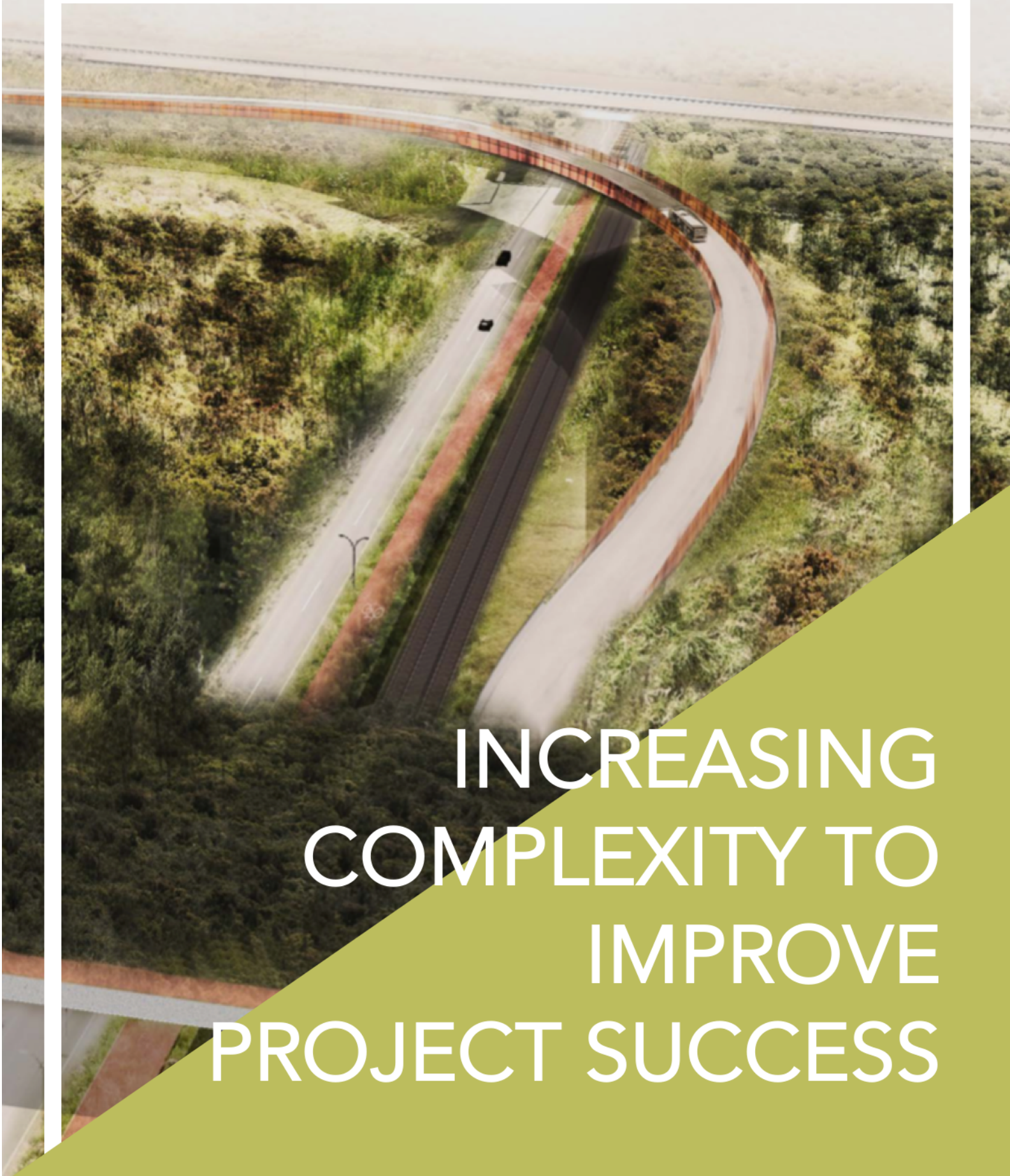

INCREASING COMPLEXITY TO IMPROVE PROJECT SUCCESS

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Master thesis – final report

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Preface

This thesis is the proud result of six months' work. The final hurdle of the MSc program of Construction Management and Engineering and years of study at the Delft University of Technology. Last 6 months have been exciting, challenging, informative, sometimes daunting but mostly motivational. Having the ability to apply my knowledge, be challenged, gain more insights in my fields of interest and the possibility to experience this all in a working environment at APPM, was great.

In the last few years, I had the opportunity to gain a lot of fun, informative and memorable experiences during the study. Because the thesis is the last step of a long period of studying, I would like to include some of these experiences in this report. In this report, you will find some photos taken by myself, of memorable moments during the study period. During the masters, I had the opportunity to visit Hong Kong, Mexico-City and Sydney as part of two international business tours and a course about smart water and mobility, which were all unique and amazing experiences. The last photo represents my participation in the organisation of the Athletics European Championship 2016 in Amsterdam. During this event, my interest in project management and passion for athletics combined. This experience was my motivation to choose for Construction Management and Engineering, a decision I do not regret.

I would like to thank my full committee, all interviewees and the colleagues at APPM for all their assistance, feedback and support. I'm looking forward to applying the knowledge and insights gained during my studies and this research in my future working environment. I wish you a very pleasant read.

Ynze Matthijs Strikwerda
Rotterdam, November 2019

Executive summary

Context of the research

A large number of the project organisations of large infrastructure construction projects have difficulties coping with the current static and dynamic project complexities. The Dutch infrastructure market sees its projects become more complex and Rijkswaterstaat advices to limit and reduce the complexities to improve the situation (Rijkswaterstaat, 2019). The Dutch economic institute for the construction sector, published that 20% of the infrastructure construction projects and 30% of the water related construction projects are delayed in the execution phase (EIB, 2019). Researches, however, suggest that adding extra complexities to the project could create synergies and therefore new solutions. An increase in project complexity could increase the level of support and appreciation by the project participants and external stakeholders and thereby improve the level of project success (Bil & Teisman, 2017; Cohen, 2015; Giezen, 2012).

Research question

This paradox of using complexity to improve an infrastructure construction project forms the fundament for this research. Where the literature extensively discusses project complexity and suitable project management approaches, a knowledge gap can be identified on the analysis of the practical elaborations of the management approaches and its adaptations after an increase in project complexities on large infrastructure construction projects. For this reason, the goal for the research was to analyse how project organisations cope with present project complexities and how project organisations respond to an increase in complexity. The goal was also to illustrate how project organisations increase their complexity, what their motivation was to include an extra objective and what the impact was on the project.

To contribute to the understanding of the subject and analyse the practical elaboration of project complexity and project management approaches, the following research question was used for this research:

What adaptations in the project management approach have to be made when a new objective is purposefully included in the project thereby increasing the number of involved interest groups?

Explanatory case study

An explanatory case study, with four cases, was used to determine if and how project organisations adapted their project management approach, after the inclusion of a new objective and thereby increasing the number of involved interest groups. In comparison with the results from an individual and cross-case analysis, the needed adaptations for a successful response to the increase in number of involved interest groups could be determined.

In preparation for the case study a literature study was performed to review the available knowledge on project complexity, project stakeholders, project success and project management approaches. Based on the literature study a theoretical framework was developed, describing two project management approaches and their corresponding project management activities. The first approach describes a management style with a focus on control, including a strict definition of the goal and a focus on front-end analysis. The second approach focusses on flexibility and is most suitable for projects with many uncertainties and a broad goal definition.

For the case study, 11 management professionals from four different cases, were interviewed. The selected cases are all infrastructure construction projects, in which an extra objective was purposefully included in the project by the project organisation. Based on the interview results and a project document review a case analysis was performed, describing the project characteristics, project complexities, the extra objective and project success. The theoretical framework, based on five concepts of project management approaches from the literature, was used to determine the project management approaches before and after the decision to include an extra objective to the project. On this basis, the changes in the project management approach could be determined.

The results from the individual case analysis were used for the cross-case analysis, in which the different subjects were compared to determine the relations between the adaptations in the project management approach and the project characteristics, complexity, objective and project success.

Expert session

In addition to the case study, an expert session with sixteen management professionals was organized to discuss the results and extend the data used to support the conclusion of the research. The experts were, among others, asked too to determine their willingness to change the project management approach when significant changes to the project were applied. In addition, the experts were asked to specify if they ever changed the project management approach on one of their construction projects. These results were than compared with the findings of the case study.

Results

The case study illustrates that for all four cases the social complexity was increased by the addition of an extra objective in which an extra interest group was included to the project. Social complexity can be described as complexity as a consequence of a large number of external stakeholders involved on the project.

The changes to the project management approaches as a consequence of this extra objective, were in three of the four projects small to none. Only in one of the projects, considerable changes in the approach were determined. In this project the extra objective was not properly assessed before inclusion and as a consequence, multiple difficulties occurred on the project. These difficulties and other problems in the collaboration with the contractor, caused the interpretation of project success, by the project organisation, to decrease. As a consequence, to this decrease the project organisation shifted from a flexible approach to an approach focussed on control.

The project organisations had different motivations to include the extra objective, for example: improving appreciation from the client or external stakeholders, a reduction of potential risks or continuation of the project. One motivation all projects had in common, the project organisations felt the responsibility for the direct surroundings of the project.

The expert session illustrated that most project management professionals are willing to change their project management approach, when the project is substantially changed, due to for example, a significant change in the project complexity. Nevertheless, the results do also illustrate that this measure does not happen very often. The results of the expert session would suggest that project organisations are not flexible enough to adapt the project management approach, or the extra objectives or scope changes are not significant enough to motivate or force project organisation to adapt their approach. Which corresponds to the projects of the case study in which in three of the four cases the extra objectives were relatively small compared to the main objective and had no negative impact on the planning or budget of the project. In two of the projects, the organisation only facilitated the execution of the extra objective, where the other two project organisations executed the work themselves.

FINAL CONCLUSION

The cases investigated showed limited flexibility; the new included objectives did not significantly impact project planning, budget or the primary objective. As a consequence, no or limited adaptations to the project management approaches needed to be made by the project organisations.

No conclusion could be drawn on the needed adaptations, because the project organisations showed limited flexibility by only including an extra objective in which the effect on the project were neglectable. This conclusion does however illustrate that project organisations could include and extra objective to their project and thereby increase the number of involved interest groups, without any needed adaptation to the project management approach, provided that the following five conditions are met: [1] the extra objective is small of scale, [2] the project organisation acts a facilitator for the execution of the extra objective, [3] the objective is included to the project in the design phase, [4] complexity dimension "social complexity" is present on the project and [5] the extra objective is properly analyses and a supporter for the objective is appointed.

Recommendations

The research recommends project organisations of large infrastructure construction projects to determine the expected project complexities on the project. The determination can be done on the basis of the available literature, for example by the use of the TOE-framework (Bosch-Rekveldt, Jongkind, Mooi, Bakker, & Verbraeck, 2011). Based on these determined complexities, in collaboration with all project participants, the

most suitable project management approach for the project should be determined. Thereby improving awareness for the project complexities, creating a shared understanding of the project approach and creating the opportunity to increase the level of project success by increasing an already present project complexity in the design phase of the project.

The developed theoretical framework from this research could be used to further analyse the composition of project management approaches in the current infrastructure construction projects. This would contribute to a better understanding of how project organisations compose a project management approach when specific complexities are expected. Further research could focus on the variable "terms of reference" as this was appointed most important during the expert session. Further research needs to determine the limitation of the two determined project management approaches. In addition, determine the limitations of an extra objective which can be included to the project without a too significant negative impact to the project.

Keywords: Project management, infrastructure construction projects, complexity, project management approach, adaptive project management, case study.

