Management of organizational interfaces to improve the success of large road infrastructure projects.

As perceived by the contractor

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CME Master Thesis
Delft University of Technology
# Colophon

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Preface

Before you lay the fruits of my labor that have culminated into a thesis for the master Construction, Management & Engineering. This master is tutored at the University of Technology in Delft and, upon completion, awarded with the title Master of Science. The topic of interest has been guided by Heijmans, a major contractor for whom this research aims to facilitate economic growth.

It was September 2009 when I started studying architecture at Delft University. The profession of architect seemed to fit an adolescent like me, who’s childhood had been filled with Lego’s and drawings of imaginary structures (including floor plans and cut-sections). But studying is not always a smooth process. In the third year my motivation declined and I spent less time on campus. This gap was easily filled with extra curricular activities like rowing and cycling. One day I was cycling through the city and I rode past the construction site that is the Delft railway station. Millions of questions entered my mind, like “How can one construct such complex projects, which take 5, 10 or even 15 years?”, “How do they cope with a continuously changing environment?”, and “How does one make it a success, with so many stakeholders and disciplines involved?”. Fascinated by these type of construction projects and the complexity they bear I decided I needed to change my educational path. No longer designing complex architecture, but managing complex projects. The choice was easily made to apply for the master Construction, Management & Engineering, with this thesis as a direct result.

First of all I would like to express my appreciation to Leo, my mentor at Heijmans. Our brief brainstorm sessions have always inspired me and gave me new insights. Second I’d like to thank my graduation committee for their knowledge. Hans for helping me focus when I started to diverge. Bauke for leaving me with more questions at the end of our meetings than at the beginning. And especially Marian for guiding me through the graduation process when times where rough. Furthermore I’d like to acknowledge Jolande for welcoming me at Heijmans and all the Heijmans colleagues who took the time to participate in the research.

As for my family I would like to thank my mother for her unconditional love and support. It hasn’t always been easy but you have raised a blessed son. Furthermore a special thanks to my loving girlfriend Simone. Your belief in me will always help me achieve my dreams. Finally I’d like to dedicate this thesis to my recently departed father. You have always motivated me to explore the world on my own, on my own pace, making my own decisions, doing what I love. This is the greatest gift a son could ever want. Thank you.

Maarten Kröse
Delft, 3 November 2017
Executive summary

Despite continuous efforts to improve, the construction industry is prone to failure of large infrastructure projects in terms of time and cost overruns. The inherent complexity of infrastructure projects make this a difficult issue to grasp. Much research has been directed towards this phenomenon with diverging results. More recently the concept of interface management (IM) is emerging in scientific literature. Project interfaces are the common boundaries between people, systems, equipment, or concepts. There are different types of interfaces to be distinguished: physical, contractual and organizational. This research focuses on the organizational interfaces which can be seen as the relations between the different stakeholders on the project. It is believed good interface management is contributing to the success of infrastructure projects.

The research has been executed at Heijmans, a major contractor in the Netherlands. Operating in the construction industry, Heijmans is no stranger to the current difficulties with infrastructure projects. This is reflected in a number of loss-making projects in 2016. Heijmans recognizes the need for improvement and feels IM can be a possible solution. Currently the general opinion at Heijmans is that insufficiently managing organizational interfaces is directly related to project failure. The purpose of this research is to explore which organizational interfaces are related to project success, from a contractors perspective, and how this can be improved.

In order to assess which organizational interfaces are present on infrastructure projects an exploratory case study has been performed. Four road infrastructure projects with integrated contracts, executed by Heijmans, have been assessed. This has been done by interviewing 22 members of responsible project team through semi-structured interviews. Also, as the concept of project success is rather abstract, a literature study has been conducted to elaborate upon this concept from multiple viewpoints.

Current literature shows that the definition of project success is different for each stakeholder on the project. Performance indicators are used to measure the performance of a number of variables related to the project. These variables by themselves do not define project success. It is the perceived value towards each performance indicator which judges the success of a project. Clients are mainly interested in indicators related to the outcome of the project. End users find a project successful when it meets their expectations. Contractors continue to value indicators related to costs, time and quality, most important.

The research identified a number of organizational interfaces present on road infrastructure projects with integrated contracts at Heijmans, namely internal relations within Heijmans, the relations with the client, and the relation with subcontractors. Furthermore two additional units of analysis are
investigated. The boundaries between project phases and the atmosphere within the project team. The four cases show that the relationship with the client is the most influential interface. A relationship based on mutual trust is related to project success, whilst a relationship dominated by discussions and conflict results in lower project success. The case study has revealed there is a difference with respect to client type. In general, projects in cooperation with Rijkswaterstaat were more successful in comparison to projects with lower government organizations such as provinces and municipalities. This conclusion can be generalized according to additional data on projects executed by Heijmans in 2016.

The root cause for this difference in relationship is the level of knowledge and experience from the client on integrated contracts. Integrated contracts expect the contractor to take control of the project after it has been awarded. Rijkswaterstaat has sufficient expertise with these contracts, which means they are able to hand over control of the project to a contractor, thus allowing Heijmans to be the expert. Provinces and municipalities have less experience, which leads to controlling and reserved behaviour. These clients find it difficult to give away control of the project. This behaviour frustrates the process for the contractor, resulting in less control and lower project success.

As the nature of the relationship is related to the success of the project, this research recommends a set of control measures which can be deployed to improve the quality of the client-contractor relation. First of all, proactive behaviour by the contractor during the project is required to build a relationship based on mutual trust. This starts in the tender period where sufficient time must be reserved to get to know the client. It is important to create an understanding of the interests and the motives of the client. Furthermore Heijmans must make clear agreements on the project requirements. Expectations must be made explicit and both client and contractor need to agree on what is included in the contract and what is not. This can be achieved by a well prepared project start up in which the contractor can take away any insecurity or doubt the client has regarding the project. Finally, as evaluation is currently undervalued, both client and contractor should acknowledge project evaluation is a mandatory part of all projects. It is important to not only assess the project, but also the quality of the relationship. A good relationship between client and contractor is essential for project success.
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List of abbreviations

BIM ............. Building Information Model
BVP ............. Best Value Procurement
DBFM ........... Design, Build, Finance and Maintenance
D&C ............. Design and Construct
EMAT ............ Economically Most Advantageous Tender
EPCM ........... Engineering, Procurement and Construction Management
IM .............. Interface Management
KPI .............. Key Performance Indicator
LGO ............. Lower Government Organization
MIRT ............. Meerjarenplan Infrastructuur, Ruimte en Transport
PFU ............. Project Follow Up
PMP ............. Project Management Plan
PSU ............. Project Start Up
RWS ............. Rijkswaterstaat (Ministry of Waterways and Public Works)
SPC ............. Special Purpose Company
Chapter 1

Introduction

A high quality infrastructure network is of great importance to a nation’s prosperity. Adam Smith, founding father of classical economics, already described the importance of infrastructure with respect to economic growth back in the 18th century. He concluded that infrastructure decreases the cost of transportation of goods, stimulating trade between nations (Smith, 1776). The majority of international trade in the 18th century took place over water. Other modes of transportation rose quickly when the invention of the steam engine started the industrial revolution. The railway network became a good alternative to bring goods to nations without access to waterborne transport. This was soon followed by an extensive road network. Together these infrastructure networks have connected the world in a way Smith could have never imagined.

The Netherlands has one of the most dense road networks in the world. In 2017 there is a total of 139,294 kilometer of roads present (CBS, 2017). This number consists of 5,357 kilometers of highway, 7,757 kilometers of provincial roads and 126,180 kilometers of municipal and local roads. The Netherlands is well known for its high quality infrastructure network. In order to keep this network up to date, the Ministry of Infrastructure and Environment has drafted a multi-annual plan called: Meerjarenprogramma Infrastructuur, Ruimte en Transport (MIRT). This document holds the strategic planning and progress of all infrastructure projects executed by the state, provinces and municipalities (Ministerie van Infrastructuur en Milieu, 2017). The MIRT shows an available budget of 6,8 billion euro in 2017 in order to upgrade and maintain the road and water infrastructure network. This number is expected to increase with more than 10% to 7,6 billion in 2021 (Economisch Instituut voor de Bouw, 2017), showing the importance of infrastructure in the Netherlands.

These investments by the government enable a continuous flow of infrastructure projects, resulting in an attractive climate for possible investors. This is also reflected in the Global Infrastructure Investment Index, where the Netherlands has entered the top 10 of most attractive nations for infrastructure investment (Financieel Dagblad, 2016). On top of this, the Dutch economy as a whole profits above average from infrastructure investment. One percent investment in infrastructure of the gross domestic product accounts not only for 1.8 percent of economic growth, but also for 34,000 new job positions according to Standard and Poor’s (2013). This is far more than neighboring countries Germany and Belgium, with 1.4 and 1.2 percent respectively (Volkskrant, 2015a).
1.1 Project failure

Even though there are many incentives to invest in infrastructure projects, this is not without risks. The construction industry has a long and rather persistent tradition of large infrastructure projects failing to deliver on-time and within budget (Flyvbjerg et al., 2003; Morris, 1990; Singh, 2010). The Netherlands is no exception to this and has its own gallery of honour regarding failed projects. The best known example is the North/South metroline in Amsterdam. It was originally planned for delivery in 2005 at 817 million euro. But the completion date is currently set at 18 July 2018 at 3.1 billion euro. However, contractors are still doubtful if this target will be met (NRC, 2016). Another example is the high-speed railway line running from Amsterdam to Brussels. The initial budget was estimated at 3.4 billion euro in 1995 (Algemene Rekenkamer, 2014). The project has faced major problems that caused the costs to escalate rapidly. When completed in 2009 the costs had risen to roughly 7 billion. The added issues with the V250 (Fyra) trains, which were removed due to poor manufacturing quality, increased the total costs to almost 11 billion euro (Volkskrant, 2015b).

One might say that with the lessons learned from failing projects it must be possible to prevent issues in the future. But the problem of large infrastructure projects failing is stubborn and history seems to repeat itself. There has been a plethora of research done towards all possible causes leading to this failure. Rosenfeld (2014) concludes that premature tender documents, changes in owners’ requirements and unrealistically low tender-winning prices are the root cause of cost overruns. Flyvbjerg et al. (2004) have found project costs to be highly dependent on the length of the execution phase of a project. Furthermore Shane et al. (2009) have expanded this list of causes by adding factors such as: scope creep, poor estimating, project complexity, schedule changes, contractual conflicts and many others. These studies provide an extensive array of factors possibly contributing to project failure. Despite all this research infrastructure projects are still prone to failure in terms of time and costs. The many possible factors that contribute to project failure make it a complex issue to grasp.

1.2 Interface management

In order to cope with complexity, a project is divided into various activities (Nicholas and Steyn, 2012). For infrastructure projects these are for example contract management, tender management, risk management, stakeholder management, verification of requirements, planning, design, maintenance, and many others. All of these activities together contribute to the result of a project. The factors contributing to failure mentioned in section 1.1 are mainly aimed towards understanding issues coming from one of these parts. There is a factor however that has been underexposed in literature (Chen et al., 2008). This factor is about the interaction between the different parts of a project: the project interfaces. It is the complexity of this interaction that is perceived most predominant by project managers (Geraldi and Aldbrecht, 2007). Metaphorically speaking are project interfaces the cement that keeps the bricks together in order to build the house. This is referred to as interface management (IM). IM exposes the relations between the parts within a project and how these affect the overall project success.

The concept of IM was first defined as “the management of common boundaries between people, systems, equipment, or concepts” (Nooteboom, 2004). It clearly recognizes the managing of boundary
conditions, or in other words: the project interfaces. This definition has been altered by Chen et al. (2008) to reflect the complex interactions regarding these common boundaries. They have defined IM as follows: "the management of the boundaries between such project entities as people/participants, processes/phases, resources, contracts, costs, schedules, systems/functions, and safety/risk to enable a dynamic and well-coordinated construction system". Whilst this definition encompasses all project interfaces, different types can be distinguished: physical, contractual and organizational interfaces (Pavitt and Gibb, 2003). Physical interfaces are considered the connections between two or more physical elements that make up the design of the project. Contractual interfaces are related to the responsibility for a certain element of the system. Organizational interfaces can be seen as the relations between different stakeholders involved in the project, for example the client-contractor relationship, but also the relation with other stakeholders on the project, or the boundaries between departments within the organization. This is shown in figure 1.1.

Morris (1983) has been the first to recognize the value of IM for project success. He states the importance of identifying all project interfaces for good project control. IM has been further recognized by Nooteboom (2004) calling it the cornerstone of good project management. More recently research has shown that IM is effective for mitigating the adverse impact of project complexity (Ahn et al., 2016). Furthermore projects with systematic IM show less dispersed costs growth when compared to projects without systematic IM (Shokri et al., 2016a). Finally IM enables the application of emerging management philosophies such as LEAN construction and Agile Project Management (Chen et al., 2007).

Even though it is more than 30 years ago that Morris has first pointed out the importance of IM, the research on the subject remains very thin. This is because IM is a relatively new discipline within the construction industry (Shokri et al., 2016a). Leaving many area's in this field yet to be explored. This research adds to the existing knowledge on IM linking it to organizational interfaces.
1.3 The complexity of road infrastructure projects

Road infrastructure projects are complex entities, for instance because of many stakeholders involved, a multidisciplinary nature, the diversity in contract types and the long lead time (Brockmann and Girmscheid 2008). This interplay of many stakeholders, disciplines, contract types and lead time is what ultimately defines all the organizational interfaces on road infrastructure projects. In order to fully grasp the extent of these interfaces it is necessary to understand the factors adding to project complexity.

When looking at the diversity in stakeholders, there are firstly main stakeholders like the client, the contractor, subcontractors and possibly an investment firm. These organizations each have their own interest regarding the project. The client is often a governmental body with the goal to improve mobility and accessibility for a certain region. The contractor has a commercial interest and aims to earn money. Not only for the continuation of the organization, but also as a responsibility to its many shareholders. Next to the main stakeholders there are stakeholders such as neighboring residents, nature interest groups, and small private and/or commercial parties. The project affects these parties as well, positive or negative. Noise pollution and decreasing quality of surrounding nature during construction have a negative impact for example. But a positive impact can be when the project brings higher quality cycling routes or a newly built transfer location for the local wildlife. All these different interests need to be managed as conflicts with stakeholders can severely delay the project (Olander and Landin 2005).

The multidisciplinary nature of road infrastructure projects is easily seen in the many specialists coming from a wide range of disciplines working on a project. Civil engineers for the design of civil structures like bridges, tunnels and junctions. Road specialists for the asphalt, the lineage, guiding rails and traffic modeling. Electrical engineers for the traffic lights, matrix signs, and systems for speed enforcement and the monitoring of traffic. These are considered the three main disciplines when it comes to road infrastructure project design. However, other activities can require additional specialisms: soil sanitation, laying pipelines, noise barriers, geodetic engineering, and many more.

