. Analyzing the nature of the program and its surroundings is also mentioned by Thiry (2007), it is required to continuously assess and manage the program environment, particularly stakeholders' needs, and expectations.

The demands, success criteria, and concerns of the client of the program should be enacted. These are not only on the content but have to do with the way a program should be successfully executed as well. The demands of the client could, for instance, be the lead time, budget, and level of effectiveness. Those demands and success criteria can be categorized into the control criteria that have been discussed; lead time will be part of the pace control criteria, and budget will be part of effectiveness.

The program's opportunities and threats could be dynamic since the programs have to do with a rapidly changing environment (Prevaas, 2018). Examples are a change of directors, a change in regulations, or economic changes. Those can influence the control criteria. Thiry, 2007 Includes the identification of emergent, unplanned input that can trigger those changes. By defining those opportunities and threats, it is possible to be prepared. Defining can be done by qualifying the chance of happening and the impact it provokes.

Prevaas (2018) adds to Consider a prioritizing of two or three control criteria, effectiveness is always on the agenda, and the criteria influence one another. Every control criteria are elaborated and divided into manageable parts. Those manageable parts can be seen as control mechanisms. This will be discussed in a paragraph later on.

Plan the program

Planning the program focuses mainly on making a concrete plan for controlling the control criteria. The control criteria, pace, feasibility, efficiency, flexibility, and effectiveness, discussed in previous paragraphs, function as tools for the program manager to take into your own hands, also called control mechanisms. In this upcoming paragraph, the content and the way the control criteria should be treated as explained.

Pace is about the speed at which goals must be achieved, efforts must be carried out, and resources must be made available. The aspects of steering to have control over can be:

- what are important milestones for the goals and benefits
- what timing, duration, milestones, and capacity apply to the efforts (in outline)
- how you manage the dependencies between efforts and with the environment
- how to ensure that the resources are available at the right time
- which lead times belong to the stages and the stages in the implementation stage
- how and with what regularity you update the schedule of the program
- what the margins and underlying assumptions of the planning are.

Schedules will be key to those aspects visible. However, it is wise to plan those schedules on the program level, not too detailed. Thiry (2007) emphasizes the importance of the control mechanisms pace as well. He notes that "Periods of stability, during which benefits are allowed to impact the organization, should be spread significantly throughout the program to pace it."

Feasibility refers to the probability goals and efforts can be achieved. Also, it refers to means becoming available and usable. Different kinds of factors that vary per program can influence feasibility. Examples are:

- the competition on the market
- the availability of resources
- the way the program is organized
- external pressure on the organization
- technical feasibility
- tension with law and regulation.

Risk management, strategic environmental management, and communication could help intervene in a program's feasibility.

Efficiency is about to what extent the goals add value, the efforts are viable, and the means used. The level. of efficiency depends on different aspects.

To steer towards efficiency, efficiency has to be made clear as far as possible in the control plane. This consists of:

- what the costs and, if possible, the financial returns look like
- where the resources come from and what alternatives there are
- how resources are allocated to efforts
- what the payback period of the program is expected to look like
- how income, expenses, liabilities, cash flow, etc. are monitored
- how and with what regularity you update the budget for the program.

Flexibility means to which extent goals can be adjusted, efforts can be adapted, and different means can be used. Due to the complex and rapidly changing environment programs have to deal with, it is necessary to develop a flexible approach.

Aspects that are important considering flexibility are, for instance;

- insecurities on the desired results
- influence and dependence of the environment
- development of technology

Tools to steer on those aspects include the prioritization of parts of the program, alternative scenarios, the overview of changes at program and effort level (change management), insight into acquired learning experiences, environmental analysis and the communication plan.

Effectiveness is to which extent goals and benefits contribute to the program's ambitions. Also in which the efforts contribute to the goals and the benefits to the efforts.

Managing the effectiveness of a program will require planning out in detail the following things:

- how and who defines prioritizes and monitors the benefits and costs
- how and how often you test and review the realization of income and expenditure
- what you do to prevent or limit double counting
- how you determine and assess the effectiveness of the efforts
- which assumptions apply to the effectiveness of efforts
- what you do to test the quality of products from projects
- how to ensure that the resources are and remain of sufficient quality.