List of figures

List of tables

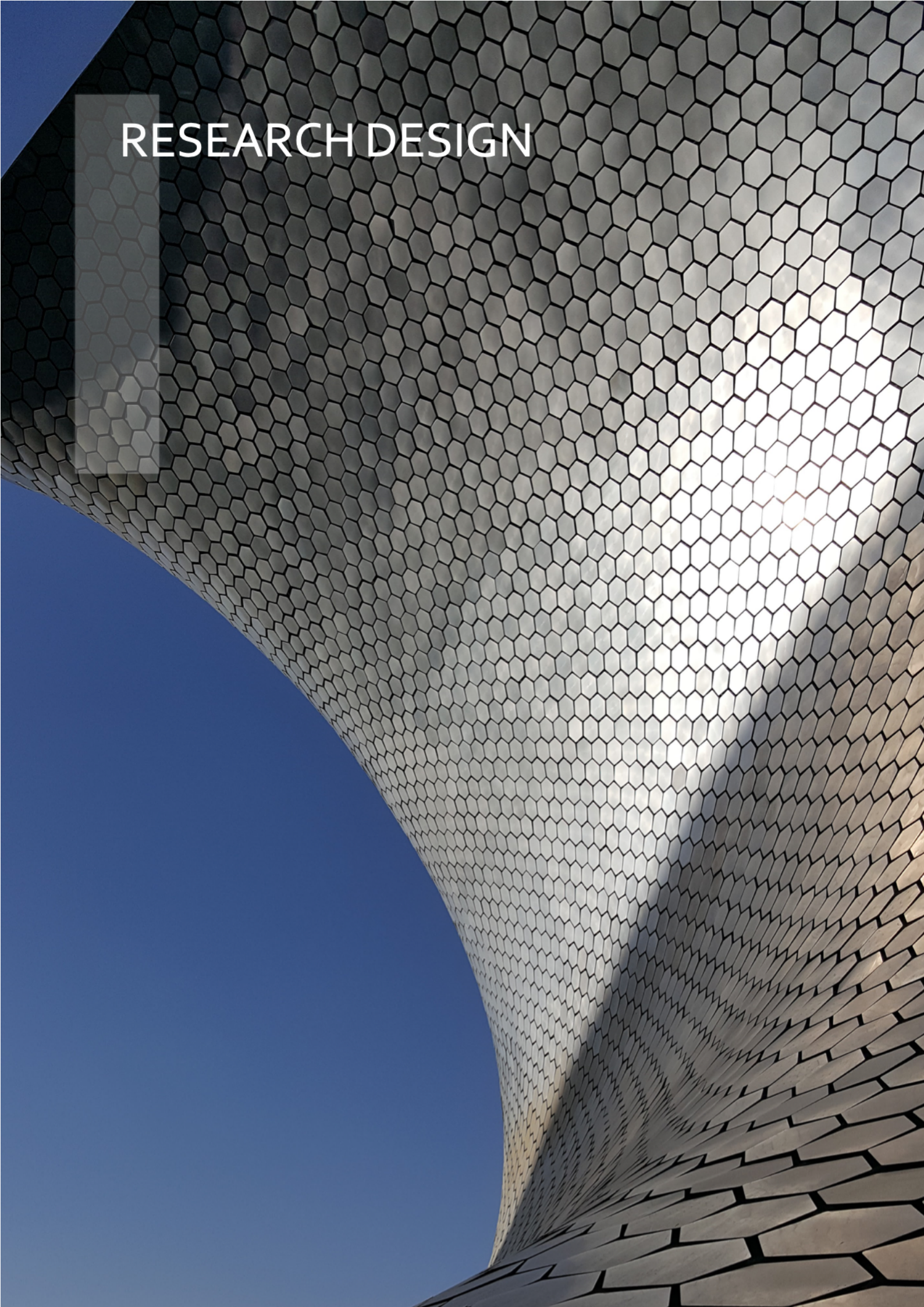
List of pictures

List of abbreviations

Abbreviation	Dutch	English
GNR	Goois Natuurreservaat,	*Nature reserve in Gooi area*
IB	Ingenieursbureau Amsterdam	*Engineering firm of municipality of Amsterdam*
IPM-model	Integraal projectmanagement model	*Integral project management model*
OG	Opdrachtgever	*Client*
ON	Opdrachtnemer	*Contractor*
RAW-Bestek	Rationalisatie en Automatisering Grond-, Water- en Wegenbouw	*Rationalization and automation of Ground, Water and Road constructions*
VTW	Verzoek tot wijziging	*Request for change (official document)*
WIOR	Werk in openbare ruimte	*Construction works in public space*

Table of content

RESEARCH DESIGN



PART I

The following sections will elaborate on the context and problem statement of this research. The chapter starts off with a general introduction about the current infrastructure construction projects in the Netherlands followed by an insight on the problem this industry is currently facing. To get a better understanding of the problems and possible solutions a research was set up. The goal and research question for this research can be found in the paragraphs 1.2 and 1.3. Paragraph 1.4 provides a reading guide for the report. Based on these definitions the research design was developed which can be found in chapter 2.

1. Context

The *Cobouw*, a Dutch newspaper for the construction industry, dedicated multiple articles on the recently started tunnel and train station construction project "Zuidasdok" in Amsterdam. "Zuidasdok already €100 million more expensive" (Stil, 2019), "First delays for Zuidasdok, even before start of the execution"(Clahsen, 2019), "Zuidasdok delayed, project more complex than expected" (Doodeman, 2019). This €1,4 billion project was initiated in 2012 and would be one of the largest infrastructure projects in the Netherlands (Het Parool/ANP, 2019). The realization of a highway tunnel and new train station is needed to adjust for expected traffic numbers and improve the connectivity of Amsterdam. Execution of the works started in 2019 and it was expected to be finished in 2028. However, only two months in execution and the work was already €100 million more expensive than budgeted (Stil, 2019). The project is, by the contractor and initiators of the project, identified as more complex and riskier than expected (Molijn, 2019).

This example is not a standalone case, the list of infrastructure construction projects with excessive cost overruns and delays is long (De Leeuw, 2019a, 2019b, 2019c; R. Koops, 2019b). According to the Economisch Instituut voor de Bouw (Economic institute for the construction sector), an increase in delayed infrastructure and water projects is clearly visible (Koenen, 2019). The Dutch economic institute for the construction sector, published that 20% of the infrastructure construction projects and 30% of the water related construction projects are delayed in the execution phase (EIB, 2019).

ZuidasDok, Amsterdam
Start of project: 2019
Contract: D&C
Delay: > 2 years
Costs: > €100 million extra
Problem: Project more complex than expected. Last-minute changes on the design have a big impact on the project.

Source: (Doodeman, 2019b)

Ring Groningen
Start of project: 2019
Contract: D&C
Delay: ± 36 months
Costs: > €1 million extra
Problem: rejected final design was the cause for an internal quarrel

Source: (De Leeuw, 2019b)

As illustrated by Chou & Yang (2012, p. 47): "With the developments in society, the construction projects tend to grow in scale, involving vast numbers of professionals, long life cycles, and complex interfaces. As a consequence, the types and quantities of construction-related information have become quite large and complex." If processes on the project are too complex to understand, participants on the project lose track of which tasks need to be executed and the project comes to a standstill (Van der Vaart, 2019). Bil & Teisman (2017) describe this to be the reason that project participants, and especially public authorities, prefer avoiding too much complexity to be able to understand the project and its tasks.

There is however another view on the issues of large construction projects. The great uncertainty in estimations on these mega projects cannot be the only reason for these problems, as argued by Flyvbjerg (2008). In many of these projects there is a tendency for 'strategic misrepresentation' in which participants deliberately under-estimate cost and time for political and strategic reasons (Flyvbjerg, 2008). Also 'optimism bias' is present because people are naturally inclined to estimate things more positively than one could objectively derive from practice (Flyvbjerg, 2008). And lastly, 'technological sublime' where participants focus on the latest technology, drawn to new technology, aesthetics and other novelties. Politicians and engineers feel the temptation to go where no one has gone before (Trapenberg Frick, 2008).
And because of the three problems, simplifying the project, dividing the project in smaller projects, narrowing the objective of excluding systems or tasks, would not solve all these cost overruns and time delays. Next to this, reducing the complexity and uncertainty could make a project too simple (Giezen, 2012). "Too simple projects with a focus on keeping a tight control on time and budget, could lead to an underperformance in integrating different sectors and influences that might add value to the project" (Giezen, 2012, p. 789). Putting main focus on simplification of the project and reduction of complexities and uncertainties results in the risk of ignoring the project's strategic potential. Parties could end up in a lock-in, the chosen direction of solutions is narrowing, and other possible solutions disappear (Bil & Teisman, 2017).

Project Stationsplein Oost in Utrecht serves as an example of a complexified project with a successful outcome (see info table on the next page). Increasing project complexity, by increasing the number of problems and possible solutions, leads to synergies and unique solutions (Bil & Teisman, 2017). The Stationsplein Oost project got stuck because parties focused on their own interests and solutions. The project manager initiated to take a step back and complexify the project by introducing more subsystems, problems and possible solutions. As a consequence, multiple problems and solutions got linked and created new integral design possibilities. "The project was more complex on process, structure and content but finding the right and broadly supported solution was made easier" (Bil & Teisman, 2017, p. 48).

Sealocks IJmuiden
Start of project: 2016
Contract: DBFM
Delay: > 27 months
Costs: > €220 million extra
Problem: Design proved impossible during realization

Lightrail Hoekselijn
Start of project: 2014
Contract: UAV
Delay: > 2 years
Costs: > €90 million extra
Problem: More complex than expected. Multiple malfunctions in the software, bridges and installations.

And even if reducing complexity would reduce possible delays and cost overruns, reducing complexity is not always possible, as changes to those large construction projects are inevitable due to for example ground conditions, incomplete scope definitions and client's requirements (Eriksson, Larsson, & Pesamaa, 2017). On the one hand, complexity is mentioned to be the cause for many cost overruns and delays on infrastructure construction project (Rijkswaterstaat, 2019), where on the other hand, increasing project complexity stimulates the integration of different project sectors to possibly increase the project's value or project support and therefore making some endangered projects feasible again (Bil & Teisman, 2017; Wytzes, 2015).

1.1 Problem

Most current infrastructure construction projects have difficulties to finish on time and within budget. The complexity caused by the large number of systems and their interlinkages, causes most large and complex construction projects to be over budget and not finished on schedule (Flyvbjerg, Bruzelius, & Rothengatter, 2014; Morris & Hough, 1987; Williams, 2005). Rijkswaterstaat, the Directorate-General for public works and water management of the Netherlands, published a report in May 2019 on the challenges and ways of improvement for the infrastructure construction sector in the Netherlands. The report, stresses that complexity on these projects has increased, and this increase will continue (Rijkswaterstaat, 2019, p. 18). Rijkswaterstaat advice is to improve preconditions for these projects, by among others, limiting their complexity (Rijkswaterstaat, 2019, p. 8) and introduce a "two-phase-process" for projects with a high complexity, in with the budget for the project is determined after the design and engineering phase (Rijkswaterstaat, 2019, p. 7). After these phases more information is known, which leads to less uncertainties and risks.

On the other hand, researchers emphasize the opportunities and benefits of (extra) complexity to the project (e.g. Bil & Teisman (2017)). Simplified projects have the tendency to underperform in the integration of solutions (creating synergies), keeping a tight schedule and keeping the project within budget (Giezen, 2012). Besides this, Hertogh (Cohen, 2015) emphasizes that "infrastructure can eventually be cheaper when more functions are added, sometimes projects need to be broadened and complexified to improve satisfaction, to add more energy to the project". Increasing project complexity stimulates the integration of different project sectors to possibly improve the projects result (Wytzes, 2015).