The contract type can also add complexity to a project. Currently there is a broad spectrum of integrated contracts available, each requiring a tailored approach. This spectrum ranges from a Design & Construct contract, where the contractor is responsible for the design and construction of the project, to the Design, Build, Finance, Maintenance & Operate (DBFMO) type contracts. These contracts are characterized by a maintenance component and a party responsible for the project finances. This is usually arranged by creating a SPC (special purpose company) in which all parties unite and take on the contract, adding a whole new dimension to the project. Project alliance contracts are also possible. The essence of these contracts is to share the project risk and reward between client and contractor (Ross 2003). Next to this wide spectrum of contracts, a similar spectrum exists for reimbursement methods. Lump sum, fixed price/variable scope and performance based incentives are a few examples of more traditional reimbursement methods. However this is also evolving with the rise of BVP (Best Value Procurement) where the award is based upon a combination of price and quality considerations (Gransberg and Ellicott 1997). Because each project is different, a contractor has to adapt to many different contract types and procurement methods.
Another aspect that adds to the complexity of road infrastructure projects is the factor of lead time. Because of the size of these projects, it takes a long time to tender, design, execute and maintain the project. On average it takes two years for the tender and the design to be completed, another three years for project execution, and possibly there is a maintenance requirement which can last up to 25 years. Because of this long duration other variables that influence the project might change. These changes have an effect on the project and can be hard to forecast.

1.4 Problem analysis: Recovery for Heijmans

This research has a strong link to project management in practice as it is executed in cooperation with Heijmans. Heijmans is a major contractor operating in the Netherlands. With a turnover of almost 2 billion euros they are currently ranked 5th in the list of large Dutch contractors (CoBouw, 2016). Heijmans has a widespread variety of expertise in the construction industry, ranging from the development of (non-) residential buildings to civil- and infrastructure projects. However, there have been a few difficult years for the construction industry, and for Heijmans. Ever since the financial crisis commenced in 2008, contractors have faced difficulties in maintaining a healthy financial situation. Throughout the period 2012-2014 Heijmans has adopted large projects in the context of market development and (new) contract types. With these new contract types, the risk and responsibility have increasingly shifted from client to contractor (Szentes and Eriksson, 2015). This shift was insufficiently recognized and/or managed by Heijmans leading to a dramatic loss of 110 million euros in 2016. Out of which 82 million is originating from infrastructure projects (Heijmans, 2017). This is shown in figure 1.2.

This negative result has led Heijmans to change its strategic course in order to facilitate financial recovery. The focus returns to the Dutch construction market with the disinvestment of the German and Belgian business units. Furthermore Heijmans has stated they will now exclusively enlist on tenders in cooperation with risk bearing partners that have a proven track record within the industry. With this shift in focus, Heijmans recognizes the need for process optimization, efficiency and integration of systems on large construction projects (Heijmans, 2017). The purpose of this focal shift is to make Heijmans financially healthy again, thus enabling growth.
In order to achieve the mentioned goals, Heijmans recognizes the need for action. But as of today, little has been done to investigate exactly how and where problems arise during projects. Different views towards these issues are present among Heijmans’ higher management levels. Heijmans has been trying to pinpoint the exact reasons for the negative results of the last years. Insufficient risk management, optimistic calculations, information loss during the project, tight scheduling, unclear project requirements, conflicts with the client. Many of the failure factors for project failure identified by literature are also recognized by Heijmans. More recently IM has also caught the attention of Heijmans, and they assume that they are insufficiently managing interfaces on their infrastructure projects. However, this is just an assumption based on individual perception and gut feeling of project managers. Empirical evidence that supports these assumptions is lacking. By using Heijmans as the subject, this research will add both to the knowledge gap in scientific research as to the knowledge gap at Heijmans.

1.5 Outline of the research

The design of this research is given in chapter 2. This chapter elaborates upon the problem definition and describes the research objective, scope, questions and approach. The relevance of the research is also discussed. Chapter 6 elaborates the different viewpoints regarding project success derived from a literature review. Furthermore the success of a project is assessed and described from different viewpoints. Chapter 3 describes the design of the case study, followed by chapter 4 which holds the actual case studies. Each case is briefly described followed by the results. Chapter 5 compares the individual case studies to each other in order to define the most influential organizational interface regarding the success of large road infrastructure projects. Chapter 7 describes the framework and provides recommendations for improvement regarding the most influential organizational interface. This framework is evaluated in chapter 8. This evaluation is done by tender managers from Heijmans who are experienced in large infrastructure projects. The limitations, discussions regarding generalization of the framework and recommendations towards further research are given in chapter 9. Lastly the conclusions of this research are presented in chapter 10.
Chapter 2

Research design

This chapter contains a description of the research design. It starts with a brief overview of the problem definition followed by the research objective and research scope. Next the research question is motivated, which will guide in achieving the objective of the research. This is followed by the research approach. This chapter concludes with a description regarding the relevance of the research, both scientifically and for Heijmans.

2.1 Problem definition

As stated in chapter Heijmans is facing difficulties during its infrastructure projects. Resulting in loss making projects and conflict situations with clients. This is the main problem that is further investigated in this research.

To cope with this problem Heijmans feels the need for optimization, efficiency and integration of processes surrounding its infrastructure projects (Heijmans 2017). However, as was also mentioned in chapter there are many possible failure mechanisms for infrastructure projects. Heijmans wants to combat project failure in their projects, but the root cause of the problem is vague and indistinct.

Based on experience regarding recent infrastructure projects, Heijmans feels insufficient interface management is a major contributor to the dramatic results of 2012 to 2016. But what exactly are interfaces for Heijmans? Currently Heijmans defines interfaces as the "connection between two or more elements within a project". In which an element is open for interpretation. An element can be organizational: people, departments, subcontractors, suppliers. An element can be technical: materials, systems, technology. Or an element can be environmental: clients, investors, end users. In essence, Heijmans finds interfaces widespread throughout the entire construction spectrum.

This definition is very similar to the definition presented by Chen et al. (2008), who define interfaces as "boundaries between project entities". Heijmans also distinguishes three different types of interfaces which are in line with the types given by Pavitt and Gibb (2003). The first glance of interfaces appears when looking at the current company model of Heijmans, shown in figure 2.1.
In almost every large road infrastructure project, Heijmans takes on the role as main contractor. Depending on the contract, Heijmans is responsible for the design, planning, preparation, execution and/or the maintenance of a project. When a project tender is won, a project organization is constructed for that specific project. This project organization is considered the management team of a project. The project organization is headed by the project manager. He/she is responsible for the performance of the project and reports directly to the board of directors. Furthermore the project organization is completed with members originating from all different departments within Heijmans. These departments range from the road- and civil works disciplines to design engineers, geodetic engineers and process management staff.

The project organization has relations with many other actors or groups. First of all the client, for which they manage the project. But also internal interfaces, between the project organization and other departments within Heijmans. Then there are local stakeholders whose interests might be affected by the project. Relations with subcontractors, who are contracted to construct the project, are also present. Heijmans defines these relations as organizational interfaces. In conclusion Heijmans believes that insufficiently managing these organizational interfaces is what causes lower success rates on their large road infrastructure projects.
2.2 Research objective

Heijmans reckons IM is a possible cause for the problems regarding infrastructure projects. Immediately investigating the status of organizational interfaces however might be jumping to conclusions. It is unclear whether the perceived lack of interface management is directly correlated to lower project success at Heijmans. There is a whole spectrum of possible causes why an infrastructure project could underperform. Scope changes, inadequate budget, missing information, calculation errors and distrust among stakeholders (Rosenfeld, 2014) are just a few examples.

The aim of this research is to investigate which organizational interface is most correlated to lower project success regarding the infrastructure projects executed by Heijmans and how its negative effects can be mitigated. This can be achieved by means of a framework for Heijmans concerning future infrastructure projects, which will assist Heijmans in its road to recovery. And to finish this report, recommendations will be made to use the results of this research in a broader sense than infrastructure projects at Heijmans. This will be a first (small) step to resolve problems in interface management in general, where gut feeling and best guesses should make way for informed and substantiated statements based upon empirical evidence.

2.3 Research scope

This research focuses on organizational interfaces on large road infrastructure projects at Heijmans. This section explains the choices that result in this scope.

Heijmans is the focal point of this research. As a major contractor, Heijmans operates in three sectors: housing, public buildings and infrastructure works. Infrastructure projects are notoriously complex and known for their drawn out project duration, technical challenges, varying interest of stakeholders and high risk profile (Fellows and Liu, 2012). Large contractors have long standing difficulties in managing large infrastructure projects, with Heijmans being no exception. This becomes painfully visible in the year 2016, where infrastructure projects were responsible for 87% of the losses in operational results (Heijmans, 2017). Because of this, the focus in this research is on infrastructure projects at Heijmans.

Infrastructure as a whole is a broad definition. It is a service network which concerns the transportation of people and goods. Transport infrastructure generally consists of the following modes of transport: air, rail, road, water, cables and pipelines. Heijmans executes projects in every sector. Examples are: runway maintenance for Schiphol airport, cable management for electricity masts, maintenance on bridges and sluices in and over waterways. However the majority of infrastructure projects taken on by Heijmans belong to the road category. Therefore this type of infrastructure projects is chosen for assessment.

Road infrastructure projects are categorized in three risk profiles by Heijmans (appendix A). Projects with a budget from three to twenty million euro are flagged as "category 2 projects". Projects with a budget greater then twenty million euro are considered "category 3 projects". Due to their size these projects are more likely to be complex, resulting in a higher risk profile. Therefore category 2 and 3 projects are most prone to organizational interface issues, meaning they are the focus of this research.
Currently there are many ideas and assumptions which point towards organizational interfaces as the root cause of project failure. However these statements lack empirical evidence to support them. This research attempts to elucidate these statements by focusing on the correlation of organizational interfaces and project success.

2.4 Research questions

The main research question which is derived from the problem definition, research objective and scope is the following:

*How can organizational interfaces be better managed, in order to improve the success, from a contractor’s perspective, of large road infrastructure projects?*

In order to answer the research question, sub-questions have been formulated. These sub-questions are stated below:

1. How do organizational interfaces affect the success of large road infrastructure projects at Heijmans?
2. How is project success defined from a contractor’s perspective?
3. How can Heijmans improve the project success with respect to organizational interfaces?

The first research question elaborates on the different viewpoints of stakeholders on project success. In order to assess how organizational interfaces affect project success, from a contractors perspective, the definition of project success from their viewpoint needs to be established first. Once this definition is known it can be linked to the organizational interfaces in the main research question.

The second research question assesses which organizational interfaces are present on large road infrastructure projects at Heijmans and to which degree they affect the defined project success from a contractors viewpoint. Linking the organizational interfaces to large road infrastructure projects mentioned in the main research question.

The final research question isolates the most influential organizational interface on project success for Heijmans. Once this interface is identified measures for improvement can be provided. These measures allow Heijmans to mitigate the negative effects of this interface with respect to project success.

Together these research questions answer the main research question and therefore achieve the research objective.
2.5 Research approach

The root cause of the problem is vague and indistinct as was mentioned in section 2.1. Because of this four large Heijmans’ road infrastructure projects will be explored holistically. This exploratory approach allows for a thorough assessment of these projects and all organizational interfaces present. The aim of this case study is to fully understand what, why and how organizational interface related issues have occurred during these road infrastructure projects. The case study assesses which interfaces were present and to which degree they affected the project success, answering sub question two. The design of this case study is described in chapter 3.

Next a literature study is executed that elaborates upon the definition of project success. Project success will be defined for different stakeholders involved in road infrastructure projects. It is essential to unfold how success is defined from a contractors perspective, hereby giving answer to sub question one.

The last steps of this research are to isolate the most influential organizational interface towards project success in order to mitigate the negative effects, or to enhance the positive effects. This is achieved by recommendations for Heijmans using a framework for project control. This framework is evaluated by tender managers from Heijmans, effectively answering sub question three. An overview of the research approach is given in figure 2.2.

2.6 Relevance of the research

It is expected that the results of this research will add to both the knowledge gap in scientific research as the knowledge gap at Heijmans mentioned in chapter 1. Scientific research towards IM is becoming a topic of interest lately. Especially since IM is linked to tackle project complexity (Ahn et al., 2016) and project risks (Shokri et al., 2016). This research contributes to the existing knowledge gap by linking the effect of organizational interfaces to the success of large road infrastructure projects.

The knowledge gap for Heijmans regarding IM, or the perceived lack of IM, is exposed by the performed case studies. The analysis and resulting framework are expected to diminish issues regarding organizational interfaces on the short term. On the longer term the framework can be improved to maximize its contribution to the financial recovery of Heijmans.

The outcome of this research has increased value if the results can be generalized. One can think of the applicability of the framework to other type of projects, organizations, interfaces, markets, etc. The degree in which the framework can be generalized is discussed in-depth in chapter 9.
Figure 2.2: Steps taken during the research

1. Case study preparation
2. Case study analysis
3. Literature study
4. Framework Recommendations
5. Evaluation by Heijmans
6. Discussion
7. Conclusion

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Chapter 3

Case study design

This chapter elaborates upon the design of the case studies and the process to investigate each case. The chapter concludes with an overview of the criteria used to select the cases, supplemented with the selected projects.

3.1 Basic design: holistic and multiple case

As was mentioned in chapter 2 this research aims to investigate the phenomena of organizational interfaces and how they affect the project success. A case study approach is best suited to answer this explanatory question as its purpose is to expose how or why something has happened (Yin, 2009). In order to better understand this phenomenon, the focus must be, within each selected case, on the relationships between a number of variables and how they change over time (Swanborn, 2010). This process of changing variables has ultimately led to either project success or failure. Due to the exploratory nature of the research question, the project is best assessed holistically. The complexity of infrastructure projects (as discussed in section 1.3) substantiate the exploratory nature of the research question, and therefore the case study approach.

Yin (2009) has provided us with four basic types of design for a case study. These types are shown in figure 3.1. This research is holistic and has a single unit of analysis: the organizational interfaces. Furthermore multiple cases are investigated to enable a cross-case analysis, improving the accuracy of the study’s findings. The chosen design is highlighted with a red box in figure 3.1.
Figure 3.1: Basic types of design for case studies (Yin, 2009), with a red box around the chosen design.
3.2 Case study process

Due to the exploratory nature of the case study, the chosen method for qualitative data acquisition is a semi-structured interview. This method is used to understand how certain things work or behave (Easterby-Smith et al., 2002). It does not limit the respondents to a set of pre-determined answers. Furthermore, it allows for the exploration of important themes or issues. The interview protocol used is described here.

1. Interviewee selection: When Heijmans takes on a project, an internal project team is formed. This group of people is often referred to as the 'core-team' or 'management-team'. Within this team, there is a number of set roles that are required. These roles are: project manager, process manager, design manager, execution manager, environment manager, manager civil works execution, manager road execution. The goal is to interview each role on each project. The process starts by contacting each interviewee and briefly introducing them to the research. At the end of this introduction, they were asked if they would like to participate by means of a one-hour interview. Upon approval, a meeting was scheduled.