An important tool is the "Goals Efforts Network" diagram that provides insight into the expected effectiveness. Other tools used are "an integrated feasibility test on the effectiveness of efforts," benefit profiles, and benefit realization plan.

Monitor the progress

Monitoring the progress of a program is to alert the program manager to any critical events that do not conform to the expected standards (Lycett et al., 2004). Within the phase of monitoring the progress, Prevaas (2018) has focused in his book on the different kinds of data and what to focus on. The seven different kinds of data that can be monitored are (Prevaas, 2018):

- Realization of income and expenses
- Use of results and other outcomes
- Realization of results and changes
- Progress in efforts
- Use and consumption of resources
- Relevance of goals and ambition
- Developments, risks, and issues

During the process of gathering data, it should be kept in mind that gathering data is not a goal; it is a mean. Furthermore, data should be relevant, future-oriented, reliable, valid, comparable, available on time, and profitable (Prevaas, 2018).Best Management Practice, 2011 Adds to this that it needs to be complete and accurate.

A sound aggregated information management system could be used on the program level to address information both between projects and the program and between projects within the program (Thiry, 2007). Assuming progress should result in management interventions that avert the program from drifting off the program's goals (Best Management Practice, 2011).

Compare, assess and report

Within the phase of compare, assess and report, the five control criteria are examined based on the overall program, the goals, the efforts, and resources. This will lead to proposing and choosing measurements to control the progress of a program. An analysis will be done based upon the five control criteria and the goals of the program. Also, the efforts and means of programs, in general, can be explained based upon the control criteria. With this analysis, the change will be observed and converted into measurements.

Proposing and choosing measures

By proposing and choosing measures to gain more control of programs, there are different possibilities. Prevaas (2018) proposes: adjust, reschedule, re-program, do nothing or quit. This last option will lead the program to the last stage of the control program cycle. Best Management Practice (2011) designate the point in time where such a decision is made the end-of-tranche review. Those are critical and assess the viability of the program.

Taking control measures, evaluate and update

When the measures are chosen, just executing those is not enough. The effect the measures bring about is important to be enlightened. It gives insight into whether to use the measure again one time and what else is needed. You also update the control plans from time to time so that they fit the new situation. Taking control measures could be done in all kinds of sizes and at different moments during the program execution. In practice, it will probably not be as structured as adumbrated in previous paragraphs. Evaluating the taken control measures allows organizational learning. Updating the plan could be when circumstances are quite changed, which results in a plan that might not fit anymore. Updating the plan results in a management approach that is always based on a realistic and substantiated plan.

B

Data Retrieving

B.1. Program-related documents used in this study

Program	Document	Date
Bridges & Quay Walls	Concept annual plan 2021 - Information management v0.3	31th of July 2020
Bridges & Quay Walls	Market strategy Program Bridges & Quay Walls	16th of June 2020
Bridges & Quay Walls	Goals Efforts Network Program Bridges & Quay Wall V2.6	14th of January 2020
Bridges & Quay Walls	Progress report PBK January - June 2020	January-June 2020
Bridges & Quay Walls	Program plan (Repair and Connect) B&K	14th of April 2020
Bridges & Quay Walls	Dashboard April 2020	April 2020
Bridges & Quay Walls	Progress letter to Council Members	17th of December 2019
Bridges & Quay Walls	Plan of Action	2th of July 2019
Road tunnels	Program plan Road tunnels Amsterdam Version 1.0 D	30th of November 2018
Road tunnels	Management letter Q4	January 2020
Road tunnels	Quarterly progress report Q4 2019	January 2020
Road tunnels	Quarterly progress report Q3 2020	October 2020
Road tunnels	Program plan Roadtunnels Amsterdam Version 1.1	1st of May
Flood protection program	FPP Controlling, control dashboard MT12-11	7th of February 2020
Flood protection program	Program Plan 2019-2023	8th of November 2020
Flood protection program	Controlplan FPP (MT) 1509	12 of November 2019
Flood protection program	FPP Knowledge and Innovation Agenda	19th of November 2019
Flood protection program	Annual report 2019	19th of November 2019