If project complexity creates the opportunity to improve the project, it can be suggested that the way project organisations cope and manage complex projects could be the reason why so many of these projects are delayed and over budget and not necessarily the complexity itself. The literature describes the types and characteristics of most complexities these infrastructure construction projects face.

How complexifying revived Stationsplein Oost, Utrecht
After years of negotiation, planning and cancelations, a new masterplan for the area around Utrecht central station was established in 2003. Part of this masterplan was the realization of a new square between the new train station and the shopping center: Stationsplein Oost. All participating parties focused strongly on their own interests and saw every opportunity as a risk to their interests. Years of difficult and slow negotiations did not lead to a design supported by all parties. This changed when in 2010 the project was complexified by the introduction of new possibilities, problems and solutions. This expansion of the project resulted in synergies and a new integral design. Even though in this approach the project was financial, technical and managerial more complex, finding a broadly supported solution was easier. Previously separated solutions and problems were combined to generate an integral and high-quality design (Bil & Teisman, 2017). The project was finished in 2019 and includes an open square, surrounding food and shopping facilities, a large rooftop and the largest bicycle parking garage in the world.
Source: Bil & Teisman (2007)

The literature also describes multiple project management approaches for project organisations suitable for projects with complexities. For example, the research of Burns and Stalker in 1961, who describe two management styles: mechanic vs. organic. In which the mechanic approach is focus on a high degree of control and organic, focussed on flexibility. The available knowledge of project complexity and project management approaches will be elaborated in sections 3.1 and 3.5 of this report.

In an ideal situation, project organisations would benefit from project complexity, as described by Hertogh (2015) and Wytzes (2015). Project organisation should create a positive link between project complexity, project performance and the project objective (Bil & Teisman, 2017; Voinov & Bousquet, 2010). However, project organisations face difficulties coping with the current static and dynamic project complexities. Next to this, every project has its own characteristics, therefore requires a fit-for-purpose management approach to successfully achieve all objectives (Hertogh & Westerveld, 2010). As a consequence, to the difficulties most project organisations face, these parties try to reduce project complexities and uncertainties to keep projects on time and on budget. Unfortunately, this solution takes away the opportunity to expand the objective of the project to improve the project success, by for example creating one solution for multiple problems or creating more support and appreciation by involving more participants to the project (Bil & Teisman, 2017; Giezen, 2012). A project management approach capable of coping with project complexities could improve project success and could provide the opportunity to increase project complexity to improve the project.

While research describes different project complexities and project management approaches, not much research is executed on the practical elaboration of these complexities and management approaches in the current infrastructure construction projects.

Based on the described problem, the following problem statement was developed:

Problem statement

Project organisations have difficulties coping with an increasing level of complexity on the current infrastructure construction projects and describe the reduction of this complexity as possible solution. The literature however describes the opportunities and benefits project complexity could provide to those projects. There is a knowledge gap on the practical elaborations of project management approaches and increasing project complexities to cope and manage the project complexities on large infrastructure construction projects.

1.2 Research objective

As illustrated in the previous section, complexity of a project can lead to cost and time overruns. However, if project complexity is managed well, it can have a positive effect on the project (Bil & Teisman, 2017). Broadening and complexifying an infrastructure construction project could improve project satisfaction and could reduce project cost (Cohen, 2015). By implementing more functions to the project, thereby involving more project participants and generating more budget for the project. This extra objective or complexity could make a project feasible or could increase support or appreciation for the project from parties involved.

The literature describes two types of project management styles, as will be elaborated in section 3.5. The purpose of this research is to analyse how these project management approaches are implemented in the current infrastructure construction projects. But also, if and how project organisations adapt their project management approach in case the complexity of the project is increased.

The cases which are investigated in the research implemented an extra objective to the project and thereby increased their project complexity. The research also analyses these extra objectives, their impact on the project and the motivation of the project organisation to include an extra objective to their project.

The research was based on the following research objective:

Examine the adaptations in the project management approach, when a project organisation purposefully incorporates a new objective to the project and thereby increasing the number of interest groups.

Based on the results of the research provide an insight in the practical elaboration of project management approaches and purposefully increasing project complexity to infrastructure construction project in the Netherlands.

1.3 Research Question

On the basis of the problem statement and the goal of this research a research question was composed. This research question will be supported by a set of sub-questions. On the basis of the project goal the following question was formulated:

What adaptations in the project management approach have to be made when a new objective is purposefully included in the project thereby increasing the number of involved interest groups?

The research question emphasizes that the project organisations purposefully decided to include an extra objective to the project. The inclusion is a conscious decision by one or more members of the project organisation, to improve the outcome of the project or reduce the risks on planning or costs during the execution of the project.

Interest groups are groups of people or parties/organisations that have some interest or stake in the project. In case of this research it is of importance that not an individual, but a group of people or parties/organisations is included to the project (Ackermann & Eden, 2011). Because only with the inclusion of a group of people or party/organisation the project complexity is increased.

The research starts with examining factors of project complexity, project success and project stakeholders and the relations between these factors. Secondly several project management approaches, available in the literature, are analysed to describe the activities to which these approaches can be identified. Afterwards, a case study including a cross case analysis was performed. The research design is described in chapter 2. The main research question is supported by the following four sub-questions.

1. What are the consequences on project complexity of an increase of the number of interest groups on the project?
2. What project management approaches suitable for simple and complex infrastructure construction projects are defined in literature?
3. What changes in the project management activities can be observed, when an extra objective is included to an infrastructure construction project?
4. What is the preparedness of project managers to adapt their project management approach?

As clarification, a set of project management activities determine the project management approach of the project organisation. This will be elaborated in sections 3.5 and 3.6.

The first question identifies the relation between number of interest groups and project complexity, needed to describe the complexity and increase in project complexity on the project of the case study. The second research sub-question was used to identify what project management approaches were described in the literature. In literature the project management approaches are described by a set of project management activities. This knowledge was needed to relate the identified project management activities from the projects from the case study with a specific project management approach. The results from this question were used to answer the third research question, where the changes in these project management activities and thereby project management approach could be analysed.
On de basis of the results from the individual case and cross case analysis some questions arose which were presented during an expert session. Which answers the fourth and last sub-question.

1.4 Reading guide

The research can be divided in four phases. The first two phases of the research are used to build a framework for the research. This framework consists of a description of the context of the research in chapter 1, the research design (chapter 2) and literature study (chapter 3). The literature study concludes with the answers to research sub-questions 1 and 2. The third phase of the research is focussed on the case study. This phase includes a description of the case study approach (chapter 4), the case analysis of four cases (chapter 5) and the cross-case analysis (chapter 6). The theoretical framework developed in chapter 3 (literature study) is used to perform the case analyses. The final phase of this research is the conclusion, including an expert session (chapter 7), discussion (chapter 8), the final conclusion and recommendations of the research (chapter 9). The research approach is also graphically illustrated in figure 1. The research methodology and framework are described in chapter 2.

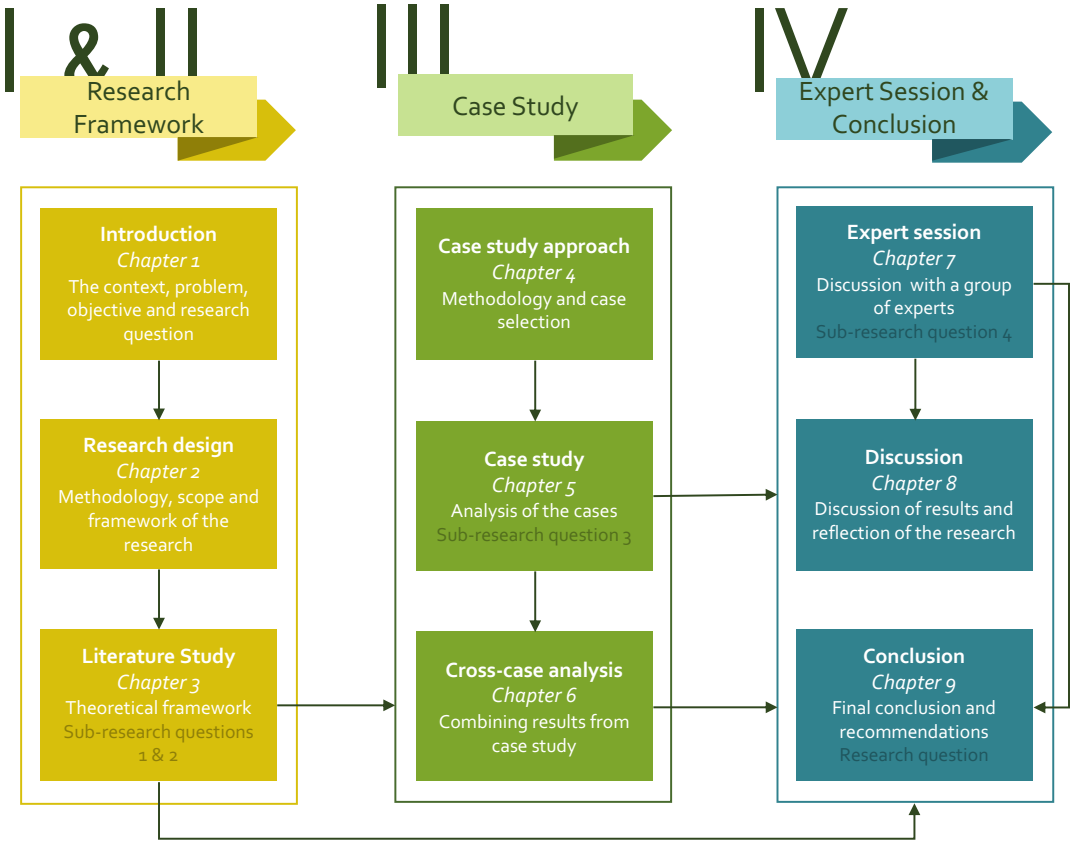


figure 1 Research approach of the report

2. Research Design

This chapter describes the used methodology in the research, the scope of the research and an overview of the developed framework.

2.1 Methodology

Dependent on the data required to answer a research question, multiple research methods could be used, such as a survey research, experiment, case studies, grounded theory approach and desk research (Verschuren & Doorewaard, 2010). The preferred research method depends on three conditions: (1) the form of the research question, (2) the extent of control a researcher has over behavioural events and (3) whether focus of the research is on contemporary or historical events (Yin, 1994). Because this research included a "What" research question, the behavioural events could not be controlled and the research focussed on contemporary events, a case study including several interviews was the fit best. Compared to the other methods, case studies are a qualitative research method that can deliver in-depth information of ongoing or completed projects. A case study could illustrate what and why decisions were taken, how they were implemented and with what consequences. These "decisions" could also be "events" or for example "occurred processes".

In case studies a distinction could be made between three variants: exploratory, descriptive and explanatory (Yin, 1994). Exploratory case studies are mostly done in the initial phase of the research to explore the area, this type of study has an inductive character. Descriptive and explanatory studies are mainly based on the results of a literature study or review. The case studies in those cases are used to compare the theory with the practice, these types therefore have a more deductive character. For this research an explanatory cases study method was used.