2. Interview protocol: The interview consisted of three parts. The first part is the introduction of the research, the explanation why they are relevant for this interview and what type of questions they can expect from this interview. The second part is the actual interview itself. The interview always opens up with the question: "What has been your role on the project and how did you experience this?" During the interview, the interviewee is invited to do most of the talking. The researcher is merely there to extract information. This is best achieved by asking the why question. Interviewees were also frequently asked if they could think of examples to illustrate their experiences. During this part of the interview, the researcher makes sure different units of analysis are being discussed. The last part is the wrap up of the interview. The interviewee is told what will happen with the information he/she provided and is asked about relevant colleagues who could contribute to the completeness of the research. This information can be used by the researcher to initiate more interviews.

3. Validation protocol: Each interview was recorded in the light of data validation (after the approval of the interviewee). Each recording has been manually processed by the researcher. This is done by typing out what has been said, resulting in a transcript of each interview. When this is completed, the file has been sent to the interviewee for validation. When the interviewee approves the content, the interview process is finished and the data can be used as input for the research.

3.3 Units of analysis

In order to provide a holistic view of each case, certain units of analysis are addressed during the interview. As was mentioned in chapter 2, this research focuses on the organizational interfaces: the relations between different parties involved in the project. The first three units reflect upon the three main relations found in each infrastructure project: internal relations, the client relation and the relations with the subcontractors. The fourth unit does not assess a relation, but it does assess the interface between project phases, for example between design and execution. The fifth unit,
project team atmosphere, is no strict interface but it has its place in the research. The atmosphere within the project team could affect the nature of, for example the client relation, and thus affect this organizational interface. These units of analysis will help to understand how the organizational interfaces on road infrastructure projects affect the project success. The units are:

- **Internal relations**: The first unit that is assessed are the internal relations within Heijmans. This concerns not only the relations between the members of the project team. But also the relations between the project team and other departments such as procurement, design engineers or the board of directors. Higher integration among these parties is desirable and has shown to increase the performance of construction projects ([Baiden and Price] 2011). On the contrary, a fragmented approach reduces the overall project success ([Egan] 2002).

- **Client relation**: Another unit that will be addressed is the client-contractor relationship. Studies have shown that a partnering relationship based on trust, commitment and good communication can bring significant benefits ([Black et al.] 2000) ([Bresnen and Marshall] 2000), whilst a conflict filled relationship negatively impacts the cost performance of construction projects ([Chen et al.] 2014). Did both parties understand each other and was it a cooperating relationship? Or was the relationship filled with discussions and conflict?

- **Subcontractor relations**: The contractor-subcontractor relationship is also elaborated upon. Subcontractors can be responsible for up to 90% of the total value of a construction project ([Hinze and Tracey] 1994) making them vital for any general contractor like Heijmans. Building a trustworthy relationship between general contractors and subcontractors remains difficult due to payment issues, low health and safety standards and/or low quality of craftsmanship ([Arditi and Chotibhongs] 2005). This could contribute to a distrustful, cost driven relation which can be harmful for the project ([Dainty et al.] 2001a) ([Greenwood] 2001). A relationship based on trust and mutual interests lessens conflicts ([Zhang et al.] 2016b) and can even enhance the economic performance of the general contractor ([Kale and Arditi] 2001).

- **Project phases**: The fourth unit is related to the transition between project phases. A construction project starts with the tender phase and runs through the design phase, the execution phase up to the delivery to the client (and possibly a maintenance aspect). These phases are staffed with a variety of people each having their own expertise mostly based on tacit knowledge ([Senaratne and Sexton] 2009). However transferring this knowledge between the different phases of a project is shown to be ([Kamara et al.] 2002).

- **Project team atmosphere**: The fifth unit assesses the overall atmosphere of the internal project team. There are many benefits to a good team atmosphere which reflect upon every unit of analysis mentioned earlier. Well integrated teams work towards mutually beneficial outcomes for both client and contractor ([Baiden et al.] 2006), stimulate equality and respect among team members ([Dainty et al.] 2001b), and a no-blame culture encourages the sharing of tacit knowledge between team members ([Zhang et al.] 2016a).
3.4 Selection of projects

The number of possible projects that were eligible for this research have been limited by the following criteria:

- Road infrastructure project
- Date of completion
- Contract size
- Multidisciplinary
- Heijmans as main contractor

The project selection process started with the portfolio of projects executed by Heijmans, as is displayed on the public website. The research is focused on road infrastructure projects, which gives the first criterion. Currently Heijmans has a total of 46 infrastructure projects listed in its portfolio, but not all are road projects. Out of 46 projects, 31 can be considered road infrastructure projects. The other 15 consist of sluices, railway lines, cycling paths and even soil research.

The second selection criterion concerns when the project took place, because the method for data acquisition is semi-structured interviews. This means people are asked for their opinions and personal experience about the project. It is important in the light of reliability of information that people remember what and when certain events happened. Because of this the start of the project must have taken place no more than 5 years ago. This criterion reduced the total number of potential projects to 23.

The third selection criterion is related to the size of the project. The contract size for a representative case must be greater than 3 million euros. This value was chosen as it represents the cut-off point for category 2 and 3 contracts by Heijmans. This reduced the total number of potential cases to 13.

The fourth criterion is to make sure the projects have a multidisciplinary nature. All 13 cases met this criterion.

The fifth selection criterion demands that Heijmans must be fully responsible for the project. The reason is that this research originated from a desire at Heijmans to increase their project success, therefore, only projects executed by Heijmans alone are representative. This means no other parties organized in an SPC or similar constructions. This reduced the number of potential projects to 7.

On the list of 7 remaining projects Heijmans found three projects that were not favoured to be exposed to investigation. These projects are ongoing and performing very poorly. It was thought that an investigation could possibly harm the project even further. Because of this Heijmans did not approve of these projects taking part in the research. This resulted in a total of four projects eligible for a case study, shown in figure 3.2.
The four cases cover a broad range of variations with respect to client type, contract type, technical complexity and project location:

- These four projects are executed for three different clients. In two projects the Department of Waterways and Public Works (Rijkswaterstaat) is the client. One project was commissioned by the province of Zuid-Holland, another by the municipality of Leiden. They are all governmental institutions but differ in size and working area.

- The projects had two different contract types. Three were contracted through a traditional Design and Construct contract. One has a maintenance aspect which is embedded in a DBFM contract.

- The technical complexity between the projects differs greatly. The project with the lowest technical complexity consists of expanding a section of road from two lanes to three lanes. Whilst the project with the highest technical complexity has multiple new civil structures combined with a movable bascule bridge.

- The last variation is related to the project location. Projects were located in both rural and urban areas. Also soil conditions varied greatly from sturdy sand to wet peat with high groundwater levels.
Chapter 4

Case studies

This chapter describes the results and analysis of the four case studies. First a description concerning all roles within a project team is given. This is followed by a section which describes the data that was gathered and the method used for analysis. Each case study starts with an introduction to the case, furthermore a brief description of the most influential events. Every case study is concluded with the results of the interviews.

4.1 Project roles

This research is executed from the perspective of the project team. The project team consists of members on key positions with their own responsibilities. These members together are considered the management team. There is a general structure of this team composition but is important to mention that these are not set in stone. Some roles can be excluded depending on the project. On the other hand some roles that are mandatory can remain unfulfilled due to a lack of competent personnel. Figure 4.1 illustrates the theoretical organization chart of a project team at Heijmans, according to their company standards.

- **Project manager**: The project manager has the highest authority in the project team and is
heading a project team. The project manager is responsible for the end result of the project. He/she has a direct link to the board of directors and must keep them updated on the status of planning and budget regarding the project. Next to this the project manager is the first contact point for the client. Discussions with the client regarding scope changes, scheduling changes or risks are first addressed with the project manager.

- **Tender manager**: Officially the tender manager is not part of the project team. However, as tender managers often stay on the project to become project managers, it is included in this description. The tender manager stands at the head of the tender team. He/she is responsible for the entire tender process which results in a bid towards the client. In this process the tender team translates the clients demands to a conceptual design.

- **Design manager**: The design manager is responsible for the design of the project as a whole. When the project is awarded, the level of detail of the conceptual design, made in the tender phase, is increased in various steps. First the preliminary design, then the final design, and finally the implementation design. The design manager leads calculators, engineers and technical draftsmen throughout the design phases.

- **Environment manager**: The environment manager handles all contacts with the other stakeholders surrounding the project. It’s the responsibility of the environment manager to built on the relations and the support of these stakeholders. He/she provides information regarding the project to keep them informed and up to date. But also feeds any concerns or issues these stakeholders might have regarding their interests back to the project team.

- **Process manager**: The process manager is responsible for all supporting processes around the project. These processes include contract management, risk management, systems engineering with ISO certification, validation and verification of requirements, document management systems, etc. Due to the amount of tasks, larger projects often have more than one process manager. Project managers also have a small team surrounding them taking on some of these responsibilities.

- **Execution manager**: The execution manager handles the work preparation and construction of the project. He/she is responsible for the planning, site-personnel, and communication with subcontractors and suppliers. First the execution manager assists with engineering, technical drawings and the feasibility of the design.

- **Discipline leaders**: Heijmans Infrastructure has three main disciplines: road, civil and cables. Each are headed by its own discipline leader which are responsible for a part of the design. This starts in the design phase as they give input on the feasibility of the design. As the project progresses through the preparation phase and the execution phase, the discipline leaders are responsible for the management of on-site workers, subcontractors and suppliers.

For the completeness of the research the goal was to interview all project roles present at each case. However this was not achieved due to various reasons. On smaller projects one person would take on multiple roles, environment manager and process manager for example. On larger projects however, one role could not be fulfilled by one person alone, resulting in multiple people responsible for one role. This is most seen within the role of process manager. Contract and risk management often require a different skill set with respect to systems engineering and document management systems. Another reason why people could not be interviewed is because they were no longer available. This was mostly because someone was no longer working for Heijmans, but also due to maternity leave.
4.2 Data acquisition

The resulting data consists of a set of 22 transcripts from the interviews. Table 4.1 shows which roles have been interviewed for each case. This table holds a total of 23 roles. This difference in due to the environment manager for A1 A&B and A12 parallel. This role has been fulfilled by the same person, meaning one interview for both projects was sufficient. This is indicated by the black dots. Furthermore there are four people interviewed who are not part of the management team. These are two project engineers, which predominately worked on the design of the project. There is one project coordinator, this role can be seen as the link between design and execution. Finally there is the Project Management Plan (PMP) advisor. This role assists in drafting the PMP. This person operates closely with the project and process manager, but is officially not part of the management team.

<table>
<thead>
<tr>
<th>Project role</th>
<th>OBSP</th>
<th>A12 VEG</th>
<th>A1 A&amp;B</th>
<th>A12 Parallel</th>
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<tbody>
<tr>
<td>Project manager</td>
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<td>Disc. leader cables</td>
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<td>Project coordinator</td>
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<tr>
<td>Advisor PMP</td>
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<td>Project engineer</td>
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*Table 4.1: Overview of all roles interviewed per project*

4.3 Data analysis

The analysis process starts by reading each transcript for a first time. The amount of information is overwhelming at the beginning. This first read is to get familiar with the case, its stakeholders and the general feel of the project. Next follows the second reading. This time multiple colored markers are used to highlight important events, decisions or phrases related to the themes mentioned in chapter 3. For each theme a different colour was used, resulting in a colorful collection of pages. The next step is to read the transcripts again but this time focusing on a certain color. The aim is to compare each section and to find overarching factors for each colored section. The challenge is to search for a definition that is wide enough to encompass large sections of text, but narrow enough to be clearly distinguished from other factors. These factors are not predetermined and are different for each case. When the factors are known, the next step of the analysis is to check which transcripts hold sections of text to which a certain factor can be applied. This is an iterative process and consists of reading sections of text, comparing them to each other, applying the factor, possibly changing a factor, reading the transcript again. Eventually this process results in a list of factors and to which transcript it can be referred. In other words, how many interviewees agree on a certain factor.
4.4 Case: OBSP

The first case that will be assessed is the 'Ontsluiting Bio Science Park' or OBSP in short. The project OBSP was put on the market by the municipality of Leiden in the fall of 2013. The city of Leiden is located between two highways, the A4 and A44. These are connected through the N203, a major traffic artery that lies south-east of Leiden. The main entrance to the Bio Science park, located east of Leiden, crossed with the N203. This was causing longer and more frequent traffic jams. The project aimed to separate these two streams thus improving the overall flow of traffic (Gemeente Leiden, 2014a).

After a 9 month tender period the project was awarded to Heijmans in the summer of 2014. Heijmans has won the tender predominantly on the MEAT-criteria. These mainly included the aesthetic quality and the synergy with the landscape. This was achieved by the involvement of an architect for the civil structures, and a landscape architect for the connection with the environment. The design consisted of a newly built underpass, the widening and relocating of current roads, and the (re)construction of two cyclist tunnels. This was embedded in a 25 million euro Design & Construct contract. The construction began in the fall of 2015 and the project was completed in December 2016. Whilst the target planning was met, the project resulted in a major loss for Heijmans.

4.4.1 Results

For this case a total of 7 people were interviewed. Their roles are shown in table 4.2. This table also shows during which phase of the project these people were fulfilling this role. The results of the interviews are given in figure 4.3. The results will be described according to the five themes mentioned in chapter 3.

Figure 4.2: Artist impression of the OBSP project (Gemeente Leiden, 2014b)
1. **Internal relations:** The factor acknowledged by everyone is the disciplines operating as islands. Integration among the disciplines was experienced as poor. This is strengthened by the fact that the design team was not based on the project location, which is mentioned by two respondents. Some designers have never visited the construction site. Furthermore each discipline was responsible for its own budget. This led to individual behaviour and losing track of what is best for the project as a whole. Another major factor mentioned by everyone is the insufficient verification and validation of requirements. This problem arose in the tender phase and recurred throughout the whole project. Requirements were insufficiently managed and, because of the low cohesion between disciplines, were transferred between the disciplines many times. Lastly, mentioned by three respondents is the nuisance of people working on other projects alongside OBSP.

2. **Client relation:** Mentioned by all respondents is the difficult communication with the client. This is strengthened by the presence of an external contract management party between the client and Heijmans. This resulted in major issues and discussions about the project requirements stated in the contract. This eventually led to over 200 change orders, a factor also noted by six respondents. These factors combined caused the relation between client and contractor to be based upon conflict and distrust.

3. **Subcontractor relations:** With respect to subcontractors four respondents mention the conflict with Movares concerning a part of the design. Many other subcontractors were involved. A traffic agency, an architect and a landscape architect for example. However only two respondents feel this number of subcontractors negatively influenced the project.