Table B.1: Program-related documents used in this study

B.2. One pager for interviewees

One pager for interviewees in Dutch

Introductie

Renovatie van bestaande infrastructuur staat aankomende jaren in Nederland centraal om verschillende redenen. Zo is veel infrastructuur in dezelfde tijdsperiode gebouwd is en zal in de aankomende jaren het einde van de levensduur bereikt worden. Verder heeft onderhoud aan infrastructuur in de afgelopen jaren onvoldoende plaats gevonden en wordt renovatie verkozen boven het vervangen van bestaande infrastructuur,

aangezien dit een hogere investering vraagt. Renovatieprojecten worden regelmatig gezamenlijk in een programma georganiseerd, wat verschillende voordelen met zich meebrengt. Een karaktereigenschap van een programma is dat met het gezamenlijk organiseren meer bereikt kan worden dan wanneer projecten individueel georganiseerd zouden worden. Het gebruik van dezelfde middelen, de integrale management aanpak en het repetitieve karakter komt doeltreffendheid en efficiëntie ten goede. Schaalvoordelen, netwerksynergiën, continue kwaliteitsverbetering, afname van onzekerheden en vermindering van tijd en geld dragen bij aan de voordelen. Voor infrastructurele renovatieprogramma's worden vaak programmadoelstellingen geformuleerd. In dit onderzoek worden deze doelen onderverdeeld in twee categorieën: functioneel en maatschappelijk georiënteerd. Functionele doelstellingen gaan over de initiële reden om renovaties uit te voeren, zoals het verlengen van de levensduur van infrastructurele assets of voldoen aan de huidige normen. Anderzijds worden er doelstellingen opgesteld die breder georiënteerd zijn en de focus legt op maatschappelijke meerwaarde, zoals duurzaamheid en de omgeving. De collectieve aanpak die programma's karakteriseert en het streven naar een synergie geven programma's veel potentie. Het beheersen van zowel functionele als maatschappelijke doelstellingen is hierbij zeer relevant.

Probleem definitie
Het beheersen van deze programmadoelstellingen blijkt erg complex te zijn onder andere omdat doelen breed zijn opgesteld, vele stakeholders betrokken zijn en de coördinatie van informatie lastig blijkt te zijn. Daarbovenop komt dat de mate van controle op programma niveau een moeilijkheid kan zijn; wanneer een te gedetailleerde controle wordt uitgevoerd kan het tot veel bureaucratie leiden, echter is een te globale controle ook niet wenselijk, want dit zou voor te weinig grip op doelstellingen kunnen zorgen.

In dit onderzoek zal onderzocht worden hoe op programma niveau, zowel functionele doelstellingen als doelstellingen gefocust op maatschappelijke meerwaarde), beheerst kunnen worden. Middels interviews en het bestuderen van beleidsdocumenten zal onderzocht worden hoe gestuurd wordt op deze twee verschillende soorten doelen en wat de valkuilen zijn. Middels literatuur en bestaande theorieën zal in een latere stap bekeken worden hoe ingespeeld kan worden op deze valkuilen.

Interviews
Tijdens interviews met programmamanagers en programmabeheersers wordt onderzocht hoe sturing op doelstellingen van infrastructurele renovatieprogramma's in de praktijk plaatsvindt. Hierbij wordt ingezoomd op de verschillende fases van het beheersen van een programma en aspecten waar nog winst behaald kan worden. Middels verkregen kennis in de praktijk kan er verkend worden welke theorieën gebruikt kunnen worden om moeilijkheden bij het beheersen van programmadoelstellingen te verminderen. Globaal zullen we tijdens het interview in gaan op de volgende vragen:

- Hoe beheersen programmamanagers functionele en maatschappelijke doelstellingen van infrastructurele renovatieprogramma's in de praktijk?
  - Tijdens het opzetten
  - Tijdens het monitoren van voortgang
  - Tijdens het bijsturen
- Wat gaat er goed in het proces en waarom? Wat kan er verbeterd worden en waarom?
- Is er een (bewuste) andere aanpak voor het beheersen van de twee verschillende soorten doelen op programmaniveau? Zou er naar uw mening een andere aanpak moeten zijn?
- Een karaktereigenschap van programma's in theorie is de synergie: het uitvoeren van projecten gezamenlijk in een programma biedt meer dan wanneer de projecten afzonderlijk van elkaar worden uitgevoerd. Herkent u dit in uw programma? Wordt hierop gestuurd?