Case studies most often include interviews which can be structured or unstructured or something in between. In unstructured interviews, there is no standard questionnaire, but questions arise during the interviews. This approach gives the opportunity to elaborate on answers of the respondents. A good method when personal experiences and thoughts are important for the research. In a structured interview there is a protocol for the questions. This way data generated by the interviews is easier to compare. This approach of interviewing is mostly used in a survey, where unstructured or semi-structured is mostly used in case studies. In a semi-structured interview, which was used for this research, a list of questions was drawn-up to make comparing cases possible, but the opportunity was created to elaborate on answers to extend the information generated in the interviews.

The first phase of the research was focussed on finding the available information on the subjects of the research in the literature. For the literature study, five subjects of interest were selected to provide a sufficient level of knowledge based on the literature to analyse the cases on their complexities and success. Determine their project management approach before and after the inclusion of an extra objective. Finally analyse the involved stakeholder group, the extra objective and its effects on the project management approach and complexity. The results of this literature study can be found in part II of the report.

The literature study was used to develop a theoretical framework. This theoretical framework describes two project management approaches and their related project management activities. One for relatively simple infrastructure construction projects, the other for complex infrastructure construction projects. By comparing identified activities on the case projects with the activities from the framework the project management approach could be determined. This framework was then used to develop the interview protocol for the case study (see figure 2, p 9).

As described earlier, most project management approaches are a balance between the two extremes, a division was made between 5 project management approaches. A score of 1 was given to the focus on control approach and a score of 5 was given to the focus on flexibility approach, score 2, 3 and 4 are a balance between these two approaches. Based on this framework the second phase of the research was initiated, during this phase the framework was compared with the practice. The case study consisted of a set of 4 projects. All the selected cases are infrastructure construction projects which purposefully included a new objective during the project. More on the selection of the cases and the method of the case study, is described in part III of this report.

Chapter 5 of the report described the individual case analysis in which the cases are analysed on their characteristics, complexity, project success, the extra objective and project management approach. The activities from the theoretical framework were used to identify the project management approach of the project organisation before and after the inclusion of the new objective. These results were then used to perform a cross case analysis, in which the results from the case analysis were compared. These illustrate the similarities and differences in consequence of the inclusion and the process towards and during the inclusion.

The last phase of the research includes the results of an expert session, organized to discuss some outstanding questions arisen from the case and cross case analysis. This expert session was executed by a group of 16 experts from APPM, which were all not related to the cases investigated for the research. Based on the results from the cross-case analysis and the extra information from the expert session, the discussion and conclusion were drawn-up (see figure 2). The discussion is included with the limitation of the research and the conclusion is supported by a list of practical and theoretical recommendations. The conclusion, discussion and expert session can be found in part IV of this report.

2.2 Scope of the research

A scope was required to define the boundary limits of the research and define what was included and excluded in the research. The research was limited to integral projects in the fields of infrastructure construction projects, including multiple actors from different disciplines. The research was executed in collaboration with APPM management consultants, who provided most of the data for the research. Mainly for this reason, all interviewees represented the client side of the project organisation. Beside this, many different objectives could be included on the project, this research however focussed on project organisations who included an extra objective and thereby including an extra interest group to the project.

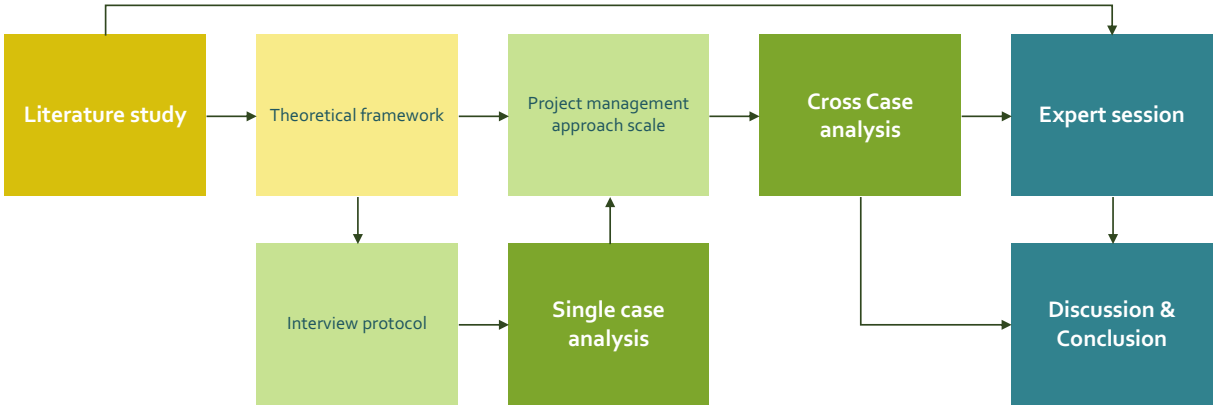
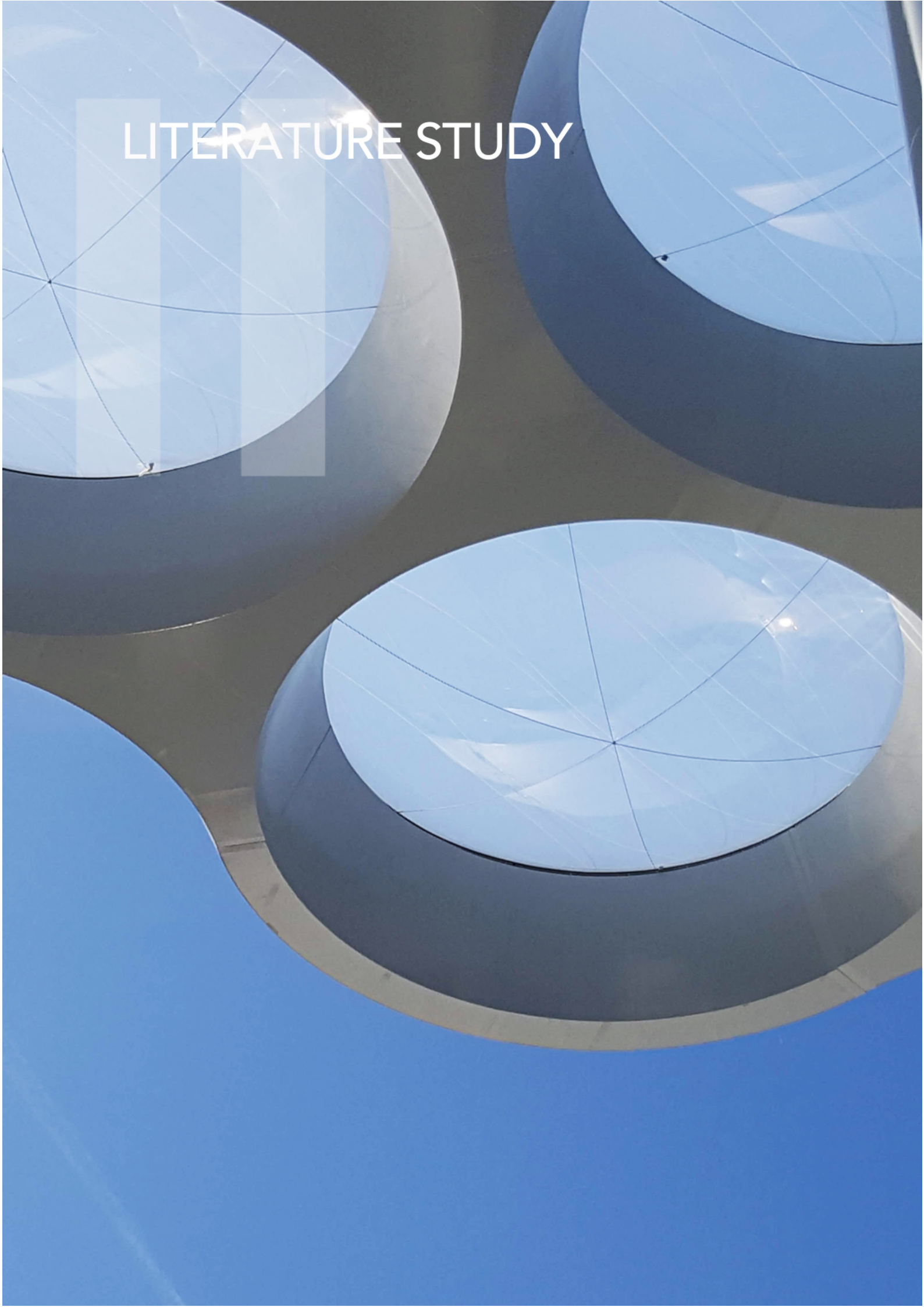


figure 2 Framework for the research. The colours correspond to the colours in the research approach in figure 1.

II

LITERATURE STUDY



PART II

As the basis for the research, a literature study was performed. The results from the literature study form one of the three essential information sources to conclude the research. The other two sources of information are the experiences from the interviewees from the case study and knowledge gained from all available documentation on the cases from the case study. More on this can be read in part III of this report.

3. Literature study

In order to structure the literature study, a selection of five elements has been drawn up to provide a basis for the research and the theoretical framework. These elements are selected based on the research question and sub-questions and provide the required information to execute the case and cross-case analyses. The definitions from the literature were used to analyse and describe the cases. The literature study concludes with a theoretical framework to determine the project management approach of the cases as will be described in part III of this report. The five elements selected for the research are:

1. Definition of complexity in infrastructure construction projects
2. Description of project success
3. Project phasing in construction projects
4. The influence of stakeholders on a construction project
5. Project management approaches for construction projects

In the literature research, the elements are examined individually and in conjunction with each other. Via a quick scan, of the available literature on the described elements, a large number of articles and researches were found. Based on the year of publication, researchers, publisher, number of times quoted and relevance to the scope of the research a selection was made to be analysed to create an overview of the available definitions of the elements. This method of literature review leads to the snowball principle in which references in interesting articles were used to find new interesting articles. In addition, recommendations from fellow students, colleagues and committee members were used for suitable reports and papers.

The findings of this literature study are described in the sections below. The chapter ends with a conclusion that also includes the theoretical framework. This framework consists of described two project management approaches characterised by a list of project management activities. These activities are used to compare the available scientific literature with the practice in the case study.

3.1 Project complexity

Multiple interpretations can be found on the definition of the complexity of projects. There is still a lack of clear understanding of what constitutes project complexity (Bakhshi, Ireland, & Gorod, 2016). Bakhshi et al. performed an extensive literature review and found three primary models of project complexity: The Project Management Institute view, the System of Systems view and the Complexity Theories view. Based on their review the writers agreed to define complex projects as "An intricate arrangement of the varied interrelated parts in which the elements can change and constantly evolve with an effect on the project objectives" (Bakhshi et al., 2016, p. 1203). In other words, complex projects consist of multiple elements, which are correlated and affect each other. Additionally, the elements of complex projects continuously evolve, which affects the project objectives and creates uncertainties during the design and implementation of the project.

3.1.1 Definitions of project complexity

According to Geraldi & Adlbrecht (2007), complexity can be divided into three concepts: the complexity of faith, the complexity of fact and complexity of interaction. The complexity of faith can be described as the complexity involved in creating something unique, solving new problems or dealing with a high level of uncertainty (Geraldi & Adlbrecht, 2007). A large number of possible outcomes characterizes this sort of complexity. In such situations, the management should be flexible because of the uncertainty and lack of factual information; one should have faith in the solutions. The complexity of facts refers to a large number of interrelated elements. The management team will not have enough time to collect and analyse all elements and relations and will have to generate decisions without having all the required information. The last complexity that of interaction is usually present in interfaces between locations, multiculturality, political ambiguity. High complexity of interfaces will lead to a high number of meetings, messages and possible misunderstandings (Geraldi & Adlbrecht, 2007).