4. **Project phases:** Acknowledged by everyone as a clear negative factor is the fact that no one from the tender team continued on the project after it was awarded. Loss of information is the main consequence and mentioned by everyone. Furthermore calculation mistakes and insufficient risk management in the tender are perceived to be factors that negatively influenced the project success. This was mentioned by a majority of the respondents. Another factor is the late involvement of the execution organization. There is a demand for input from the execution organization in the design of the project. Late involvement from the execution organization results in design errors influencing the feasibility of the project. It is perceived this can be avoided by early involvement of the execution organization.

5. **Project team atmosphere:** Despite the stress put on the project due to the factors mentioned earlier, the overall team atmosphere remained good. Some respondents mentioned a common enemy (client) unites. Only one respondent felt tension arose among the members of the project team.
Figure 4.3: Results from the OBSP interviews

<table>
<thead>
<tr>
<th>Negative</th>
<th>Influence on the project success</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team atmosphere remained good</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Tension among project team members</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unclear division of scope and responsibilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Too many stakeholders with their own interests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design team not based on project location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial situation of Heijmans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>People also working for other projects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conflict with subcontractor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complexity surrounding the construction site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract managing party between client and contractor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insufficient risk management in the tender phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Many change orders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late involvement from execution organization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tight planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplines as operative islands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conflict relation between the client and contractor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information lost in the transfer between project phases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insufficient verification/validation of requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficult communication with client</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculation mistakes in the tender phase</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Internal relations
- Client relation
- Subcontractor relations
- Project phases
- Team atmosphere
4.5 Case: A12 VEG

The second case that will be assessed is the ‘A2 Veenendaal - Ede - Grijsoord (VEG)’. The A12 VEG project was put on the market by RWS in the spring of 2013. The A12 highway is a major artery that connects the German Ruhrgebiet with major cities in the Netherlands such as Utrecht, The Hague and Rotterdam. The project concerns a 11 kilometer section of the A12 located between the city of Ede and the intersection of the A12 with the A50 at Grijsoord. The goal of the project is to widen the road by adding one additional lane on both sides. This section largely cuts through the nature reserve of the lower Veluwe. Because of this, taking account of quality of nature is a major focus area. This is embedded in the project by the construction of various wildlife crossings and an eco-friendly bank.

In August 2014 the project was awarded to Heijmans. It concerned a Design, Build, Finance & Maintain (DBFM) contract with a total value of 80 million euros. Characteristic for a DBFM contract is the formation of a Special Purpose Company (SPC) who will sign the contract with the client. The SPC consisted solely of Heijmans Capital, in which Heijmans BV owns 20% of the shares. The other 80% are owned by 3i group, which is an investment company. The SPC forwards the contract to the Engineering, Procurement & Construction Management (EPCM) company, which was Heijmans Infra. The SPC is responsible for the contract management and the EPCM is responsible for the design, construction and maintenance of the project. The involvement of 3i group in the contract appears to conflict with the selection criteria in chapter stating Heijmans must be fully responsible for the project. Officially the client signed the contract with the SPC, but in practice the EPCM was responsible for all communication with the client regarding the project. Because of this, the selection criteria still holds, making the project eligible for the research.
Construction of the project started in February 2015 and was scheduled to take 22 months. LEAN principles were successfully deployed on the planning which shortened the total execution time to 16 months. The project was delivered in the fall of 2016 with a positive result for Heijmans. Heijmans remains responsible for the maintenance of the project till 2032.

4.5.1 Results

For this case a total of 6 people were interviewed. Their roles are shown in table 4.3. This table also shows during which phase of the project these people were fulfilling this role. The results of the interviews are given in figure 4.5. The results will be described according to the five themes mentioned in chapter 3.

<table>
<thead>
<tr>
<th>Project role</th>
<th>Tender</th>
<th>Design</th>
<th>Preparation</th>
<th>Execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project manager</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design manager</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process manager</td>
<td></td>
<td>•</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment manager</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Execution manager</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project engineer</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3: Presence of project roles throughout the project phases - A12 VEG

1. **Internal relations:** There has been one success factor all respondents agree upon. This has been the statement *stick to the plan*. This guiding principle resulted in little scope changes and allowed the design to be finished before the start of the execution. Another important factor was the stimulation of an integral approach and cooperation. This has been strengthened by having the project team, including the design engineers, work on the project location. A factor that requires attention is the need for explicit agreements, which is mentioned by five respondents. This is related to another factor which is the underestimation of systems engineering on the project. Many systems were new on this project and therefore not fully operational in the design phase. Because of this agreements regarding requirements for example were not yet explicit.

2. **Client relation:** One defining factor for the success of this project is the open relation with the client. This relation was experienced pleasantly as the client was very cooperative, and showed respect for the commercial interests of Heijmans. Furthermore all respondents mention the focus on project output by the client. This allowed for a certain degree of design freedom for Heijmans. The client also had good communication with local stakeholders and interest groups so Heijmans knew their needs and what to expect.

3. **Subcontractor relations:** The project did not have many subcontractors so there is little focus on these relationships. However the few subcontractors with a possible influence on the design were contracted as early as possible. This is mentioned by three respondents as possible success factor.

4. **Project phases:** With respect to project phases everyone agrees on the fact that the execution organization needs to be involved earlier. There is a great demand for input in the design, but the design engineers are unable to get to this information when the execution organization is
not yet involved. A major success factor is the amount of people which continued on the project after the tender phase. The reason for this being the retention of information and knowledge.

5. **Project team atmosphere:** All respondents agreed on the good team atmosphere. They attribute this to a young project team with highly motivated and dedicated people. The team matured quickly and people were willing to work for each other as everyone had the same end result in mind. Project success and important milestones are celebrated with the whole team.

<table>
<thead>
<tr>
<th>Negative</th>
<th>Influence on the project success</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Stick to the plan&quot;</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Open relation with client</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Highly motivated and dedicated project team</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Client primarily interested in project output</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Many people continued the project after the tender phase</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Stimulating integral approach and cooperation</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Project team on one location</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Design frozen before construction</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Comprehensive structure of meetings</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Low technical project complexity</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Lean planning applied</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Early involvement from crucial subcontractors</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Little change in project team members</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Client had intensive contact with local stakeholders</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Difference in work attitude from Heijmans’ specialists</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Involvement of asset management failed</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Need for explicit agreements</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Systems engineering underestimated</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Late involvement from execution organization</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

*Figure 4.5: Results from the A12 VEG interviews*
4.6 Case: A1 Apeldoorn & Beekbergen

The third case that will be assessed is the 'A1 Apeldoorn & Beekbergen' case. The project A1 Apeldoorn & Beekbergen was put on the market by RWS in the fall of 2015. The project is part of a series of projects aimed towards the improvement of traffic flow between Apeldoorn and the German border. This section of the A1 was facing increased delays caused by freight traffic. Widening of the current track and improving the intersection with the A50 is important for the availability and economic development of this region.

The project was awarded to Heijmans in the spring of 2016 according to the Best Value Procurement (BVP) tender process. BVP revolves around acquiring the highest possible value for the client. In a BVP tender the client formulates the requirements for the project, but the contractor defines how these requirements will be met. This results in a conceptual solution on which a preliminary award is granted. Then follows a clarification phase in which both client and contractor clearly formulate their interpretation of the requirements. This phase also aims to manage expectations and to minimize risk. Only when both parties agree on the proposed solution a final award is granted.

The solution Heijmans proposed consists of the widening of the A1 and the A50. Furthermore the intersection of the A1 and the A50 is reconstructed. This is done by building a new bridge over the A50 and strengthening the existing bridge by adding extra columns underneath. This resulted in a Design & Construct contract for 20 million euros. The construction began in the fall of 2016 and the project is expected to be delivered at the end of 2017. The project is currently on schedule and within budget.

4.6.1 Results

For this case a total of 4 people were interviewed. This is less in comparison with the other three cases, because many roles on the project did not account for a full-time function. In order to keep the core team small, some roles have been taken on by the same person, allowing him/her to be fully present on the project. Table 4.4 shows the people that have been interviewed. The results of the interviews are given in figure 4.7. The results will be described according to the five themes mentioned in chapter 3.
1. **Internal relations:** There is great agreement among the respondents with respect to the internal relations. Everyone positively felt the result of a small and compact team. This was achieved by combining project roles so people would work full-time on the project. Because of this responsibilities were clear and knowledge was easy to access. Keeping the team small resulted in a highly motivated and dedicated team, a factor that is acknowledged by all respondents. Another factor that contributed positively to the internal relations is having the project team working on one location. A negative factor that was mentioned by one respondent is the lack of awareness concerning project feasibility by the design engineers. Design engineers often are not fully aware of the actual situation on the project location. This results in a design that is not feasible as the location does not allow certain design decisions.

2. **Client relation:** All respondents also agree on the good relation with the client. In the early stages of the project the team has put in lots of effort to build a strong relation with the client. This was achieved by a good clarification phase in the tender, where project requirements and expectations were made clear for everyone. The result is a relationship based on mutual trust, which is a success factor according to all respondents. This is strengthened by the client allowing Heijmans to take initiative. The client lets Heijmans be the construction expert and is not tempted to continuously interfere and frustrate the work process.

3. **Subcontractor relations:** Crucial subcontractors have been involved early and were invited to participate in the design phase. They were asked to provide input regarding the design from their area of expertise. All respondents acknowledge the positive impact on project success derived from subcontractor involvement.

4. **Project phases:** The results regarding the project phases are somewhat diverse. Two respondents experienced the early involvement from the execution organization as a success factor. The early involvement was driven by the project coordinator role, which is a key role that links the design and execution phases. Furthermore whilst many people continued the project after the tender phase, only two respondents acknowledged this as a success factor.

5. **Project team atmosphere:** The team atmosphere was experienced pleasant by all respondents. People were able to oversee the project due to the low technical complexity. This resulted in a feeling of responsibility for the end result. Furthermore the full-time presence of project team members is seen as a positive contribution to the overall project atmosphere.

### Table 4.4: Presence of project roles throughout the project phases - A1 Apeldoorn & Beekbergen

<table>
<thead>
<tr>
<th>Project role</th>
<th>Tender</th>
<th>Design</th>
<th>Preparation</th>
<th>Execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project manager / Disc. leader roads</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Process manager / Contract manager</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Project coordinator / Disc. leader civil</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Environment manager / Execution manager</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

29
<table>
<thead>
<tr>
<th>Negative</th>
<th>Influence on the project success</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relation with client based on mutual trust</td>
<td>![Yellow Bar] 4</td>
<td></td>
</tr>
<tr>
<td>Small en compact project team</td>
<td>![Blue Bar] 4</td>
<td></td>
</tr>
<tr>
<td>Combination of project roles</td>
<td>![Blue Bar] 4</td>
<td></td>
</tr>
<tr>
<td>Focus on a good relation with the client</td>
<td>![Yellow Bar] 4</td>
<td></td>
</tr>
<tr>
<td>Highly motivated and dedicated project team</td>
<td>![Green Bar] 4</td>
<td></td>
</tr>
<tr>
<td>Good clarification phase with client</td>
<td>![Yellow Bar] 4</td>
<td></td>
</tr>
<tr>
<td>Early involvement from crucial subcontractors</td>
<td>![Purple Bar] 4</td>
<td></td>
</tr>
<tr>
<td>Low technical project complexity</td>
<td>![Blue Bar] 3</td>
<td></td>
</tr>
<tr>
<td>Project team working on one location</td>
<td>![Blue Bar] 3</td>
<td></td>
</tr>
<tr>
<td>Early involvement from execution organization</td>
<td>![Red Bar] 2</td>
<td></td>
</tr>
<tr>
<td>Project role that links design and execution</td>
<td>![Red Bar] 2</td>
<td></td>
</tr>
<tr>
<td>Comprehensive structure of meetings</td>
<td>![Red Bar] 2</td>
<td></td>
</tr>
<tr>
<td>Many people continued the project after the tender phase</td>
<td>![Red Bar] 2</td>
<td></td>
</tr>
<tr>
<td>Pleasant cooperation between disciplines</td>
<td>![Red Bar] 2</td>
<td></td>
</tr>
<tr>
<td>Client allowed Hoijmans to take initiative</td>
<td>![Yellow Bar] 1</td>
<td></td>
</tr>
<tr>
<td>1 Rapid verification/validation of requirements</td>
<td>![Red Bar]</td>
<td></td>
</tr>
<tr>
<td>1 Design engineers lack awareness of project feasibility</td>
<td>![Blue Bar]</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 4.7: Results from the A1 Apeldoorn & Beekbergen interviews*
4.7 Case: A12 Parallelstructuur

The fourth case that will be assessed is the 'A12 Parallelstructuur'. The project 'A12 Parallelstructuur' was put on the market by the Province of South-Holland in the summer of 2013. North of Gouda lies the A12 highway. This highway is the main artery for traffic coming from the east of the nation heading towards Rotterdam or The Hague. West of Gouda the A12 intersects with the A20. This intersection is prone to traffic jams during rush hours. This is caused by the current design of the A12. Traffic coming from Gouda heading to either The Hague or Rotterdam are currently entering a funnel. The project aims to provide an alternative for traffic heading to The Hague. Besides separating the two main flows of traffic, the project also provides for a better accessibility of surrounding municipalities by lessening cut-through traffic.

![Figure 4.8: Overview of the A12 Parallelstructuur project](Provincie Zuid-Holland, 2014)

The project was characterized by it’s technical complexity. Included in the project is the construction of an opening bridge over the river Gouwe. Currently the A12 passes underneath the river with an aquaduct. Building the bridge in close proximity could harm the structural integrity of the aquaduct. Another difficulty is the presence of a railway line which also required a newly built bridge. Furthermore a new road, the N457, had to be constructed to connect the A20 with the A12. Finally the soil conditions were very poor due to the presence of peat.

The project was awarded to Heijmans in February 2014 according to a 65 million euro Design & Construct contract. Construction started in July 2014 and was expected to take 2 years in total. Heijmans was facing difficulties getting the final design approved. Because of this Heijmans decided to start the construction without the approval of the final design by the Province of South-Holland. These issues between client and contractor remained present and eventually the construction was stopped all together. The project was completed in December 2016, 6 months behind the target schedule. The final design has been accepted by the client in the spring of 2017. This project resulted in a loss for Heijmans of approximately 9 million euros.
4.7.1 Results

For this case a total of 6 people were interviewed. Their roles are shown in table 4.5. This table also shows during which phase of the project these people were fulfilling this role. The results of the interviews are given in figure 4.9. The results will be described according to the five themes mentioned in chapter 3.

<table>
<thead>
<tr>
<th>Project role</th>
<th>Tender</th>
<th>Design</th>
<th>Preparation</th>
<th>Execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project manager</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Design manager</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Process manager</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Environment manager</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Disc. leader civil</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Advisor PMP</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Table 4.5: Presence of project roles throughout the project phases - A12 Parallelstructuur

1. **Internal relations:** The main factor that negatively influenced the project are the disciplines operating as islands. This is acknowledged by all respondents. Each discipline was responsible for its own budget, this led to individualistic behaviour and unwillingness to cooperate. The poor teamwork as a result fueled the tension among project team members. Another factor which negatively affected the internal relations is the opportunistic behaviour by Heijmans, driven by the financial situation of Heijmans at the time. The budget was extremely tight which challenged all disciplines to lower their costs. Because of this the integrated project approach was lost.