B.3. Information interview respondents

Code	Participant	Programme	Date of interview
BQWWP1	Programme director	Bridges & Quay Walls	18-02-2021
BQWP2	Department director control	Bridges & Quay Walls	20-01-2021
BQWP3	Programme control manager (planning, risks, budget)	Bridges & Quay Walls	21-01-2021
BQWP4	Programme control manager (information, quality)	Bridges & Quay Walls	04-02-2021
R1	Programme director	Roadtunnels	13-01-2021
RTP2	Department director control	Roadtunnels	19-01-2021
RTP3	Programme manager Integral Design and Excecution	Roadtunnels	08-03-2021
RTP4	Controllor within department control	Roadtunnels	15-02-2021
FPP1	Programme director	Flood protection programme	24-02-2021
FPP2	Department director control	Flood protection programme	25-01-2021
FPP3	Department director Technology, Knowledge & Innovation	Flood protection programme	26-01-2021
FPP4	Programme control manager (planning , risk, budget)	Flood protection programme	21-01-2021

Table B.2: Information interview respondents

B.4. Interviewprotocol

The interview protocol contained three sections. The first section was the introduction section and was designed to find out more about someone's current function within the program and his or hers responsibilities. In the second section participants were asked about the way goals on program level were controlling, including the three different phases that are distinguished. Once this was covered, barriers experienced in this process were discussed. Then, the synergy as characteristic of a program was explored together with the barriers that come across. Finally, the interview was wrapped up by asking if everything was covered. All questions were open-ended questions. The interviewprotocol is described below in more detail, in Dutch.

Deel 1: Introductie (5-10 min)

- Introductie onderzoek: Afstudeeronderzoek CME, begeleid door AT Osborne
- Doel onderzoek: Inzicht krijgen in het beheersen van zowel primaire als secundaire doelstellingen binnen infrastructurele renovatie programma's; informatie verkrijgen over de huidige aanpak en eventuele verbeterpunten
- Duur gehele interview: 1 uur
- Uw gegevens worden vertrouwelijk behandeld. Vindt u het akkoord als ik dit gesprek opneem, zodat ik het gesprek kan terugluisteren zodat uw waardevolle antwoorden niet verloren gaan? Na transcriptie wordt deze verwijderd.

Categorie	Onderwerp	Vragen
Introductie	Achtergrond en functie	Hoe lang bent u werkzaam in uw huidige functie? En in deze organisatie? Hoelang bent u al werkzaam op programmaniveau?
	Rol met betrekking tot beheersen van programma doelstellingen	Wat zijn uw taken en verantwoordelijkheden met betrekking tot beheersen van programma doelstellingen?

Table B.3: Interviewprotocol- introduction questions

Deel 2: Beheersing programma doelstellingen - oriëntatie (30-40 min)

- Zoals u heeft mogelijk gelezen heeft in de informatie die ik u toegestuurd heb worden er twee soorten programmadoelstellingen herkend bij infrastructurele renovatie programma's: functionele doelstellingen (verlengen van de levensduur van assets) en doelstellingen gefocust op maatschappelijke meerwaarde (duurzaamheid, omgeving, etc.).