The three groups of complexity tend to develop in the same pattern, namely starting very high at the start of the project, decreasing in the procurement and production phase and increasing towards the end of the project. The complexity of interaction was specified as most intense, according to their research (Geraldi & Adlbrecht, 2007).

Another model of project complexity is that of a system of systems, which can be described as a set of interdependent systems with their capabilities, that operate together to achieve additional desired capabilities. (The MITRE Corporation, n.d.). However, researchers, as Boardman & Sauser (2006), tried to define this term based on characteristics instead of an abstract definition. Their characteristics are the most cited for system of systems: autonomy (system makes independent choices), belonging (the ability to choose to belong to SoS), connectivity (the ability to stay connected), diversity (evidence of visible heterogeneity) and emerge (formation of new properties as a result of developmental of evolutionary process). Gandhi, Gorod, & Sauser, (2008) combined these characteristics with the definition of flexibility to illustrate what is needed to create an "optimized space" where a point of maximum adaptability for a system of systems can be found. All characteristics need to be in this optimized space to achieve "flexibility dynamic" as they call it. They illustrate that this flexibility in system of systems is needed to be able to cope with the dynamic environment most large projects face nowadays. Figure 3 illustrates the "optimized space" and characteristics of the system of systems and what these characteristics need to be to achieve the flexibility dynamic.

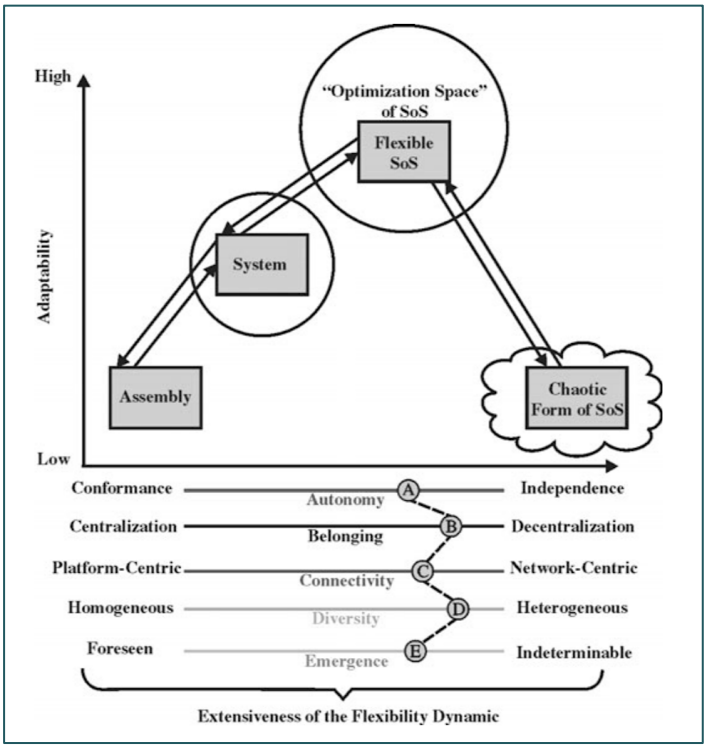


figure 3 Flexibility of System of Systems (Gandhi et al., 2008)

One of the problems with project complexity is that it is a highly subjective matter which is based on the project managers' perception. This perception of complexity is the sum of some aspects of project complexity, followed by a judgement of the element. The elements for this perception are the impact of the element and the influence the project manager has on that element, the experience of the project manager and the project context or contextual variables. How these elements are judged is based on the project managers interest, which is influenced by his role on the project and his personal values, (Kool, Bosch-Rekveldt, Hertogh, & Kraneveld, 2014).

The result of the high complexity of projects is a high degree of uncertainty which makes it challenging to define the scope, costs, duration and requirements of the project early on. There is also uncertainty on how different components interact when joined together as a system because of the interdependence of most components (Sapolsky, 1972). On top of that, the components remain subject to change throughout the whole project. To prevent losing their validity, an adaptable approach on schedules and budget is needed (Leijten, Koppenjan, Heuvelhof, Veeneman, & van der Voort, 2010). New forms of project management are developed to cope with these complexities and uncertainties.

Looking at the model developed by Hertogh & Westerveld (2010), a distinction is made between detail complexity and dynamic complexity. Both complexities require a different approach to project management to be able to cope with this. A high level of detail complexity requires systems management. This form of management is characterized by decomposition of time, end product and organisation as well as specific management processes. This management style can be seen as a control approach and most often uses breakdown structures to divide the systems into smaller, more manageable pieces.

A high level of dynamic complexity requires an interactive management approach (Hertogh & Westerveld, 2010). This approach focusses on alignment, redefinition of the problem and change of scope, using short term predictability and the application of variation. When both the level of dynamic and detail complexity is high, the dynamic management approach could be the solution. This approach is a balance between the systems and interactive management approaches, dependent on the complexities present in the project. There are, however, some tensions between these two management approaches. Where the systems approach is decisive, focused on hard results and content and stability, the interactive approach is built upon support, appreciation, co-operation and anticipation on dynamics. It is for this reason crucial that project organisation define the expected complexities at the start of the project to create a fit for purpose management approach. Tailoring the project management style to the project characteristics to create this fit for purpose management approach is essential for two practical reasons (Eriksson et al., 2017):

1. Complex projects need the right project management approach; therefore, the level and type of complexity needs to be identified in early project stages. The higher the complexity, the higher the need for the fit-for-purpose project management approach.
2. Implementation of flexibility-focused or dynamic project management approaches involves collaboration, explorative learning and adaptation. Due to their synergism and systemic nature, activities strengthen each other's effects and should thus be implemented together, not in isolation.

3.1.2 Identification of project complexity

To create a fit-for-purpose project management approach based on the characteristics of the project, the complexity of the project needs to be identified, as mentioned by Eriksson et al. (2017).
De Bruijn, De Jong, Van Zanten, & Kortsen (1996) developed three dimensions to characterize complexity on administrative, automizing, civil or military technology, infrastructural or spatial development projects. De Bruijn et al. (1996) makes a distinction between technological, social or organisational complexities.

Technical complexity

Technical complex projects are characterized by new and innovative techniques and materials, which create uncertainties in the realization and test phase of the project. The exact operations and placement of these innovations are, in most cases, uncertain (De Bruijn et al., 1996). Also, because of the long duration of most large infrastructure construction projects, new and improved technologies and systems could develop during the execution of the project, which could affect the requirements of the project.

Social complexity

Complex infrastructure construction projects have a significant influence on the surroundings and the environment. Large infrastructure construction projects have a large number of interfaces with its surroundings; this has consequences for its direct environment and for this reason, changes could have a significant impact on the current environmental, economic and societal relationships (Hertogh, 1997). De Bruijn et al. (1996) identify social complexity as a large number of actors involved in large construction projects. All these actors have their interests, requirements and wishes they would like to see to be realized or included on the project. Most actors have some connection, collaboration, dependencies or attitudes towards each other, which complexifies the situation Hertogh (1997). The number of involved interest groups could vary per project phase, and not all information about the project is equally distributed over the actors.

As a consequence, multiple risk perceptions on the project could arise, which could affect the project. Besides this, in most of these projects, there is an unbalanced distribution of benefits and burdens. The interest groups that experience the nuisance of the project are not always the actors that benefit when the project is finished Hertogh (1997).

Organisational complexity

Organisational complexity could occur in situations where the client acts complexifying; this means an increase in linkages between tasks or an increase in quality requirements for the project. Complex projects do not stand alone; most projects consist of multiple interfering projects or clients require coupling of more construction projects, sometimes with projects with different functions of purposes (Hertogh, 1997).

According to research from De Bruijn et al. (1996), there is an increase in organisational complexity when the project is more ambitious, large of scale, of long duration, including an incapable project organisation and a significant time pressure. As a consequence, the project organisation has to deal with more uncertainties and dynamics, and it will be harder to steer and align the involved actors.

Other complexifying factors are external goals which are not explicitly identified in the project requirements (Hertogh, 1997). These large infrastructure projects are often used the implement innovative technologies or improvement of the competitive position of the contractor or client.

These three dimensions of complexity could be expanded by Hertogh & Westerveld (2010) developed dimensions: financial complexity, law and regulation complexity and time complexity.

Financial complexity

Complex projects could be characterized by a substantial financial investment of public or private money. Due to the uncertainties and dynamics these project face, making an exact calculation of the financial budget is almost impossible. This causes financial risks with possible significant losses of public or private money. For this reason, projects with this level of complexity reserve large sums of money for unexpected events or expenditures.

Law and regulation complexity

To execute large infrastructure construction projects, policymakers, architects and contractors must comply with a large number of rules and regulations. In many cases, these rules and regulation are not well aligned, which makes complying with them extra tricky. Large infrastructure projects are, in many cases, a sensitive topic in regional and national politics. Politics gets involved in every detail of the project and could postpone projects or works to wait for research outcomes or judgements (Hertogh, 1997). Also, the application for different permits from different political entities could lead to delays in the project and thereby causing new financials risks (Hertogh & Westerveld, 2010).

Time complexity

Characterizing for these large infrastructure construction projects is the long duration. In most cases, projects could take up to 10 to 15 years from initiation to completion. During this long period, changes on rules and regulation but also wishes and requirement of the actors could occur, which complexify the project (Hertogh & Westerveld, 2010). Also, most infrastructures are relatively static with a life span of decades. This static character could create tensions with its dynamic environment, including fast-changing opinions, necessities and requirements. Most large infrastructure construction projects are involved with political attitudes and interest and their rules and regulations (Hertogh, 1997).

T Technical complexity	O Organizational complexity	E External complexity
High number of project goals	High project schedule drive	Level of competition
Non-alignment of project goals	Lack of Resource & Skills available	Instability of project environment
Unclarity of project goals	Lack of Experience with parties involved	Company internal strategic pressure
Strict quality requirements	Lack of HSSE awareness	Lack of experience in the country
Project duration	Interfaces between different disciplines	Remoteness of location
Size in CAPEX	Number of financial sources	Interference with existing site
Number of locations	Number of contracts	Required local content
Newness of technology (World-wide)	Number of different nationalities	Lack of company internal support
Lack of experience with technology	Number of different languages	Political influence
High number of tasks	Presence of JV partner	Dependencies on external stakeholders
High variety of tasks	Involvement of different time zones	Variety of external stakeholders' perspective
Dependencies between tasks	Size of project team	Number of external stakeholders
Uncertainty in methods	Incompatibility different pm methods / tools	External risks
Involvement different technical disciplines	Lack of trust in project team	
Conflicting norms and standards	Lack of trust in contractor	

figure 4 TOE model for grasping project complexity (Bosch-Rekveldt et al., 2011)

In addition, most large and complex projects are rarely characterized by a strait and step-by-step process. In most cases, the project is an iterative process with continuous feedback and feedforward activities in all phases of the project, for this reason indicating a 'point of no return' is almost impossible.

Bosch-Rekveldt, Jongkind, Mooi, Bakker, & Verbraeck (2011) developed a framework, the TOE-framework, to asses project complexity. Applying this TOE-framework for a project generates a footprint which could be used to asses where complexity on the project is expected. The framework could improve project management by knowing, understanding and characterizing these complexities from the start and in subsequent project phases on the project (Bosch-Rekveldt et al., 2011). The framework consists of three categories: technical, organisational and external complexities (see figure 4). The Framework is a guide for different parties and stakeholders on the project to discuss which aspects of the project make the project complex. Based on that outcome, more or less effort could be invested in, for example, risk management, process management or stakeholder management to deal with the project complexity.