2. **Client relation:** The relation with the client was very poor. Many factors are responsible for this and are agreed upon by all respondents. First of all the presence of a contract managing party between Heijmans and the client caused major issues. The client had outsourced all contract management to Arcadis which made direct communication with the client impossible. Next to this Arcadis was extremely thorough with the validation of project requirements. This resulted in a relationship based on conflict with the client and also Arcadis.

3. **Subcontractor relations:** The project knew two major subcontractors. Movares who was responsible for the design of the movable bridge, and Hillebrand who was contracted for the major civil structures. Heijmans has made both subcontractors responsible for the verification of certain requirements. However this verification was insufficient according to four respondents.

4. **Project phases:** As the conflict relation with the client was so defining for this project, the respondents did not reveal much about the transfer between project phases. Three respondents mentioned that many people continued the project after the tender, however these people were soon replaced. This led to a loss of information. The project team member responsible for the project planning was also replaced by the project manager. The reason being not functioning as required. Furthermore the execution organization was not involved on time. Two respondents view this as a negative factor.

5. **Project team atmosphere:** The project was plagued with discussions and issues, both internally between the disciplines, as well as externally with the client and Arcadis. This has a major
influence on the project team atmosphere. All respondents agree this led to frustration and incomprehension among the project team. Many developed an aversion to go to work. Some even were forced to leave the project because of stress related illnesses like a burn out. There have been attempts to improve the cooperation but these have failed to achieve their goal.

<table>
<thead>
<tr>
<th>Negative</th>
<th>Influence on the project success</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Calculation mistakes in the tender</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>High technical project complexity</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Late involvement of execution organization</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Client not willing to pay for project value</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Aversion to go to work</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>MEAT criteria seen as legally binding by the client</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Information lost in the transfer between project phases</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Many changes in the project team personnel</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Insufficient verification of requirements by subcontractors</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Insufficient budget for the project</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Financial situation of Heymans</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Conflict with client regarding risk ownership</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Opportunistic behaviour by Heymans</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Conflict relation between the client and contractor</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Frustration and incomprehension among the project team</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Tension among project team members</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Disciplines as operative islands</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Extremely thorough validation of requirements by contract managing party</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>No communication possible with the client</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Contrast managing party between client and contractor</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.9: Results from the A12 Parallelstructuur interviews
Chapter 5

Cross case analysis

This chapter provides a comparison between the cases. This analysis is executed according to the themes that were mentioned in chapter 3. After the analysis the most influential organizational interface will be isolated. This is done by translating the results of the interviews into numerical values, representing the degree to which the interviewees agree with each other.

5.1 Internal relations

Regarding the internal relations the following stands out. The two loss-making projects, A12 Parallelstructuur and OBSP, both took place when each discipline had its own director and budget. Little cohesion between the disciplines led to operative islands. People were mostly concerned with their own interests, losing sight of the project as a whole. In 2015 this structure expired. The three main disciplines (roads, civil and cables) were united under one director and one budget. This change in perspective is clearly visible when looking at the other two projects. Integral cooperation was stimulated and the project team was kept small by combining roles. Furthermore the project team, including the design engineers, were stationed on the project location. This improved the flow of information which increased the overall knowledge concerning the project. The small project team also caused the team to mature quickly. Agreements were clear, people were dedicated to the project and milestones were achieved.

A problem is the late involvement of the execution organization. Design engineers require information from the execution organization regarding the feasibility of the project but are not able to access this. Heijmans understands the need for early involvement but in practise this remains difficult. This is related to insufficient resources and capacity regarding staff. The execution organization is still concerned with other projects when they are asked to provide input for the design engineers.

5.2 Client relation

The cases show a clear difference between the projects where RWS is client, and the projects where local governmental bodies operated as client. RWS is acquainted with DBFM and D&C contracts and knows how to manage these themselves. RWS is decisive as they have knowledge about the current state of the market. They allow Heijmans to take the initiative and be the expert. Heijmans contributes to the relation by honoring agreements and signaling possible problems in advance. Both parties are
aware of each others interests and respectful of these. This results in an open relation based on mutual trust, which is a factor for success.

Opposite to a open relationship stands a conflict relation with the client. Local governments, municipalities and provinces, have little knowledge of DBFM and D&C contracts. Because of this they involve an external contract management consultant. This party writes the contract and feels they need to defend it with force. Heijmans expected a certain level of design freedom, as is custom with these contracts. However the client was unable to give this freedom by requesting a contract management party to strictly enforce the contract. This results in discussions concerning project requirements and risks. In between these conflicts the clock keeps on ticking so the pressure for Heijmans to meet the deadline increased.

However, a certain caution towards these results must be exercised. Heijmans has taken high risks in the year 2014. The decision to take high risks was fueled by opportunism and hunger for work. Opportunities were already calculated in the tender and project risks were underestimated. Heijmans has deliberately chosen for this strategy but it failed when confronted with lower governmental clients.

5.3 Subcontractor relations

Heijmans distinguishes its subcontractors in two categories: major and minor subcontractors. Major subcontractors have an important role in the project and are made responsible for some of the project requirements. For example Movares who took on the design of the movable bridge at the A12 parallelstructuur case. On all cases Heijmans tried to involve the major subcontractors early as their input affects the design of the project. This was achieved only partially. Heijmans fails to define what is expected from these subcontractors with respect to the verification of requirements.

Minor subcontractors are not responsible for the design but only for the execution of the work. These subcontractors are approached in the preparation phase by the procurement department. They have little influence on the project success.

5.4 Project phases

There is a clear distinction visible regarding this theme. The two profitable projects, A12 VEG and A1 A&B, are characterized by a small project team who started in the tender and continued the project after it was awarded. Because the majority of the project team continued the project, knowledge and information is secured throughout each phase. However people leaving the project results in loss of information as agreements are currently inexplicit. Heijmans recognized the need for explicit agreements to counter the loss of information should team members leave a project.

At the OBSP case no one from the tender team continued the project. This has been a major factor which negatively affected the project success. The transfer of information from the tender team to the design team was very poor, leading to extreme loss of information. Furthermore the relationship with the client had to be rebuilt but unfortunately this failed.
5.5 Project team atmosphere

The team atmosphere has a great influence on the project success. Having the project team together on one location stimulates cooperation and integration. Another factor which contributes to cooperation is full time presence by team members. This results in a highly motivated and dedicated project team which matures quickly. Successes and milestones are celebrated which improves the team atmosphere even further. This was seen on the two profitable projects. On the lesser performing projects the team atmosphere varied. The A12 Parallelstructuur case was plagued with internal conflict which negatively influenced the team atmosphere. This was strengthened by the disciplines acting as operational islands which lowered the willingness to cooperate. On the OBSP case the team atmosphere was less afflicted by internal conflicts. However the tight scheduling of the project caused some forms of stress which negatively impacted the team atmosphere.

5.6 Most influential organizational interface

This section isolates the most influential organizational interface as was mentioned in chapter 2. In order to find this interface a quantitative analysis approach is applied to the data. One of the beneficial aspects of using a quantitative approach is that is provides the means to filter out a large number of confounding variables that could obscure the main qualitative findings (Abeyasekara, 2005). The manipulation of qualitative data through quantification helps achieve greater insight into the meaning of the data (Atieno, 2009). In order to compare the data sets the following equation is used:

\[ I_i = \sum_{4} A_i, \quad 0 < I_i \leq 1 \]

This equation defines the most influential organizational interface \( I_i \). It does so by the summation of the weighted average for each interface \( A_i \), divided by the number of cases, which is four. The weighted average for each interface is defined by the following equation:

\[ A_i = \sum_{n} \left| \frac{P_x}{F} \right|, \quad 0 < A_i \leq 1 \]

This equation shows the summation of the amount of people that acknowledge a specific success or failure factor \( P_x \), divided over the number of people interviewed for the case \( n \). This summation is divided over the total number of factors \( F \). It is important to note that the research aims to isolate the most influential organizational interface. This means there is no value judgment attached, therefore the term \( \frac{P_x}{n} \) is absolute. If this was not the case, success and failure factors would cancel out each other and distorting the results. A brief example is given for clarification.

In this example four people were interviewed. Let us take two factors, one success and one failure, with respect to the internal relations (IR) interface. ‘A small and compact project team’ is a success factor which is acknowledged by everyone \( \left( \frac{P_x}{n} = 1 \right) \). The failure factor, ‘design engineers lack awareness of project feasibility’ is acknowledged by just one interviewee \( \left( \frac{P_x}{n} = -0.25 \right) \). This gives a weighted average of 0.63 for this interface \( \left( \frac{1+|-0.25|}{2} \right) \). Ignoring the absoluteness of the \( \frac{P_x}{n} \) term would result in a weighted average of 0.38 \( \left( \frac{1+0.25}{2} \right) \). This is significantly lower and not a good estimate for the influence of this interface.
5.6.1 Results

The equations stated in section 5.6 together define the degree of influence of each organizational interface. Table 5.1 shows the results of each interface per case, followed by the resulting value measuring influence. By definition this resulting value lies between 0 and 1. With 0 being not influential and 1 being extremely influential. A value of 0 is impossible however as this would require none of the interviewees to mention a specific factor of influence, meaning the interface was ignored. A value of 1 is possible. This means every interviewee has acknowledged all factors mentioned to be of influence. Whilst this is highly unlikely some of the results do show a value of 1. This is because there was mentioned only one factor which assesses the corresponding interface. When everyone acknowledges this, the resulting weighted average equals 1. The organizational interfaces in the table have been abbreviated as follows: internal relations (IR), client relation (CR), subcontractor relations (SR), project phases (PP) and team atmosphere (TA).

<table>
<thead>
<tr>
<th>Interface</th>
<th>$\sum \frac{p_i}{n}$</th>
<th>$F$</th>
<th>$A_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBSP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR</td>
<td>3.71</td>
<td>7</td>
<td>0.53</td>
</tr>
<tr>
<td>CR</td>
<td>3.57</td>
<td>4</td>
<td>0.89</td>
</tr>
<tr>
<td>SR</td>
<td>0.86</td>
<td>2</td>
<td>0.43</td>
</tr>
<tr>
<td>PP</td>
<td>4.43</td>
<td>5</td>
<td>0.89</td>
</tr>
<tr>
<td>TA</td>
<td>0.57</td>
<td>2</td>
<td>0.29</td>
</tr>
<tr>
<td>A12 VEG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR</td>
<td>5.83</td>
<td>8</td>
<td>0.73</td>
</tr>
<tr>
<td>CR</td>
<td>2.33</td>
<td>3</td>
<td>0.78</td>
</tr>
<tr>
<td>SR</td>
<td>1.00</td>
<td>2</td>
<td>0.50</td>
</tr>
<tr>
<td>PP</td>
<td>3.33</td>
<td>5</td>
<td>0.67</td>
</tr>
<tr>
<td>TA</td>
<td>1.00</td>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td>A1 A&amp;B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR</td>
<td>4.75</td>
<td>7</td>
<td>0.68</td>
</tr>
<tr>
<td>CR</td>
<td>3.25</td>
<td>4</td>
<td>0.81</td>
</tr>
<tr>
<td>SR</td>
<td>1.00</td>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td>PP</td>
<td>1.75</td>
<td>4</td>
<td>0.44</td>
</tr>
<tr>
<td>TA</td>
<td>1.00</td>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td>A12 Parallel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR</td>
<td>3.67</td>
<td>5</td>
<td>0.73</td>
</tr>
<tr>
<td>CR</td>
<td>5.50</td>
<td>7</td>
<td>0.79</td>
</tr>
<tr>
<td>SR</td>
<td>1.00</td>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td>PP</td>
<td>1.50</td>
<td>4</td>
<td>0.38</td>
</tr>
<tr>
<td>TA</td>
<td>2.33</td>
<td>3</td>
<td>0.78</td>
</tr>
<tr>
<td>Combined score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR</td>
<td>2.67</td>
<td></td>
<td>0.67</td>
</tr>
<tr>
<td>CR</td>
<td>3.27</td>
<td></td>
<td>0.82</td>
</tr>
<tr>
<td>SR</td>
<td>2.93</td>
<td></td>
<td>0.73</td>
</tr>
<tr>
<td>PP</td>
<td>2.36</td>
<td></td>
<td>0.59</td>
</tr>
<tr>
<td>TA</td>
<td>3.06</td>
<td></td>
<td>0.77</td>
</tr>
</tbody>
</table>

Table 5.1: Results of the cross case analysis
Chapter 5. Cross case analysis

The results underpin the outcome of the qualitative analysis. It is clear that the relation with the client is the most influential organizational interface. The score of 0.82 represents a high level of influence on the performance of large road infrastructure projects. As was mentioned in section 5.6, this score is absolute, meaning the influence can be both positive or negative. The qualitative data acknowledges this as well. A good and open relationship with the client contributes to project success, whilst a relationship based on conflict and discussion hinders this.

Close to the client relation stand the scores of team atmosphere and subcontractor relations with 0.77 and 0.73 respectively. However, the value of these scores is mostly defined by a score of 1 on the weighted average on some cases. There were less factors mentioned by the respondents regarding these units of analysis compared to the other three. But the few factors that were mentioned were often acknowledged by all respondents. This indicates the importance of these units but also signals they are less susceptible for major problems.

The internal relations interface displays a score of 0.67. This is mainly attributed to the large amount of factors that were mentioned. Over all the cases combined, a total of 18 factors with respect to this interface were acknowledged by at least one interviewee. Internal relations are influential according to the data, but the sheer number of possible success and failure factors make this interface difficult to improve. Thorough assessment of this specific interface requires additional data, which is outside the scope of this research.

The last organizational interface, project phases, shows a score of 0.59. This can be explained by the fact that many issues related to this interface are partly overlapping with the factors belonging to the internal relations interface. Furthermore, this interface exposes the problem of information getting lost throughout the project phases. This problem is already known by Heijmans and measures to improve this are currently deployed, making this interface less interesting for further research.