Categorie	Onderwerp	Vragen
Beheersen en synergie	Functionele doelstellingen	Kunt u iets vertellen over hoe het beheersen van functionele programma doelstellingen georganiseerd is binnen uw programma/organisatie? Welke concrete voorbeelden kunt u noemen? Welke instrumenten gebruikt u?
		Kunt u onderscheid maken tussen: het opzetten, monitoren en bijsturen.
		Heeft u het gevoel dat u controle heeft op de functionele doelstellingen op programma niveau? Zo ja, hoe komt dit? Wat gaat er goed? Zo nee, hoe komt dit? Wat kan er verbeterd worden? Waar liggen kansen?
	Maatschappelijke doelstellingen	Kunt u iets vertellen over hoe het beheersen van maatschappelijke programma doelstellingen georganiseerd is binnen uw programma/organisatie? Welke concrete voorbeelden kunt u noemen? Welke instrumenten gebruikt u?
		Kunt u onderscheid maken tussen: het opzetten, monitoren en bijsturen.
		Heeft u het gevoel dat u controle heeft op de maatschappelijke doelstellingen op programma niveau? Zo ja, hoe komt dit? Wat gaat er goed? Zo nee, hoe komt dit? Wat kan er verbeterd worden? Waar liggen kansen?
	Verschil	Is er een (bewuste) andere aanpak voor het beheersen van deze twee verschillende soorten doelstellingen op programma niveau?
		Zou er naar uw mening een andere aanpak moeten zijn? Zo ja, waarom? Wat zou er anders moeten? Waar liggen kansen? Zo nee, waarom? Wat maakt dat dezelfde aanpak werkt?
	Synergy	Een karaktereigenschap van programma's in theorie is de synergie: het uitvoeren van projecten gezamenlijk in een programma biedt meer dan wanneer de projecten afzonderlijk van elkaar worden uitgevoerd.
		Herkent u dit als meerwaarde van een programmatische aanpak ten opzichte van een projectmatige aanpak?
		Herkent u dit in uw programma? Zo ja, op wat voor manier? Zo nee, ik heb in uw programma dit wel gevonden. [specifieke informatie programma] Herkent u dit als synergie?
		Wordt hierop gestuurd? Zo nee, waarom niet? Ziet u hier wel potentie in? Zo ja, hoe? Werkt deze aanpak? Zo ja, op wat voor manier? Zo nee, waarom niet en wat kan er beter? Waar liggen kansen?

Table B.4: Interviewprotocol- questions on control and synergy

Deel 3: Afsluiting (10 min)

- Januari en (begin) februari zal ik mij focussen op het verwerken van de vergaarde informatie middels interviews. Mijn planning is om mei af te studeren. Zou u interesse hebben om mijn eindrapport/tussen resultaten te ontvangen? Ik zou eventueel ook een presentatie kunnen geven aan alle geïnterviewde. Heeft u hier interesse in?

Categorie	Onderwerp	Vragen
Afsluiting	Afronding	Eventuele concluderende vraag: klopt het dat u samenvattend ..... [zelf tijdens interview proberen te formuleren en de check-vraag stellen].
		Zijn er onderwerpen niet ter sprake gekomen, die u nog ter sprake wil brengen?
		Heeft u voor mij relevante documentatie van de organisatie van het beheersen van programma doelstellingen in uw organisatie?
		Ik maak van elk interview een kort casestudy rapport; ik wil u graag de mogelijkheid bieden de transcriptie in te zien voordat deze gebruikt wordt voor mijn rapport. Wilt u deze achteraf inzien?

Table B.5: Interviewprotocol- wrap up questions

C

Case Study 1: Bridges and Quay Walls Program

Extensive case analysis is restricted for the online version and can be requested by the researcher.

D

Case Study 2: Road Tunnel Program

Extensive case analysis is restricted for the online version and can be requested by the researcher.

E

Case Study 3: Flood Protection Program

Extensive case analysis is restricted for the online version and can be requested by the researcher.