The six complexity dimensions of De Bruijn et al. (1996) and Hertogh & Westerveld (2010), can be used to determine the present complexities on an infrastructure construction project. For this reason, these dimensions were used to determine which complexities were present on the case projects and which complexity was increased by the inclusion of an extra objective. The dimensions are, however, broadly defined and not specific enough to identify the specific source of the complexity. For this reason, in addition to the dimensions, the theory of Bosch-Rekveldt et al. (2011) was used to determine more specific, which complexity characteristics were present in the cases.

3.2 Project phasing

Large infrastructure construction projects could be characterized into five different phases. According to Koppenjan (2005), the five characterizing phases are: initiation, definition, design, realization and operation and maintenance (see figure 5, p.17)

During the first phase, the initiation phase, the problem is analysed, and the project is initiated by a project organisation or a client. The phase is finalized with an indication of the intended project results. During the definition phase, these intended project results are elaborated, including a definition of the expected role for the client and the project manager.

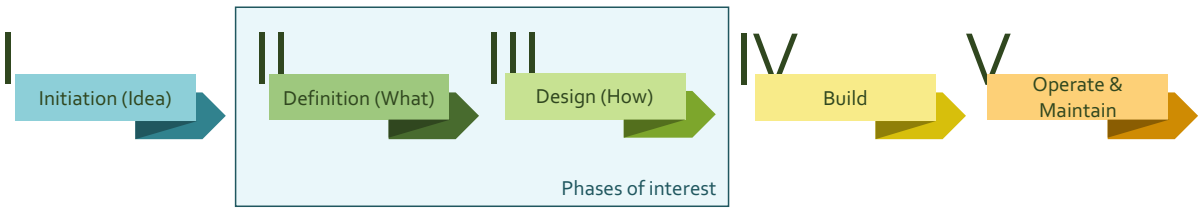


figure 5 The 5 phases of project management by Koppenjan (2005) included in the phase of interest for this research

The designated project manager develops the project definition and in rough detail, the project approach. This phase is also characterized by the definition of the list of wishes and requirements for the project. The scope of the project is thereby defined.

During the design phase, the third phase, the project results are elaborated and designed. In accordance with the list of requirements, the project team develops solutions and ideas to reach the objective of the project. During this phase, scope changes could be applied to for example combine projects, improve the solution to create a more efficient execution for the project, this phase and the definitions phase are particularity interesting for this research due to the flexibility in scope. During this phase, contracts are developed, and tenders are set up, all in preparation of the execution, maintenance and operation phase. During these last two phases, the project is realized, and the results are transferred, maintained and operated. Scope changes during the execution phase are expensive and must be avoided. However, this could sometimes be beneficial or necessary for the project (Koppenjan, 2005).

The concept of Koppenjan on project phasing was used to determine in which of the project phases an extra objective was included to the case projects.

3.3 Project success

A project can be defined as a set of activities that must all be completed in accordance to specific objectives by utilizing the recourses of a company (Bakar, Razak, Karim, Yusof, & Modifa, 2011). The set of defined activities in accordance with the specified objectives should, therefore, be completed to end a project successfully. Looking in history, a change in the objective for project success is visible, various forms to define project success can be found. "In the 1960s project success was defined by the technical terms: if the product works, the project was successful" (Khosravi & Afshari, 2011, p. 186). This changed in the 1980s where three objectives were introduced: [1] completion on time, [2] completed within budget and [3] delivered with the demanded level of quality according to the technical requirements of the project (Kerzner, 1987). Customer satisfaction was added to this list in the late 1980s.

The objectives as defined in the 1980s are also known as the Iron Triangle that places cost, time and quality in the centre of project success. This model for project success criteria is still inextricably linked to most construction projects nowadays. The method Earned Value Analysis (EVA), for example, provides a straightforward and consistent method for the evaluation of project performance based on two of the criteria from the iron triangle. The model also allows comparisons between projects utilizing the project indices SPI (schedule performance index) and CPI (cost performance index) (Howes, 2000). This method compares the estimated values for planning and costs with the actual output during the execution of the project. Not only does this give a clear and simple overview of the progress of the work, but the method also provides an index value to make a comparison with other projects possible. There are, however, some limitations: because the numbers are based on past performance, the EVA does not always give a sensible prediction in cost and planning for the project completion (Howes, 2000). Future work could be entirely different and unrelated to already completed parts. Next to this, the method does not take variations to the project into account in forms of additions or omissions to the project or its objectives (Howes, 2000), which is often the case in projects where there is much uncertainty at the start. Howes (2000), therefore suggests analysing and appreciating all changes, which have an impact on the relationship between work packages influencing cost and planning, by all parties on the project, including the clients. He emphasizes that variations to the original plan are an essential part of the project management process.

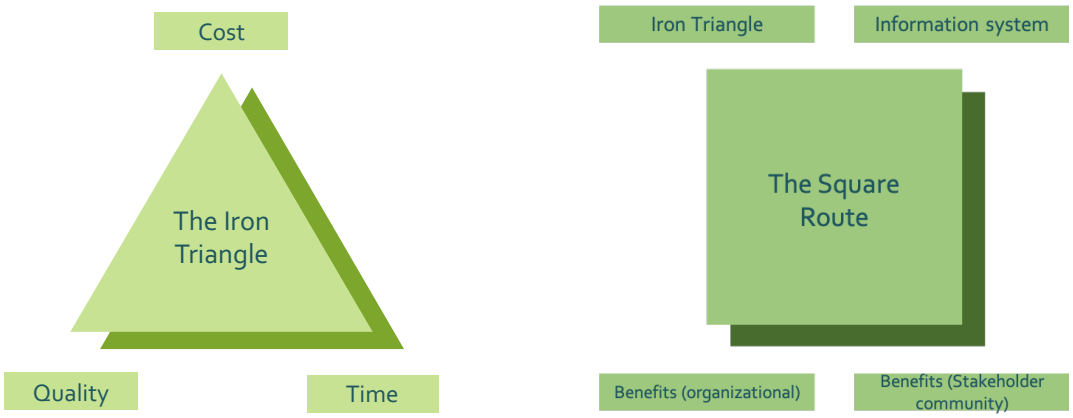


figure 6 The Iron triangle (left) and the Square Route model (right)

Although the iron triangle (see figure 6) is still used in many projects to measure project success, Atkinson (1999) illustrated the limitations of this method. Based on a literature study Atkinson (1999) introduces a new model: the square route method to understanding success criteria (see figure 6). In this method, he introduces the factors: "benefits on organisation level" and "benefits on stakeholder community". To be more specific, project success can be measured on the level of improved efficiency or improved effectiveness of the project organisation. Nevertheless, personal development and professional learning can be part of the success factors of a project (Atkinson, 1999; Crawford, Hobbs, & Turner, 2005).

Atkinson (1999) refers to earlier studies from himself Atkinson (1997) and Handy (1995) who described two types of errors: type I errors occur when something is done wrong, type II errors are if something is forgotten or not done well. According to Atkinson, the Iron triangle is a type II error in which the way the project manager measures success is not wrong but is missing something. The use of the square route would prevent these errors. "Measuring the resultant system and the benefits as suggested in the Square Route, could reduce some existing Type II errors, a missing link in understanding project management success" (Atkinson, 1999, p. 341).

Ribeiro, Paiva, Varajão, & Dominguez (2013) performed research in line with the previously discussed researches. In their research, they performed a survey with a group of medium and large Portuguese Construction companies to investigate if the success criteria for project evaluation changed. However, during their research, they discovered that completing the project within budget, time and according to the project requirements were still the most essential project evaluation criteria (the iron triangle). On the other hand, the research also illustrated that project acceptance by the customer became more important. The companies mentioned almost none of the factors from the research of (Crawford, Hobbs, & Turner, 2005) or Atkinson (1999). The only factor mentioned by the companies with some overlap is a high motivation of the project team as a success factor for the project outcome. This was however of much lower importance than the typical cost, time and quality criteria.

Project success could also be defined by project appreciation, to be more specific: the level to which the involved participants, appreciate the project results (Vuijk, 2005). Participants determine the success of the project by how much their interest is fulfilled on the project (Westerveld & Westerveld, 2001). Project appreciation can be divided into five types: appreciation from the client, the project participant, the contract partner, the user and the indirect interest groups. The interest of the stakeholder determines the level of appreciation for the project, for example, the main interest of the client is the result of the project, does the result fit all the requirements and is the project executed on time, within budget and with the required quality. The project organisation, however, has its ambitions and standards on how to execute the project. The level of project success for them could depend on their experiences of the working environment, the number of interesting and challenging tasks and a transparent project approach.

Most large infrastructure construction projects have a significant impact on the surroundings and environment (Hertogh, 1997). For this reason, the indirect interest group's appreciation is a significant part of the project success, as will be described in paragraph 3.4. Their appreciation can depend on the impact of the project, the nuisance during execution, and what this group receives in return. Also, the level of influence or involvement

Project Performance indicators	Reference
Construction cost	Cho, Hong, & Hyun (2009); Enshassi, Mohamed, & Abushaban (2009); Takim & Akintoye (2002)
Construction time	Cho et al. (2009); Enshassi et al. (2009); Takim & Akintoye (2002)
Quality	Enshassi et al. (2009)
Construction predictability, time predictability, Defects predictability, Client satisfaction with the service	Takim & Akintoye (2002)
Client satisfaction with the product	Enshassi et al. (2009); Takim & Akintoye (2002)

table 1 Project performance indicators from various researches (Alias, Zawawi, Yusof & Aris, 2014)

As mentioned by L. Koops, Bosch-Rekveldt, Coman, Hertogh, & Bakker (2016, p. 874) "Researchers in the field of project success agree on the fact that the judgement of project success depends on the perspective taken". For this reason, L. Koops et al. (2016) performed a research aiming at indicating the most important success criteria in the general perspective of public project managers in different Western European countries. Dependent on the perspective of the project manager (conventional project manager, product-driven project manager, parent-oriented manager, manager with a focus on stakeholders), different criteria were ranked as most important for project success. So not one criterion could be determined to be most important to determine project success, the criteria were dependent on the perspectives of the roles and norms and values of the country in which the project managers were active.

For the project-driven perspective, in were many Dutch project managers can be characterized, fit-for-purpose and meeting specific political and social factors within the given budget were ranked as most important for project success (L. Koops et al., 2016). The stakeholder perspective, also found in the Netherlands, focused on fulfilling the needs of shareholders, stakeholders and users and specific political and social factors.

There are more subjective indicators to evaluate project performance and project success. A list of project performance indicators can be found in table 1. These indices are generally divided into qualitative and quantitative indices. Construction cost and construction time can be scaled into quantitative indices (i.e. unit cost, award rate, construction speed, schedule growth etc.), whereas quality and client's satisfaction are of qualitative nature (i.e. system quality, turnover quality) (Alhazmi & McCaffer, 2002; Konchar & Sanvido, 2002; Ling, Chan, Chong, & Ee, 2004; Molenaar & Songer, 2002)

In the paper of Cox, Issa, & Ahrens (2003), the use of qualitative and quantitative key performance indicators in different industries is discussed. Based on a literature study, the researchers developed a list of commonly used indicators to measure the performance of projects in the general, civil and the construction industry. On this basis, the researchers developed a list of hypotheses which were tested with experts from the industry. In conclusion to this survey, the researchers showed a significant difference between the general, heavy civil and industrial construction sectors in the use of KPI's.