The first research question, "How do organizational interfaces affect the success of large road infrastructure projects at Heijmans?", can now be answered. The relationship with the client is the most influential interface on project success for Heijmans. This is mainly due to a large difference between client and contractor on knowledge and experience regarding road infrastructure projects. Subcontractor relations and the team atmosphere are also influential. They were mentioned less often but there is a general consensus towards a positive contribution when managed properly. Internal relations and transition between project phases also affect the project success. This is because these interfaces reflect the level of cooperation and integration within Heijmans. Which is directly related to the quality of the organizational processes at Heijmans.
Chapter 6

Perspectives on project success

Each infrastructure project has a certain performance, but the definition of performance is different for each stakeholder (Freeman and Beale 1992). Take a bridge over a canal for example. The client might measure performance in vehicle capacity, lifespan and maintenance intervals. The contractor is likely to measure performance in profit margins. The road users can measure performance in decreased travel time whilst local residents are only interested in the aesthetic quality and the fit in the landscape. The performance of the project is subjective to each stakeholder involved. This chapter assesses this subjectivity and defines how project success is perceived from a contractors perspective, answering the first sub-question as stated in section 2.4. First the traditional definition of project success is given in section 6.1. As this definition is shifting, the KPI’s are also changing. This is described in section 6.2. Finally, the perspective of contractors on project success is defined in section 6.3, answering the first sub-question of this research.

6.1 Traditional definition of project success

When looking at infrastructure project as a production system, the output of this system has a certain performance. In early project management literature this performance was measured along three constraints: costs, time, and scope. These constraints together are called the iron triangle (Olsen 1971). The perceived performance of the project is embedded in between these three constraints, as shown in figure 6.1.

![Figure 6.1: The iron triangle in traditional project management](Image)
The iron triangle has been a leading principle in project management until Atkinson (1999) challenged the status quo. Atkinson finds there is a difference between the actual performance and the desired performance, and how this difference is perceived by all stakeholders involved in the project. Furthermore Atkinson (1999) proposes additional performance measures related to the physical output: maintainability, reliability, etc. And performance measures related to the benefits of the stakeholders involved: strategic goals, user satisfaction, environmental impact, economic impact to the surrounding community, etc.

This idea of project success being different depending on the stakeholder is strengthened by Lim and Mohamed (1999). They propose to evaluate project success from macro and micro viewpoints, distinguishing the different perspectives of the client, contractor, users and general public. The macro viewpoint is usually applied by end users. They judge the project based on the degree in which the project achieved what it was meant to achieve. The micro viewpoint is mainly used by construction parties who define success (to a large degree) in time and money. This concept has been taken on by Sadeh et al. (2000) who constructed a framework (shown in table 6.1) which defines project success along four dimensions: meeting the design goals, the benefit to the end user, the benefit to the developing organization and the benefit to the national infrastructure. By taking in to account the benefit for different stakeholders, Sadeh et al. (2000) is acknowledging the subjective nature of project success.

<table>
<thead>
<tr>
<th>Success dimension</th>
<th>Success measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting design goals</td>
<td>• Functional specifications</td>
</tr>
<tr>
<td></td>
<td>• Technical specifications</td>
</tr>
<tr>
<td></td>
<td>• Schedule goals</td>
</tr>
<tr>
<td></td>
<td>• Budget goals</td>
</tr>
<tr>
<td>Benefit to the end user</td>
<td>• Meeting acquisition goals</td>
</tr>
<tr>
<td></td>
<td>• Answering the operational need</td>
</tr>
<tr>
<td></td>
<td>• Product entered service</td>
</tr>
<tr>
<td></td>
<td>• Reached the end user on time</td>
</tr>
<tr>
<td></td>
<td>• Product has a substantial time for use</td>
</tr>
<tr>
<td></td>
<td>• Meaningful improvement of user operational level</td>
</tr>
<tr>
<td></td>
<td>• User is satisfied with product</td>
</tr>
<tr>
<td>Benefit to the developing organization</td>
<td>• Had relatively high profit</td>
</tr>
<tr>
<td></td>
<td>• Opened a new market</td>
</tr>
<tr>
<td></td>
<td>• Created a new product line</td>
</tr>
<tr>
<td></td>
<td>• Developed a new technological capability</td>
</tr>
<tr>
<td></td>
<td>• Increased positive reputation</td>
</tr>
<tr>
<td>Benefit to the defence and national</td>
<td>• Contributed to critical subjects</td>
</tr>
<tr>
<td>infrastructure</td>
<td>• Maintained a flow of updated generations</td>
</tr>
<tr>
<td></td>
<td>• Decreased dependance on outside sources</td>
</tr>
<tr>
<td></td>
<td>• Contributed to other projects</td>
</tr>
<tr>
<td>Overall success</td>
<td>A combined measure for project success</td>
</tr>
</tbody>
</table>

Table 6.1: Project success along four dimensions (Sadeh et al., 2000)
The belief that project success is a multidimensional concept is further explored by Shenhar and Dvir (2007). They state that every project needs more than one dimension to assess success, and those dimensions vary in importance and significance, depending on the project. The research conducted by Shenhar and Dvir reveal that most project issues are not technical but managerial by nature. It is the traditional approach to project management that may be the root cause of many problems (Shenhar and Dvir 2007). They have designed a diamond-shaped framework which helps to analyze the risks and expected benefits of a project. This framework is shown in figure 6.2.

The novelty axis indicates the uncertainty of the project’s goals and/or the market. The technology axis represents the level of technological uncertainty and therefore defines the level of technical competence required from the project team. The complexity axis assesses the complexity of the project. This is mainly defined by the number of elements, (sub)systems and the relations between them. Finally the pace axis depicts the urgency of the project. This dimension assesses the time available to complete the project but also the possible risks when the project falls behind schedule.

The model is used to map out benefit opportunities and the severity of project risks. The level of innovation is embedded in the shape of the diamond, which defines the management style the project requires (Shenhar and Dvir 2007).
6.2 Evolvement of KPI’s

With a shift from the traditional iron triangle to a more broad perspective on project success, the focus on time, cost and scope is not satisfactory anymore (Low and Chuan, 2006). Therefore the addition of new (stakeholder based) performance measures has ignited a search for a range of possible Key Performance Indicators or KPI’s.

KPI’s are compilations of data measures which are used to assess the performance of a construction operation (Cox et al., 2003). It is important to note that KPI’s can be applied to both the output and the transformation process of the production system. And KPI’s can be both quantitative or qualitative by nature. Quantitative KPI’s are most accepted as performance indicators and are measurable in euros, units, man-hours, etc. Qualitative KPI’s are less accepted as performance indicators as they are difficult to measure, for example the motivation of construction workers (Cox et al., 2003).

Another way to categorize KPI’s has been developed by Chan and Chan (2004). They divide the performance indicators in two categories: objective measures and subjective measures (also shown in figure 6.3). Objective measures are KPI’s whose values can be calculated via mathematical formulas and are equal to all stakeholders, and subjective measures are KPI’s which depend on personal judgment of the stakeholders. Whilst the distinction between objective and subjective measures is valid, it does not make any value judgments concerning each KPI. It is this value judgment towards each specific KPI, which is different for each stakeholder, what ultimately defines project success (Bryde and Brown, 2005).

![Figure 6.3: Key Performance Indicators for project success (Chan and Chan, 2004)](image)

Key Performance Indicators

- Objective measures
  - Construction time
  - Speed of construction
  - Time variation
  - Unit cost
  - Percentage of net variation over final cost
  - Net present value
  - Accident rate
  - Environmental Impact Assessment (EIA) scores

- Subjective measures
  - Quality
  - Functionality
  - End user’s satisfaction
  - Client’s satisfaction
  - Design team’s satisfaction
  - Construction team’s satisfaction
Project success is no singular concept as the definition of performance changes, depending on the value judgment of the stakeholder. This results in a large range of definitions regarding project success. As of today there is no commonly agreed framework for performance measurement on construction projects. Toor and Ogunlana (2010) have made significant progress by extending the traditional iron triangle with performance indicators like safety, efficiency and effectiveness, see figure 6.4. Their framework incorporates macro and micro viewpoints as defined by Lim and Mohamed (1999), but it still lacks the value judgments of the different stakeholders.

There is research done that show that stakeholders have different perceptions regarding the importance of KPI’s that define project success (Turner et al., 2009). An extensive review on stakeholder perception towards project success comes from Davis (2014). Her research provides an in-depth literature review towards perception of project success by stakeholder groups. The outcome of this study states that:

- Project managers (representing the contractor) still perceive the success measures of the traditional iron triangle, costs, time and quality as most important.

- The client is most interested in the outcome of the project. The project is perceived a success when it conforms to the end users expectations. Another major performance criteria for clients is the efficient use of available resources on the project.

- End users primarily consider the quality of the project. From their point of view a project is successful when it meets their needs and performs according to plan.

The second research question, “How is project success defined from a contractor’s perspective?”, can now be answered. It is clear the concept of project success reaches far beyond the traditional
constraints of costs, time and scope. A great variety of frameworks for project success exists. Each acknowledging additional success measures beyond the iron triangle. KPI’s are commonly accepted and used throughout the industry to measure the performance of projects. Project success however is different for each stakeholder. A KPI on its own has no value. It is the judgment towards a KPI that ultimately defines project success. This is different for each stakeholder. A client is predominantly interested in the outcome of the project. End users are mainly looking at the quality of the project. Whilst contractors, being commercial organizations, perceive project success in terms of time and costs.
Chapter 7

Control of projects with integrated contracts

This chapter elaborates upon the framework which is constructed from the lessons learned from both the case studies in chapter 4 and 5 combined with the literature review in chapter 6. First additional project data is given to see if the problem for Heijmans can be generalized. Next the focus of the framework is described with data from the four cases. Next the framework is introduced based upon a production system approach. Finally, as the goal for Heijmans is to increase control of their projects this chapter ends with a series of control measures for Heijmans.

7.1 Generalizing the problem at Heijmans

The four cases in chapter 4 show a difference in success of projects with integrated contracts for public clients. Both cases with RWS as client were perceived a success by Heijmans. On the contrary the two cases with lower government organizations (LGO’s) as client were not. This section aims to explore whether this trend can be generalized by looking at a larger sample of projects done by Heijmans.

In the year 2016 a total of 67 infrastructure projects, with an initial budget greater than or equal to 3 million euro, were executed by Heijmans. Projects greater than 3 million are placed in risk category 2 or 3 by Heijmans and are therefore within the scope of this research. The majority of these projects, 48 in total, have a public body as the client. This is shown in figure 7.1.

As was mentioned in chapter 6 the perspective on project success for a contractor is primarily expressed in profit margins. For the purpose of generalization the project is considered successful when Heijmans was able to make a profit on the project. Projects with an outcome of approximately zero are therefore also considered non profitable. The complete data set for this analysis is given in appendix B. Due to the sensitive nature of this data for Heijmans this appendix is confidential.

Out of these 48 projects for public clients, 37 projects had integrated contracts (this includes maintenance contracts). Of these 37 integrated contracts, 16 were executed for RWS and 21 were commissioned by municipalities, provinces or water boards. The data highlights that the problems Heijmans faces with large infrastructure projects are more severe when working with LGO’s as the client. 12 out of
16 projects (75%) for RWS have been successful for Heijmans. This is in great contrast with projects for LGO’s, where only 9 out of 21 projects (43%) were a success for Heijmans in the year 2016.

![Figure 7.1: Infrastructure projects (≥ 3 million €) executed in 2016 by Heijmans per client](image)

### 7.2 Focus of the framework

As the data in section 7.1 indicates, the issues for Heijmans mostly appear when integrated contracts are used. The cases in chapter 5 show that most issues for Heijmans arise in the tender period and then seep through into the contract period. This seems primarily due to the client finding it difficult give over control of the project to Heijmans, leading to discussions, conflict and ultimately negatively influencing the project success.

The degree to which a client is able to allow Heijmans to take the lead strongly depends on the type of client. National government organizations like RWS in general have more experience with complex infrastructure projects. They have a better understanding of the integrated contracts (D&C, DBFM, etc) and they are aware of the risks these projects bear. Furthermore these type of clients often have experience with the large contractors as they have worked with them on previous projects. Lastly these clients are mainly focused on the outcome of the project, and less on the process to get there. These factors combined cause national government organizations to behave more passively within the contract period. They are trustworthy of the contractor and allow them to be the expert regarding the construction process.

In general local governmental bodies, such as municipalities and provinces, find adopting this passive role more difficult. Unlike national government organizations, a large infrastructure project is not the core business of these clients. They often have little knowledge regarding integrated contracts and the risks surrounding the project. Because of this, a contract management party is often hired by the client to act in their best interests. However in practise this complicates things even more. All these factors combined result in anxious behavior by local government bodies. They are hesitant towards the contractor and therefore are less willing to give away control of the project.

During contract period the contractor is expected to take on a leading role. The contractor has experience and a track record of infrastructure construction as it is his core business. An important
part of this role is communication with the client. The client has to be continuously informed regarding the progress of the project. Should the contractor succeed in this, the client can take on a following role. This means to trust the contractor and allowing him to be the expert on the subject. Table 7.1 shows the behaviour of client and contractor for each of the four cases.

<table>
<thead>
<tr>
<th>Project</th>
<th>Client</th>
<th>Contract</th>
<th>During tender</th>
<th>During project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Client</td>
<td>Heijmans</td>
</tr>
<tr>
<td>A12 VEG</td>
<td>RWS</td>
<td>DBFM</td>
<td>Leading</td>
<td>Following</td>
</tr>
<tr>
<td>A1 A&amp;B</td>
<td>RWS</td>
<td>D&amp;C</td>
<td>Leading</td>
<td>Following</td>
</tr>
<tr>
<td>A12 Parellelstructuur</td>
<td>Province</td>
<td>D&amp;C</td>
<td>Leading</td>
<td>Following</td>
</tr>
<tr>
<td>OBSP</td>
<td>Municipality</td>
<td>D&amp;C</td>
<td>Leading</td>
<td>Following</td>
</tr>
</tbody>
</table>

Table 7.1: Behaviour of clients and Heijmans per case

It can be seen that this behaviour was honored on the two cases where RWS has been the client. This results in a good client - contractor relationship, which is directly related to the success of the project. The data from the interviews acknowledge this as well. Appendix C holds a series of quotes originating from the members of the project teams of these projects. For example: "The contract type helps as well because we are forced to take the initiative, the client allowed this" and "When we finished the design it returned with minimal feedback, the client allowed us to be the expert and kept a level of distance", showing the importance of a client who is able to act more passively. Also the quality of the relation was mentioned during the interviews: "The relationship with the client was very open, a transparent relationship saves a lot of money", and "The mutual respect was high, they knew this was the first DBFM for us, they were thinking with us and understood why some documents were delayed". Finally the interviews stress the importance of distinctness regarding project requirements: "We made all requirements very clear, both client and contractor knew the scope of the project, what is within the contract and what is not, this was a very important step", and "We have verified all the requirements with the client to avoid discussions later on, this resulted in a good starting position". These quotes reveal the success factors related to this interface:

- A proactive contractor who is allowed, by the client, to lead.
- A transparent relationship based on mutual trust.
- Clear agreement on project requirements.