F

Expert session

F.1. One pager for respondents expert session

One pager for respondents expert session in Dutch

Introductie

Renovatie van bestaande infrastructuur staat aankomende jaren in Nederland centraal. Dit komt voornamelijk doordat het einde van de levensduur van veel infrastructuur bereikt wordt, aangezien het in dezelfde tijdsperiode gebouwd is. Deze renovatieprojecten worden regelmatig gezamenlijk in een programma georganiseerd. Een karaktereigenschap van een programma is synergie; met het gezamenlijk organiseren kan meer bereikt worden dan wanneer projecten individueel georganiseerd zouden worden. Verschillende vormen van synergie worden herkend in programma management. Enkele voorbeelden zijn het gebruik van dezelfde middelen, de integrale management aanpak en het repetitieve karakter, wat doeltreffendheid en efficiëntie ten goede komt. Infrastructurele renovatieprogramma's benutten deze synergie. Dit is terug te zien in de programmadoelstellingen. Zo zijn er niet alleen functionele doelstellingen (gericht op het verlengen van de levensduur van infrastructurele assets of voldoen aan de huidige normen), maar ook doestellingen met een focus op maatschappelijke meerwaarde (zoals duurzaamheid en de omgeving). De collectieve aanpak die programma's karakteriseert, het streven naar een synergie en het betrekken van brede programma doelstellingen geven programma's veel potentie. Echter, in de praktijk wordt het beheersen van verschillende soorten doelstellingen en de synergie als complex ervaren, en zijn er vele barrières te overwinnen.

Doel van de meeting

Middels een literatuurstudie en empirisch onderzoek is de huidige aanpak en de ervaren barrières in kaart gebracht. Het empirische onderzoek richtte zich op drie verschillende cases en is gerealiseerd door programmabetrokkenen te interviewen. Geleid door literatuur, het vergelijken van de cases en eigen interpretatie zijn oplossingsrichtingen naar voren gekomen. Het doel van de meeting is een weging toekennen aan de gevonden barrières. Daarnaast zullen oplossingsrichtingen van de belangrijkste barrières gevalideerd worden. Aanwezig zullen programma-betrokkenen van de cases en adviseurs van AT Osborne zijn.

Agenda

Onderstaand de agenda voor de expertmeeting van morgen. In de tabel zijn de gevonden barrières weergegeven. We zullen niet uitgebreid inzoomen op individuele barrières, maar middels een weging bepalen welke essentieel zijn. De focus van de meeting ligt bij de oplossingsrichtingen, die ik morgen zal presenteren. Jullie mening en praktijkervaring zullen van waarde zijn voor de validatie van de resultaten van mijn onderzoek.

1. Voorstelronde en introductie (10 min)
2. Weging geven aan barrières (tabel 1)(10 min)
3. Discussie potentie voorgestelde oplossingen (30 min)
4. Afsluiting (10 min)

F.2. Weighted barriers

Barriers are presented to the experts, including the opportunity to give a weighting based on their degree of experience in practice. In this way, barriers are validated. Table xxx shows the result in order of importance. However, the barrier 'real-time proactive planning is complex' did receive a high rating is not discussed in further detail during the meeting. This is because the barrier is based on literature and did not come from empirical research.

Barrier code	Barrières	Score
C2	Taking action is hard to when monitoring is not done structured yet	4/5
C7, S4	Lack of commitment on program management approach	3.4/5
L2	Real-time proactive planning difficult	3.4/5
C1	Drawing up goals and their KPIs, preferably quantitatively	3.3/5
C6	Determine the scope of the program	3.3/5
S2, C4	Coordinating projects within the program requires too many actions to align, tune, adapting	3.3/5
C5	The mismatch between organizational plan and control on program goals	3/5
S3	Organization of collectively addressing things not fully implemented in the organization.	3.1/5
S5	Getting the innovation developments application-oriented and used	3.1/5
L1	Goals are set up in a broad way	3.1/5
C3	Reaching program goals in balance	2.9/5
S6	Innovation is not forthcoming because of low priority or high risks	2.7/5
S1	Sometimes rivalry between projects	1.9/5

Table F.1: Barriers proposed to experts including the weighting

Benefit from future infrastructure renovation program's potential

In the upcoming years in the Netherlands, the Dutch government will focus upon renovating infrastructure assets. A shift from organizing each project individually to a more program-oriented approach is observed which comes with the potential of synergy. Moreover, not only functional goals are defined for these programs, but more and more often, also non-functional goals that focus on adding value are defined for construction programs, such as sustainability and spatial planning.

However, program organisation typically struggle gaining more control over program goals and utilizing the potential of program's synergy.

This research tries to improve both those controlling program goals and utilizing program's synergy. If you have any questions, remarks, suggestions or observations, please let me know. Enjoy reading!

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