Further analysis indicated differences in KPI's according to the level of management and the number of years of experience of the experts in the industry. The six indicators consistently perceived as being highly significant according to all the sectors were: Quality, On-time completion, Cost, safety, $/unit and units/MHR. As a conclusion, the researches advise the construction industry to better monitor and control their organisation's performance at both the field and office levels (Cox, Issa, & Ahrens, 2003). One downside of this method, to determine project success, is the limitation of only using factors related to the iron triangle (cost, quality and time). As described earlier, Atkinson (1999) describes the use of the iron triangle as a type II error, therefore missing something to determine project success sufficiently.

The literature illustrates that defining project success is a complex task for which multiple methods can be applied. The method used influences the interpretation of the level of success. Besides, different perspectives from different role owners will lead to different interpretations of the level of success. For the determination of the success rate of the cases, the interpretation of the interviewees will be combined to assess the level of success of the case projects. In addition, the impact of an extra objective on the project success was estimated, as is described in part III of the report. Paragraph 3.6 also describes stakeholders and project success to motivate why increasing the number of interest groups or include an extra objective to the project could improve or contribute to project success.

3.4 Stakeholders

Stakeholders on a construction project could be identified as a group of people or an organisation who can be affected or have an interest in the success of a project (Ackermann & Eden, 2011).
As emphasized in paragraph 3.1 most large infrastructure construction projects have to deal with a large variety and number of stakeholders. This number of actors involved can fluctuate during the project, which could create difficulties managing them. All these different actors have their interests, resources and attitudes towards the project, which are dynamic and could change over time. Most actors have some connection, collaboration, dependencies or attitudes towards each other, which complexifies the situation (Hertogh, 1997).

A power-interest grid was developed by Freeman (1984) to identify the different stakeholders and develop a stakeholder approach plan (see figure 7). This grid divides the group of stakeholders into four divisions as described by Ackermann & Eden (2011):

- Subjects, which have low power, a high level of interest (positive or negative)
- Players, who have a high level of power and a high interest in the project
- Crowd, actors who have low power and low interest in and on the project
- Context setters, this last group has high power but low interest.

Project organisations need to both understand and differentiate between these categories if they are to define and thus manage their stakeholders (Ackermann & Eden, 2011). In addition to this identification, it is critical to identify and determine the interconnections between the stakeholders. An action or decision taken by one of the stakeholders could influence the position or interest of multiple other stakeholders on the project (Ackermann & Eden, 2011). The stakeholder's power can also be dependent on its position on the project. For this reason, it is advised the develop a "stakeholder Influence Network Diagram" to map all formal and informal relations in the stakeholder network (Bryson, Ackermann, & Eden, 2007). Especially in large infrastructure construction projects, the number of stakeholders is significant and not all their interconnections are as visible at first sight.

However, these diagrams provide an insight into the actors involved and their interconnections; it does not explicitly address how to manage these stakeholders. For this reason, a project organisation could develop a stakeholder management web, which focusses on a single stakeholder. This method structures in a detailed manner, the information about specific key stakeholder's actions, objectives and motivations, and therefore provide the extra information needed to develop an appropriate approach (Ackermann & Eden, 2011).

Along with the appropriate approach, stakeholder management improves if the project organisation determines if and how the stakeholders should be involved in the project (Voinov & Bousquet, 2010). This selection of stakeholders for a participatory project is a complicated issue. Organisations should do their best to avoid selecting only stakeholders with a shared interest. Every attempt should be made to involve a diverse group of stakeholders that represent a variety of interest in the project (Voinov & Bousquet, 2010). This increases the level of support, acceptance and respect for the final results of the project. If this inclusion is an exclusive process, the results might be rejected by key stakeholders and decision-making communities.

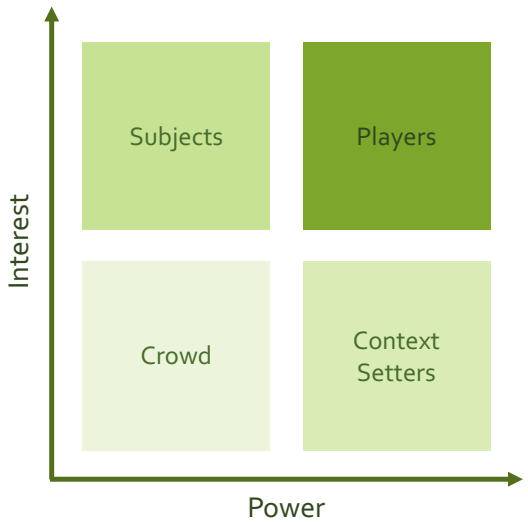


figure 7 Outline stakeholder power-interest grid (Ackermann & Eden, 2011)

For stakeholder involvement, three different types of interactions could be identified:

- Extractive used, in which knowledge, values or preferences are synthesized by the extracting group and passed on as a diagnosis to a decision-making process.
- Co-learning, in which syntheses are developed jointly, and the implications are passed to a decision-making process.
- Co-management, in which the participants perform the syntheses and include them in a joint decision-making process.

These concepts are based on the research of Timothy Lynam, Wil de Jong, Douglas Sheil, Trikurnianti Kusumanto, & Kirsten Evans, (2007)

Depending on the attitude, power and interest of the stakeholder, a selection could be made of the appropriate interaction and use of the interest group. The new involved stakeholders on the case projects are described by the four division of the power-interest group to determine their power in interest towards the projects, based on the concept of Ackermann & Eden (2011). In addition, the type of stakeholder involvement will be determined based on the theories of Timothy Lynam et al. (2007).

3.5 Project management approaches

Based on the characteristic of a construction project, a project organisation develops a project management approach. There are multiple project characteristics which influence the most suitable approach for the project. For example, scale, location, actors involved and the level of project complexity. In literature multiple approaches on project management can be found, of which some focus on the differentiation of project management approaches dependant on the complexity or simplicity of a project (Burns & Stalker, 1961; Eriksson et al., 2017; Geraldi, 2008; Koppenjan, Veeneman, van der Voort, ten Heuvelhof, & Leijten, 2011; Pollack, 2007; Szentes & Eriksson, 2015). One of the first description to identify project organisation are those of Burns & Stalker in 1961.

Mechanistic vs Organic by Burns & Stalker (1961)

Burns and Stalker (1961) suggested two styles: mechanistic with a high degree of control and organic, which focusses on flexibility. This second approach prepares for an environment of radical and rapid change.
The mechanistic approach emphasises on the specialized differentiation of tasks, including a precise definition. The organisation has a hierarchical structure of control, authority and communication, and knowledge is kept at the top. There is a tendency for vertical interaction and operations, and instructions and decisions issued by superiors govern working behaviour. Besides this, there is a greater importance to internal prestige than general knowledge, experience and skills.

The organic approach is of contributive nature of specialized knowledge and experience with shared and common tasks. Participants have responsibilities and are therefore not obliged to post problems to others. There is a shared commitment realized via a network structured project organisation. Knowledge may be located anywhere within the organisation, and information is transferred between people from different ranks. Communication focusses on information and advice rather than instructions and decisions (Burns & Stalker, 1961).

Hard vs Soft paradigm by Pollack (2007)

In correspondence to the approaches described by Burns and Stalker (1961), Pollack described two distinct paradigms, each with their particular values, ways of viewing the world and approaches to practice.

"The hard paradigm is commonly associated with a positivist epistemology, deductive reasoning and quantitative or reductionist techniques, attributes which are often associated with rigour and objectivity" (Pollack, 2007, p. 267). This management approach tends to focus on control and efficiency. An expert is in control, the goal is predetermined, and there is a focus on the underlying structure.

"The soft paradigm is commonly associated with an interpretive epistemology, inductive reasoning, and exploratory qualitative techniques, which emphasis contextual relevance rather than objectivity" (Pollack, 2007, p. 267). This approach focusses on learning, participation and the facilitated exploration of projects. There is an interest in the underlying social process on the project.

Mechanic-structured vs Creative-reflective by (Geraldi, 2008)

Geraldi (2008) describe both approaches adjusted to a type of complexity. The Mechanic-structured approach has a high intensity of complexity of fact, which requires the organisation to deal with a large amount of interdependent information. “The challenge faced by the project manager is to keep a holistic view of the project and make good decisions very quickly” (Geraldi, 2008, p. 353). The organisation should be less flexible, a detailed and systematic planning is compulsory. Changes must be avoided; they lead to chaos and are expensive. “More people are involved in the project, and, hence, changes have to be communicated to more people, and also impact the work of more people; consequently, more rework, more claims, and more costs arise” (Geraldi, 2008, p. 353).

The creative-reflective approach can be found in an environment with a high intensity of faith, a significant amount of uncertainty, mostly present in unique projects or when solving new problems. The project organisation should in such situations be flexible and based on the principle of faith, that is, "one does not know that it will work, but has faith in it, or at least ‘‘cynically'' pretends to have faith, as the team knows that the project will never get off the ground without this positive behaviour towards the success of the project awarded by faith" (Geraldi, 2008, p. 353). Scope and budget are not fixed, and the objective of the project is rather based on feeling and negotiation than of facts and figures (Geraldi, 2008).

Both Geraldi (2008) and Koppenjan et al. (2011) emphasise that both approaches should be brought together, where many fruitful combinations are possible because only in this way facilitate the achievement of the project objectives.

Predict and control vs. Prepare and commit by Koppenjan et al. (2011)

Based on these theories, Koppenjan et al. (2011) developed their interpretation of the two approaches and experiences in the field. They developed the framework to investigate how actors involved in project management of large engineering projects used and combined the perspectives of complexity and simplicity. According to their definition, “project management here represents the complete set of decisions regarding the set-up, organisation and management of a project, taken during the various phases of the project, aimed at coordinating the efforts of the various actors involved in order to successfully realise the project” (Koppenjan et al., 2011, p. 742).

The framework of Koppenjan et al. (2011) identifies two management styles: “predict and control” and “prepare and commit”. Type I also characterized as the “predict and control perspective” has a strong focus on the front-end analysis and neglecting complexity and uncertainty as much as possible. Type II, the “Prepare and commit perspective”, (Koppenjan et al., 2011), acknowledges that scope changes are inevitable, due to the many unknowns and the client's learning curve, and thus acknowledges the uncertainty and complexity of many infrastructure projects. In this approach, a close collaboration between the contractors and clients is needed. The contract should aim towards a more functional scope realization and steering of the project is more in a network structure. The relationship between the participants should be more open and more demand-driven. Moreover, managing the interfaces should be a shared task for all parties involved. The role of the project manager should be more in the background as the facilitator.

Although this type of management could have a positive effect on project performance, it will not be the solution for all complex projects. A combination of this type I and type II is needed to manage these projects successfully. Every project has different characteristics and therefore needs different types of project management approaches (Larsson, Eriksson, Olofsson, & Simonsson, 2015). Balancing requirements for control and flexibility is a complicated and delicate task, and room to manoeuvre is limited. However, Koppenjan (2011) suggests that if a project organisation does not succeed in accomplishing a balance between these two management styles, problems in the realization of these complex engineering projects could occur.

Control vs Flexibility focused by (Eriksson et al., 2017; Szentes & Eriksson, 2015)

Eriksson described the two approaches as control of flexibility focused. Eriksson et al. (2017) elaborate that complex projects need a flexibility focused approach. "The level of complexity needs to be identified in the early stages. The higher the complexity to more flexibility-focused project management practices are needed" (Eriksson et al., 2017, p. 1520). The flexibility focused approach stimulate collaboration on the project and stimulates adaptations and changes to the project. The approach focusses on explorative learning, trust and informative communication.

The Control focused approach of Eriksson et al. (2015 & 2017) focusses on working toward pre-determined objectives which are its main priority. The project organisation is top-down structured, and notifications are formally transferred. The project manager is in control and does all monitoring and spot checking (Szentes & Eriksson, 2015).