As mentioned earlier LGO’s find it difficult to hand over control of the project to the contractor. This results in both parties fighting for the lead, causing conflict, discussions and distrust. The other two cases are prime examples of this and show how the success factors mentioned earlier were jeopardized. This is again strengthened by quotes originating from the interviews (appendix C). The first topic is related to the lack of experience regarding integrated contracts: "I have seen a client with no experience with this contract type. Their organization was not ready for this", and "A major risk was the incompetence of the client". Also the poor quality of the relationship has been mentioned: "At the start we had a project start up (PSU), the client demanded only written communication, this was very strange because without a good dialogue one can not work together", and "We have spent too much
time discussing with the client over the design, the level of mutual trust also decreased because of this”. Furthermore issues with verification of project requirements can be seen: "Because the relation with the client was so stubborn we could not get the design accepted, they always found things that did not meet their requirements”, and "At some point we could not verify all requirements whilst the client could, then you lose the trust of the client”. These quotes show which factors are negatively affecting the success of the project:

- Stubborn and rigid behaviour by client.
- Poor communication between client and contractor.
- Little experience from client with integrated contracts.
- Discussions on project requirements.

7.3 Defining the framework

Infrastructure construction projects can be regarded as a production system (Maloney and Asce 2002). The system consists of three parts as illustrated in figure 7.2:

- Input
- Transformation process
- Output

There is input consisting of resources such as people, capital, materials, information and technology. These resources undergo what in management terms is called a transformation process. This transformation process has a certain duration and ends with the output. For infrastructure construction projects the output is always defined as a physical entity. A road, railway track, waterway or, in some cases, a combination of these equipped with bridges, tunnels or aquaducts. In a system the input and output are known. It is the transformation process that is dynamic and unpredictable. It is also this transformation process that defines the output of the system, or in construction terms, project success or failure.

![Figure 7.2: Model of a production system (Koskela 2000)](image)

This systems approach forms the base of the framework. It needs to be altered to better suit road infrastructure construction projects. This is done by step-wise refinement of the production system model (figure 7.2) which is transformed to the final framework.
The first step is to add two major milestones to the model which are present in all infrastructure projects. Milestones are used to signal the completion of a certain phase in the process. The first milestone concerns the award of the project from the client to the contractor. The second milestone beholds the delivery of the project. This is the point in time where the contractor hands over the project back to the client, signaling the end of the transformation process. Step one of the transformation is shown in figure 7.3.

In contrast to an infrastructure project, the model of a production system does not include the dimension of time. This means the second step involves renaming the three basic system blocks (input, transformation process and output) of the initial model. The addition of the two milestones allows for a clear distinction in three periods: tender, contract and evaluation. The tender period starts when the contractor has decided to bid for a certain project put on the market by a client. During this period the contractor analyses the program of requirements and works on a concept solution for the problem presented by the client. The tender period ends with the award of the project to the contractor, signaling the start of the contract period. During this period the contractor has a contractual agreement with the client. The client has agreed upon the solution proposed by the contractor, meaning the contractor is now legally required to deliver this solution. This period starts with the design phase, in which the concept solution is worked out to a final design. Then follows the preparation and execution of the construction work. Maintenance of the project can also be included in the contract period, depending on the type of contract. The project delivery milestone transfers responsibility for the project back to the client, ending the contract period and starting the evaluation period. In this period the project is reviewed as to whether it meets the specifications and requirements asked by the client. Furthermore this period also allows for evaluation of organizational processes during the tender and contract period. Steps two of the transformation is shown in figure 7.4.
Step three of the transformation concerns adding client and contractor to the framework and describe how they should act during each period. In the tender period the client leads in defining the project requirements. Contractors are invited to design a concept solution for the project. Ultimately the client decides which contractor is awarded the contract. When the contract period commences the behaviour of the client and contractor should switch. The contractor has experience and a track record of infrastructure construction as it is his core business. Because of this the contractor has to take on a leading role. An important part of this role is communication to the client. The client has to be continuously informed regarding the progress of the project. Should the contractor succeed in this, the client can take on a following role. This means to trust the contractor and allowing him to be the expert on the subject. In the evaluation period the roles switch back again as the success of the project is evaluated (taking in account the different perspectives of success stated in chapter [6]). The client becomes leading when evaluating the project against the needed requirements. Any defaults get reported to the contractor, who is obligated to solve them. Step three is shown in figure 7.5.

The final transformation step is to recognize the area of focus in each phase. During the tender period both client and contractor prepare for a possible contract relationship. In the beginning of the contract period the focus must be on clear agreements between client and contractor. What are the deliverables of the project? What are the risks of the project and who is responsible? Which project specifications are required? In which form is the progress of the project reported? Which communication guidelines are present? The goal is to remove any indistinctness which could become a point of discussion later on in the project. Later on in the contract period the focus should lie on monitoring all agreements concerning the project which were defined. Any deviations on KPI’s must be watched carefully in order for Heijmans to keep control of the project. Corrective measures can forth be applied in order to minimize potential harm or to maximize possible benefits. In the evaluation period there should be a strong emphasis on proper assessment of both the completed project and the transformation process. Lessons learned from this evaluation can be pro-actively applied to future projects. The final framework is shown in figure 7.6.
7.4 Measures for project control

In order to combat the number of non-profitable projects for lower government clients a series of control measures is proposed. These measures, shown in table 7.2, are given for each period given in the framework. They are aimed towards pursuing the success factors in section 7.2: proactive behaviour by the contractor, a relationship based on mutual trust, and clear agreements on project requirements. These measures allow Heijmans to fulfill the leading role during the contract period and thus keeping in control of the project.

A proactive attitude from Heijmans during projects is very important. This starts prior to the tender phase with a dialogue regarding the type of contract. LGO’s need to be educated on the workings of integrated contracts so they better understand their role and the responsibilities of the contractor. This measure aims to increase the knowledge of LGO’s on integrated contracts throughout the industry. In the tender phase Heijmans should request insight in the project requirements and the terms and conditions of the contract. LGO’s are used to traditional contracts so the integrated contract can carry faults or conflicting information. When the contract period commences Heijmans has to invite the client for a Project Start Up (PSU). During this session Heijmans can present the client with their global project approach. Heijmans must try to answer as many questions the client might have. How are local stakeholders informed? What are the major risks of the project? Which KPI’s are used and how are they monitored? What is the general project planning? What level of nuisance can be expected? The goal of this session is to take away any insecurity the client might have concerning the project. During design and construction Heijmans must keep the client informed on the progress of the project. This can be achieved via a range of options. For example project follow up meetings, reports, newsletters and time lapses. Upon completion Heijmans should invite the client and evaluate the KPI’s and performance of the project.

A relationship with the client based on mutual trust is a key success factor. Building and maintaining such a relationship takes time, something which is currently undervalued by Heijmans. When a project planning is made in the tender phase, Heijmans should include enough time, in the contract period, for the project team to work on the relation with the client. At the beginning of the contract period Heijmans should try to get to know the interests of the client and their organizational culture. What motivates them to do the project? What is valued important by the client? What is their definition
of project success? Getting to know each other creates understanding for one’s interests, strengthening quality the relationship. Another key factor is continuation regarding project staff. Heijmans should aim for as little changes in project team composition as possible. A good starting point is the ambition to continue the tender team on the project after it is awarded. Currently proper evaluation of the relationship is not part of Heijmans’ work process. Staff is usually needed on new projects which means time to evaluate is scarce. This is unfortunate as thorough reflection of one’s actions can prevent the mistakes from happening on future projects with similar clients. Therefore Heijmans must acknowledge the fact that project evaluation is an essential part of each infrastructure project. It should not be optional, but mandatory.

Clear agreements between client and contractor regarding the requirements of the project are essential to control the project. This starts in the tender period by explicitly stating the expectations of both client and contractor. After the project is awarded Heijmans should validate all the project requirements with the client before they start with the design. Any indistinctness concerning functionality, specifications, capacity, resources and planning should be eliminated to avoid conflict situations and

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Proactive behaviour</td>
<td>Lobby with clients and create awareness on contract terms and conditions</td>
<td>Tender period</td>
<td>Heijmans</td>
</tr>
<tr>
<td>by contractor</td>
<td>Request insight in project requirements and concept contract</td>
<td>Tender period</td>
<td>Project team</td>
</tr>
<tr>
<td></td>
<td>Invite client for PSU and present global project approach</td>
<td>Contract period</td>
<td>Project team</td>
</tr>
<tr>
<td></td>
<td>Keep the client informed on the project progress</td>
<td>Contract period</td>
<td>Project manager</td>
</tr>
<tr>
<td></td>
<td>Assess KPIs with client and evaluate</td>
<td>Evaluation period</td>
<td>Project team</td>
</tr>
<tr>
<td>Relationship based on</td>
<td>Calculate in time to work on the relationship</td>
<td>Tender period</td>
<td>Tender team</td>
</tr>
<tr>
<td>mutual trust</td>
<td>Keep tender staff on the project after its awarded</td>
<td>Contract period</td>
<td>Heijmans</td>
</tr>
<tr>
<td></td>
<td>Take time to get to know clients interests and organizational culture</td>
<td>Contract period</td>
<td>Project team</td>
</tr>
<tr>
<td></td>
<td>Acknowledge project evaluation is part of the process for both client and contractor</td>
<td>Evaluation period</td>
<td>Heijmans</td>
</tr>
<tr>
<td></td>
<td>Assess the relationship with the client and evaluate</td>
<td>Evaluation period</td>
<td>Project team</td>
</tr>
<tr>
<td>Clear agreements on</td>
<td>Make expectations known</td>
<td>Tender period</td>
<td>Client and</td>
</tr>
<tr>
<td>project requirements</td>
<td>Validate all project requirements with the client before start design</td>
<td>Contract period</td>
<td>tender team</td>
</tr>
<tr>
<td></td>
<td>Set boundaries and communicate these with the client</td>
<td>Contract period</td>
<td>Project team</td>
</tr>
<tr>
<td></td>
<td>Agree with client upon escalation model should conflict arise</td>
<td>Contract period</td>
<td>Project manager</td>
</tr>
<tr>
<td></td>
<td>Assess origin of change orders with the client and evaluate</td>
<td>Evaluation period</td>
<td>Project team</td>
</tr>
</tbody>
</table>

Table 7.2: Control measures related to the framework
possible change orders. Parallel to this validation process Heijmans should set boundaries towards the contract and make these known to the client. It must be explicit what is within the scope of the project and what is excluded, again to prevent discussions with the client. Furthermore an escalation model must be made should discussions arise. The start of the tender phase revolves around explicit and clear agreements which are known by both parties. Finally in the evaluation phase any change orders can be assessed. What is the origin of this change order? Which requirement was changed and why? The answers to these question can give insight for Heijmans on future projects.

The third research question, "How can Heijmans improve the project success with respect to organizational interfaces?", can now be answered. It is seen in chapter 5 that the relationship with the client is the most influential interface. This is strengthened by the additional project data in this chapter. The case study concludes that most issues arise with LGO’s on integrated contracts. The client is anxious to give away control to Heijmans in the contract period. The inability to do this frustrates the process for Heijmans. A framework is proposed for Heijmans to gain, and maintain control of the contract period. This can be achieved by proactive behaviour throughout the duration of the project, building a relationship based on mutual trust, and finally, by making clear agreements on the requirements on the project.
Chapter 8

Evaluation by Heijmans

This chapter holds the main findings coming from the evaluation of the framework. This has been done during a two hour meeting with two experienced tender managers working for Heijmans. These tender managers will be referred to as the experts in this chapter.

8.1 Evaluation process

Prior to the meeting the experts have received a copy of the first chapters of the report. This was done to prepare them for the meeting by introducing the goal and intermediate conclusions of the research. The meeting started with a presentation on interface management, the problem for Heijmans and the results from the case studies. Subsequently the framework, and the control measures derived from the framework, have been introduced. The remaining time of the meeting was used for discussion and evaluation of the framework and the control measures. The evaluation meeting has been recorded and the transcript of this meeting can be found in appendix D.

8.2 Evaluation of the framework

There is a general consensus that the framework embodies the ideology of integrated contracts. The experts clearly state the difference in working with RWS and LGO’s when integrated contracts are applied. They agree this is mainly due to the difference in knowledge and experience towards these contracts. RWS writes and manages the contract themselves which allows for a good dialogue on the terms and conditions of the contract. Due to lack of experience LGO’s often hire a contract management consultant to guard their interests. This consultant writes and manages the contract for the client, making direct communication with the client difficult for Heijmans. Consultants often behave very formal as admitting any defaults in the contract, which they wrote, would damage their credibility towards the client. This formal approach to contract management hinders a cooperative relationship with the client, which the experts feel is essential for project success with integrated contracts.
The experts state that, for integrated contracts, the client should be leading during the tender phase. It is the client who defines the project requirements. In general there is little contact with the client during the tender period, meaning the contractor can only follow. As for the contract period, both experts agree the contractor should lead, therefore acknowledging the framework. They recognize the current problems with LGO’s finding it difficult to hand over control of the project to the contractor. Leading to stubborn behaviour by the client which frustrates the process of the contractor. However the experts mention they have difficulties with the concepts of leading and following. They figure things are never black and white as the framework states. The situation is far more complex in practice, and the experts mention a contractor can never be fully leading during the contract period. The client also has certain responsibilities on which the contractor can only follow. However the experts agree that a proactive attitude by the contractor is mandatory throughout the entire relationship with the client.

8.3 Evaluation of the recommendations

An open and transparent relationship with the client is most important during the project. However the experts feel this is easier said than done. Honesty, the foundation for openness, requires a level of courage from the contractor. Admitting your weaknesses and flaws is not easy in practice. However the experts agree that Heijmans can improve on certain things to achieve this goal of an open relationship. They state a PSU is absolutely necessary to start a good relationship. It is essential to manage the expectations of both client and contractor. Agreements must be made very explicit to avoid conflict later on in the project. Heijmans must also seize this opportunity to set clear boundaries concerning the contract. What is included in the contract and what is excluded, again managing the expectations of the client. However a good PSU requires preparation. The experts feel a responsibility for them, as tender managers during the tender period, to include time for the project team to work on the relationship with the client. Currently this is not embedded in the contract period but the experts agree, if the necessity it communicated to higher management, this can be achieved.

Furthermore the experts agree that lobbying with the client over contract conditions is required. They feel clients must be better educated towards the content in the contract and how this affects the contractor. They mention that of today the client often embeds perverse incentives in the contract. For example valuing price as the main award criteria but providing incomplete or diffuse information. This leads to contractors having to make many assumptions in their bid. The contractor with the most favourable assumptions for the client, in other words willing to accept the risks, is most likely to get the contract. However for this to change the lobby with the clients must be taken on by the construction sector as a whole.

The ambition to keep the tender staff on the project for a certain duration in the contract period exists at Heijmans. However the experts mention this is difficult to achieve in practise. The majority of tenders for every contractor are not won. They mention a contractor simply can not put the tender team on hold, waiting for the decision by the client. Also some staff prefer to only be involved during the tender period. It is concluded that this ambition is a success factor but due to the mentioned factors implementation remains difficult.
Currently evaluating the relationship with the client is insufficient. This has two causes. First of all many new projects are often understaffed. When employees become available they are requested to work on new projects, leaving no time for evaluation. Second the experts feel the insights coming from the evaluation can no longer be applied to the project as it is completed. This means there is no incentive to evaluate as the project is completed. Lessons learned can be applied to new projects but the experts state that Heijmans currently fails to do so. To combat this the experts propose to continuously evaluate during the project. The lessons learned can then be applied on the remaining time of the project. It is believed this can stimulate the degree of evaluation. Another possible solution can be a sector wide performance indication benchmark for projects. The experts mention the score on so called verified performance indicators (VPI’s) is increasingly requested by clients in the tender period. A sector wide benchmark could stimulate contractors to evaluate by documenting the track record for a contractor given a certain project type. However the experts feel this is primarily the responsibility for sector associations. Its their role to improve the quality of the sector as a whole.
Chapter 9

Discussion

This chapter discusses the outcome of the research. First the limitations of the research will be addressed. Next the applicability of the results towards other fields is assessed. Subsequently recommendations for further research towards organizational interfaces and project success are described. Finally a personal reflection upon the research process is given.

9.1 Limitations of the research

The research indicates that the client - contractor interface is the most influential when looking at the success of road infrastructure projects. However the results require a level of caution upon interpretation. The study has been executed using data originating only from Heijmans projects. Furthermore only four cases in total were investigated. The project data in section 7.1 strengthens the hypothesis that interface problems mostly occur with lower government organizations. However these projects were not assessed in-depth making generalization of the research risky.

Another limitation is the way the qualitative data was acquired. Interviews as a way of data gathering are prone to certain pitfalls. The interviewer is at risk to a level of bias which could influence the response that was given. Furthermore the interviewees can withhold information which they feel is not relevant for the research. Lastly the data from the interviews is difficult to analyze and compare, possibly leading to false conclusions. Furthermore the data can only be analyzed one sided as the clients were not interviewed. The client is able to nuance the conclusions by explaining its motives.

An aspect that requires caution is the fact that the client - contractor interface has been isolated. The problems which appear on this interface are far more complex in practice. They are the result of a combination of people, processes, and circumstances. Isolation of this interface was needed for this research. However additional research is recommended towards the relations between these interfaces and how they affect each other.

9.2 Applicability in other fields

This focus of this research has been directed towards organizational interfaces in the construction of road infrastructure projects. The interface between the client and the contractor is found to be the
most dominant related to project success. In essence the framework has been developed using empirical
data originating from infrastructure projects executed by Heijmans. This section discusses whether
the findings of this research can be generalized and applied to other projects, contractors, markets, etc.

The framework given in chapter 7 demonstrates that issues between client and contractor appear
when one or both parties behave different than what is to be expected. For Heijmans this was most
frequent with lower government organizations during the contract period. The framework is aimed
towards infrastructure projects but it is expected that this can be applied on housing and commercial
construction as well. The clients in these fields are often municipalities with little experience regarding
construction contracts. This could mean they too find it difficult to allow a major contractor to be
the expert on the subject. In this case the framework can also be deployed on projects which do not
fall into the infrastructure category.

The current problems related to the client and contractor interface are widespread throughout the
construction industry. Many contractors face similar problems concerning innovative contracts in
combination with lower government organizations. The insights provided by this research can be
tailored to their organizational process and possibly aid them in better understanding the behaviour
of their clients.

The outcome of this research could also be applied towards other markets where a comparable client -
contractor interface appears. Characteristic for this interface is the presence of a client with a certain
problem. This client does not have the knowledge and resources to solve the problem and therefore
hires another party who has this expertise. A good example are information technology (IT) projects.
These type of projects feature a client, who has the desire to deliver a service to their end users, and
a contractor type organization who has experience with information technology. In this example the
same set of stakeholders appears meaning the framework could possibly be used to positively contribute
to project performance in other markets.

9.3 Recommendations for future research

Based upon the limitations of the research the following recommendations for further research are
given:

• This research looked at interfaces as isolated instances. In practise the organizational interface
issues are far more complex. This has to do with the possible inter-relatedness of the interfaces.
When one interface changes it is highly likely that others are affected. The degree of this
inter-relatedness is currently unknown.

• This research has been focused towards integrated contracts. It has to be investigated if the
conclusions with respect to client and contractor behaviour can be also applied to other contract
types.

• Organizational interfaces are not the only interfaces identified in this research. Contractual and
physical interfaces also belong within the domain of interface management. It is recommended
extend the research by assessing the effect of these interfaces on project success.
• Currently the proposed framework and recommendations are meant for a contractor working with governmental clients. If the framework can be generalized towards other types of clients has not been part of this research. Additional research is therefore recommended.

• This research has concluded that project success is a subjective definition. The focus area of this research has been the contractors viewpoint. Research towards other viewpoints such as the client, end users, local residents etc. would generate a better understanding of organizational interfaces as a whole.

9.4 Personal reflection

The point of departure for this research has been the topic of interface management. This has been inspired by the troubles that Heijmans is facing. However, it took a while to get the research up to speed. This was mainly due to the abstractness of the term interfaces. I quickly found out there had not been much research conducted towards this concept. This made the formulation of a concise research question very difficult.

The abstractness of the topic guided the research method towards an exploratory approach. Four infrastructure projects were selected as cases to be studied. The selected method for data acquisition became semi-structured interviews. Prior to this research I had no experience with this type of interviews. Careful not to lose any important data I chose to record everything that had been said. This resulted in a massive amount of raw qualitative data. The shear amount of information was overwhelming at first. I had no idea how I would ever be able to structure and analyze this data. In the following days I have tried several methods which could help me find my way in this jungle of information. At first nothing seemed to come of it but looking back now I realize that these methods have provided me with the foundation for the next step.

The last step of the research was to come up with means to improve the interface related issues for Heijmans. With all the knowledge from the interviews I could quickly narrow down a cause for these issues. Consultations with my supervisors at Heijmans, combined with my knowledge on project management from literature, allowed me to come up with a framework. This framework was able to generalize how the issues in the four cases came to be. Furthermore, the framework was very helpful in coming up with recommendations for Heijmans. The evaluation of the framework by two experts largely confirmed my theory on client-contractor interface issues, which was a very exciting.
Chapter 10

Conclusion

Due to their complexity, road infrastructure projects remain prone to failure in terms of time and costs. Interface management is an emerging concept which is believed to cope with this complexity. An interface is defined as a common boundary between people, systems, equipment or concepts. Three types of interfaces can be defined: physical, contractual and organizational. Current literature points towards organizational interfaces as the main cause of project failure. This research has investigated this subject by answering the following research question:

*How can organizational interfaces be better managed, in order to improve the success, from a contractor’s perspective, of large road infrastructure projects?*

The definition of project success varies depending on the viewpoint of the stakeholder. Key performance indicators (KPI) are commonly used to evaluate a certain level of project performance. However it is the level of significance a stakeholder attaches towards these KPI’s which ultimately defines project success. Clients are mainly interested in the outcome of the project, end users define success in the quality of the project and whether it satisfies their needs, and contractors feel a project has been successful if it was completed on schedule and within budget.

This research has identified organizational interfaces as the relations between different parties involved in the project. In order to guide the research, five themes have been addressed: the relation with the client, internal relations within Heijmans, the relation with subcontractors, the transition between project phases, and the atmosphere within the project team. The research concludes that the relationship with the client is most influential with respect to project success. Projects where this relationship is based on cooperation and mutual trust, in which both client and Heijmans’ interests are valued, are perceived successful by both parties. On the contrary, projects were perceived as failed when the relationship was characterized by discussion and conflict.

The main cause for a poor relationship between client and contractor is a lack of experience and knowledge from the client. This is mostly visible with lower government organizations in combination with integrated contracts. This lack of experience leads to controlling and reserved behaviour. These type of clients find it difficult to give away control of the project to Heijmans after it has been awarded. This is in direct conflict with the ideology of integrated contracts, where the contractor expected to manage the project on behalf of the client. This research suggests three major control measures Heijmans can deploy to improve the quality of the relationship with these clients. These are: proactive
behaviour by Heijmans, taking time to build the relationship, and making clear agreements on the requirements of the project.

Overall this research concludes that organizational interfaces affect the success of large road infrastructure projects. This is true for all identified interfaces. However the degree to which they are of influenced differs greatly. From the perspective of a contractor, the relationship with the client is most influential. It has shown that the nature of the relationship between client and contractor is related to the project success. The level of trust between client and contractor greatly defines to which degree the contractor can manage the contract effectively. A good relationship between client and contractor is key for the perceived project success of both parties, and management of this relationship should be an integrated part of each phase of the project.
References


REFERENCES


Appendices
Appendix A

Risk categories used by Heijmans

This table shows the three risk categories which Heijmans uses to assess new projects.

![Table A.0.1: Risk categories for projects at Heijmans](image)

Table A.0.1: Risk categories for projects at Heijmans (Heijmans Infra, 2017)
Appendix B

Dataset Heijmans projects 2016

These tables show the infrastructure projects, with a budget greater than 3 million euro, executed by Heijmans in the year 2016. These projects are sorted by client and contract type.

Table B.0.1: Infrastructure projects 2016 sorted by client (Heijmans Infra 2017)
Table B.0.2: Infrastructure projects 2016 sorted by contract type ([Heijmans Infra, 2017])

<table>
<thead>
<tr>
<th>Contract Type</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>Description 1</td>
</tr>
<tr>
<td>Type 2</td>
<td>Description 2</td>
</tr>
<tr>
<td>Type 3</td>
<td>Description 3</td>
</tr>
</tbody>
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[Heijmans Infra, 2017]
Appendix C

Quotes from the interviews

This appendix shows a variety of quotes from the four case studies. These quotes are related to the client-contractor interface.

<table>
<thead>
<tr>
<th>Quotes: OBSP</th>
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<tbody>
<tr>
<td>“A major risk was the incompetence of the client.”</td>
</tr>
<tr>
<td>“We have asked ourselves if there was anything that wasn’t a point of discussion. Everything was discussed with this client, absolutely everything.”</td>
</tr>
<tr>
<td>“The client has put a D&amp;C on the market for which they were not ready.”</td>
</tr>
<tr>
<td>“Communication with the client was very difficult.”</td>
</tr>
<tr>
<td>“Because the relation with the client was so stubborn we could not get the design accepted. They always found things that did not meet their requirements”</td>
</tr>
<tr>
<td>“The will of the client was the law. This behaviour have we never experienced before”</td>
</tr>
<tr>
<td>“There was a line in the contract stating: if there are any contradictions, do as the client prefers. That is ridiculous”</td>
</tr>
<tr>
<td>“The project team of the client was unable to make decisions or only pointed towards the contract”</td>
</tr>
<tr>
<td>“I have seen a client with no experience with this contract type. Their organization was not ready for this”</td>
</tr>
<tr>
<td>“We were supposed to start execution in June. However the design was delayed due to conflict with the client so we started in September.”</td>
</tr>
<tr>
<td>“We have spent too much time discussing with the client over the design. The level of mutual trust also decreased because of this”</td>
</tr>
<tr>
<td>“The client mainly frustrated our internal processes”</td>
</tr>
<tr>
<td>“It was very difficult for this client. It was their first large D&amp;C contract. They hired a contract managing party to enforce the contract”</td>
</tr>
<tr>
<td>“What made matters worse is the client thought to help us by submitting change orders after we had finished the final design”</td>
</tr>
<tr>
<td>“No one could have foresee the difficulties with this client and the amount of time was needed for all their change orders”</td>
</tr>
</tbody>
</table>

Table C.0.1: Quotes from the OBSP case
### Quotes: A1 A&B

- “One successfactor was the BVP, in which we did a very good consultation phase.”
- “We had a very intensive consultation phase with the client. Making it very clear, in eight weeks, what our plan is.”
- “We made all requirements very clear. Both client and contractor knew the scope of the project. What is within the contract and what is not. This was a very important step.”
- “We have verified all the requirements with the client to avoid discussions later on. This resulted in a good starting position.”
- “The client had a positive attitude. He was trustworthy of our expertise, shown in the consultation phase. The client was able to quickly make decisions.”
- “When we finished the design it returned with minimal feedback. The client allowed us to be the expert and kept a level of distance.”
- “The client was not tempted to interfere on every detail. This was definitely a success factor.”
- “I think we were all very focussed with respect to contractual discussions with the client. All contract agreements were made explicit.”
- “We have increased the quality of the relationship by keeping to the agreements and making sure all documents were on time.”
- “This contract type helps as well because we are forced to take the initiative. The client allowed this.”
- “We take the lead and the client is ok with this.”
- “Report problems in time. The client likes the fact that we signaled a possible problem two months in advance.”

*Table C.0.2: Quotes from the A1 A&B case*
Appendix C. Quotes from the interviews

Table C.0.3: Quotes from the A12 VEG case

Quotes: A12 VEG

- “A major advantage was the fact that we had close cooperation with the client.”
- “The relation with the client was very open. A transparent relationship saves a lot of money.”
- “The client demanded a project start-up (PSU). These sessions are focused on the relationship, not so much on the content.”
- “Nothing goes perfect, even for Rijkswaterstaat. But learning and keep trying to improve often generates understanding among the client.”
- “We had a very good relationship with the client. Its no indecisive client that sits back and waits. Its a client that asks what our needs are.”
- “It pays to invest in a open relationship with the client. They are giving us something but we also have to give them something in return.”
- “I am convinced that if we succeed, as a company, to work open and honest, we will see the fruits of our labour.”
- “The mutual respect was high. They knew this was the first DBFM for us. They were thinking with us and understood why some deadlines were delayed.”
- “Agreements with the client, validation of requirements. Are we designing what the client wants? This is all very important.”
## Quotes: A12 Parallelstructuur

- "It was a very difficult project. Mainly due to the rigid behaviour of the client" 
- "At the start we had a project start up (PSU). The client demanded only written communication. This is very strange because without a good dialogue one can not work together."
- "We had organized design sessions. However the client said: just do as the contract states. This caused lots of tension."
- "The planning had to be revised multiple times due to change orders. For each planning we had to make a new Monte Carlo analysis. I did not understand the necessity for this."
- "The execution was paused because we could not agree with the client who would bear the risks of the aqueduct collapsing."
- "The attitude and behaviour of the client made our people desperate."
- "There was no oral communication, whilst those people (the client) were housed in the same building."
- "The client was only interested in the contract. They did not even bother to look outside. They take the contract, see some minor things missing and report a negative findings."
- "A very formal client only holding on to the contract. Autistic behaviour is what I have called it."
- "We were so involved with the client. It blurs your vision. Control of the project slowly slips away."
- "The audit behaviour of this client has cost us millions on staffing."
- "At some point we could not verify all requirements whilst the client could. Then you lose the trust of the client."
- "We confronted the client with a lawsuit, which we lost. Then you have to work together for another two years. We did not make friends in doing so."
- "This was due to the stubborn behaviour by the client."

*Table C.0.4: Quotes from the A12 Parallelstructuur case*