All of the described researches identify two project management approaches. The approaches have similarities and therefore, could be combined into a new description of two management styles and their corresponding activities. Tables 2 and 3 illustrate the different activities as mentioned by Burns & Stalker (1961), Eriksson et al. (2016 & 2017), Geraldi (2008), Koppenjan et al. (2011) & Pollack (2007). The activities are divided on the basis of the eight variables from Koppenjan et al. (2011). Table 2 illustrates the activities in correspondence to a project management approach focussing on simpler projects. Table 3 illustrates the activities in correspondence to a more process management approach for complex projects.

On the basis of the description from table 2, the first approach could be described as a focus on control and avoidance of changes. The goal of the project is strictly defined, and the approach focusses on the front-end analysis to overcome complexity and uncertainty. The project manager is in control and all decisions and information go through him. The project organisation can be described as hierarchical or top-down. If information is transferred, it is done formally and only with facts and figures.

The second identified approach has a focus on flexibility. The goal is broadly defined and ambiguous and emphasised on the function of the end-product. Collaboration and participation within the project organisation are stimulated and facilitated. Interfaces management is, therefore, a shared task based on trust and personal responsibilities. The project organisation can be described as a network structure with an emphasis on the social process. Information is open, unstructured, mostly transferred informative and used for learning, personally and within the group.

The identified project management activities are used for the theoretical framework, as will be described in section 3.6 of this chapter. The theoretical framework describes the two project management approaches based on the, in this section described, researches. This framework is used to identify the project management approaches from the cases as can be found in chapter 5 for the individual case analysis.

Simpler projects	**Koppenjan (2011)** Predict and Control	**Burns & Stalker (1961)** Mechanistic	**Pollack (2007)** Hard Paradigm	**Geraldi (2008)** Mechanic-structured	**Eriksson (2016 & 2017)** Control-focussed
Terms of Reference, *the purpose/goal of the project as divined at the start and during the project*	Blueprint		Predefined goals		Tight pre-determined objectives
Task Definition *Task description broad of small*	Narrow for best control	The specialized differentiation of functional tasks. Importance and prestige of individual knowledge	No need for participation		
Contract *Type contract. Final purpose of the contract*	Task execution	The precise definition of rights and obligations attached to each functional role			Fulfil project objective
Incentives *Motivation for the contractor. What are their incentives?*	Work task based	The abstract nature of each individual task	Quantitative measures		Goal oriented
Change *Attitude towards change on the project*	Limit as much as possible	Appropriate in a stable environment	Emphasis on control, reductionist techniques	Inflexible organisation, changes are very expensive and constant changes lead to chaos and therefore must be avoided.	
Steer *What is de structure of the project organisation? How are participants coordinated?*	Hierarchical	Hierarchical and vertical structure of control, authority and communication. Working behaviour is governed by instruction and decisions made by superiors.	Emphasis on structure	Goal of the project manager is to keep a holistic view of the project and make good decisions very quickly.	Top down
Information Exchange *How is information transferred within the organisation*	Limited, standardised	Location of knowledge at the top of the hierarchy		Fact and figures	Formal notification
Interphase Management *How are the interphases on the project managed?*	Project management task		Project manager as expert	A more detailed and systematic planning is compulsory	Project manager in control, monitoring and spot checking

table 2 Overview of project management activities in relation with a project management approach for simpler projects based on the literature

Complex projects	**Koppenjan (2011)** Prepare and commit	**Burns & Stalker (1961)** Organic	**Pollack (2007)** Soft paradigm	**Geraldi (2008)** Creative-reflective	**Eriksson (2016 & 2017)** Flexibility focussed
Terms of Reference, *the purpose/goal of the project as divined at the start and during the project*	Functional		Ill defined, ambiguous goals	Functional, scope and budget are still being discussed	
Task Definition *Task description broad of small*	Broad for best cooperation	Importance and prestige of common knowledge. The "realistic" nature of the individual task	Need for participation		Stimulate collaboration on the project
Contract *Type contract. Final purpose of the contract*	Functional realisation				
Incentives *Motivation for the contractor. What are their incentives?*	System-output based	The contributively nature of special knowledge and experience	Qualitative measures	Management should be based on principle and faith, that is, one does not know that it will work, but has faith in it, or at least "cynically" pretends to have faith, as the team knows that the project will never get off the ground without this positive behaviour towards the success of the project awarded by faith.	
Change *Attitude towards change on the project*	Facilitate as much as needed	Appropriate when there a changing condition		The organisation ought to be flexible. Rework and iterations are expected	Open for adaptation of the project
Steer *What is de structure of the project organisation? How are participants coordinated?*	Network	A network of lateral structure of control, authority and communication. Superior function of information and advice rather than instructions and decisions	Emphasis on social process	It is hard to measure and control the process and output of each individual task, as cause–effect relationships are difficult or even impossible to be followed.	
Information Exchange *How is information transferred within the organisation*	Open, unstructured, demand driven	Informative communication and knowledge can be located anywhere in the network. Importance and prestige of common knowledge	Emphasis on learning	Identification of correct answers is based on feelings and negotiation	Open and explorative learning, trust and informal communication
Interphase Management *How are the interphases on the project managed?*	Shared task	The shifting of responsibility (problems may not be defined as being someone else's responsibility)	Project manager as facilitator		Dared, trust and self-control

table 3 Overview of project management activities in relation with a project management approach for complex projects based on the literature

3.6 Conclusion

According to Geraldi & Adlbrecht (2007), complexity can be divided into three concepts: the complexity of faith, the complexity of fact and complexity of interaction. This last complexity is correlated with the number of actors and interconnections involved on the project, a substantial amount results is a high number of meetings, messages and possible misunderstanding and therefore extra complexity on the project.

Six dimensions for project complexity could be identified: organisational, social, technical, law and regulation, time and financial complexity (De Bruijn et al., 1996; Hertogh, 1997). These dimensions are needed to develop a fit-for-purpose project management approach for construction projects. This tailoring of the project management approach to the project characteristics is necessary because complex construction projects need the right approach for successful project execution and implementation of the right approach involves collaboration, explorative learning and adaptation simultaneously implemented and supported by the whole project organisation (Eriksson et al., 2017).

There is, however, a problem with project complexity, it is a highly subjective matter which is based on perception. This perception of complexity is the sum of certain elements which are individually judged based on the project managers interests, which is influenced by his role on the project and his personal values. (Kool et al., 2014). Composing a project management approach based on project complexity can, therefore, be a difficult task if all the project organisation members do not align the interpretation on the type and dimensions of the project complexity.

Bosch-Rekveldt, Jongkind, Mooi, Bakker, & Verbraeck (2011) developed a framework, the TOE-framework, to asses project complexity. By knowing, understanding and characterizing the complexities from the start of the project, project management could be improved (Bosch-Rekveldt et al., 2011). One of the complexities identified is "social complexity" (De Bruijn et al., 1996) has some similarities to the complexity characteristic: "the variety of external stakeholders on the project" (Bosch-Rekveldt et al., 2011). This project complexity is caused by the fact that this variety of actors all have their interests, resources and attitudes towards the project. Next to this, an action or decision taken by one of the stakeholders could influence the position or interest of multiple other stakeholders on the project (Ackermann & Eden, 2011). Also, external influences could affect the interests or position of the stakeholders on a project, which makes it necessary to adapt their stakeholder approaches.

To develop an appropriate stakeholder management approach, the project organisation could make use of the power-interest grid (Freeman, 1984), the stakeholder influence network diagram (Bryson et al., 2007) and the stakeholder management web (Ackermann & Eden, 2011).

For most infrastructure construction projects, success is determined if the objective of the project is achieved. The commonly used tool is the Iron triangle which places cost, time and quality in the centre of project success (Kerzner, 1987). Via this tool, a project could be appointed successfully if the project was [1] completed on time, [2] completed within budget and [3] delivered with the demanded level of quality according to the technical requirements of the project (Kerzner, 1987). This method could, however, be expanded by factors: [4] benefits on organisation-level and [5] benefits on stakeholder community (Atkinson, 1999). This fifth factor could be measured by the level of appreciation by the involved participants (Vuijk, 2005). The success of the project is then determined by how much the participant's interest is fulfilled on the project (Westerveld & Westerveld, 2001). This illustrates that involving a variety of interests on the project could increase the success of the project.

In literature multiple approaches on project management can be found, of which some focus on the differentiation of project management approaches dependent on the complexity or simplicity of a project (Burns & Stalker, 1961; Eriksson et al., 2017; Geraldi, 2008; Koppenjan et al., 2011; Pollack, 2007; Szentes & Eriksson, 2015). As described in section 3.5, because of the similarities between these different approaches, a combined description of the project management approaches could be developed.

The first approach has a strong focus on front-end analysis and neglecting complexity and uncertainty as much as possible. The second approach acknowledges that scope changes are inevitable, due to the many unknowns and the client's learning curve, and thus acknowledges the uncertainty and complexity of many infrastructure projects. The most suitable or fit-for-purpose project management approach is a balance between these two

extremes, which depends on the characteristics of the project (Larsson et al., 2015). If this right approach is not found and constructed, problems in the realization of these complex engineering projects could occur (Koppenjan et al., 2011).

The description based of the researches as described in section 3.5 were used for the development of the theoretical framework. A variety of activities can describe the two identified project management approaches (for example: "open transfer of information" or "decisions are made by the superior"). For structure, every activity is classified into variables; these eight variables are from the research of Koppenjan et al. (2011). The list of activities corresponding to the two project management approaches is based on the theories of Burns & Stalker (1961), Eriksson et al. (2016 & 2017), Geraldi (2008), Koppenjan et al. (2011) & Pollack (2007).

The framework is used to determine the project management approach of the cases for the case study; for this reason, the terms are operationalized. Operationalization is the translation of abstract concepts into indicators, instruments and instructions. This operationalization is needed to order to observe or measure the concepts. (Verschuren & Doorewaard, 2010, p. 139 & 140). The terms and explanations of the researchers used for the operationalization can be found in table 2 & table 3. The operationalized terms are based on the combination of these researches. The operationalized variables can be found in table 4. This table forms the theoretical framework needed for the case study.

THEORETICAL FRAMEWORK

	Focus on control	Focus on flexibility
Terms of reference	Blueprint	Functional
The goal/purpose of the project as defined at the start and during the project.	The goal/purpose of the project is fixed as defined at the start of the project. There is a strong focus on front-end analysis and designed to overcome uncertainty and complexity. The front-end should predict expected outcomes accurately and as such produce a blue-print type scope. Budget and schedule of the project are frozen during the execution phase.	The final goal for the project is broad and ambiguous and strives to fulfil a function. Scope and budget are still open for discussion and the project starts with only functional requirements. Uncertainty and complexity on the project are accepted.
Task definition	Narrow for best control	Broad for best cooperation
Definition of the tasks for the project based on the goal/purpose	Narrow definition of the tasks to keep control and overview of everything that needs to be done. Tasks are appointed to specific parties and participant, there is a strict role division within the project organisation and participation is discouraged.	Tasks of broadly defined to stimulate collaboration and cooperation between actors on the project. There is an importance and prestige of common knowledge. Roles on the team are shared and every team member feels the importance to participate in every decision-making process.
Contract	Task execution	Functional realization
The aim and purpose of the contracts on the project	The contact stimulates the executions of specific tasks, the contract includes objectifiable requirements. (e.g. Bid-Build, RAW-contract)	The contract focuses on the realization of functions, not specific objects. (e.g. Design team, D&C, Alliance, DBFM)
Incentives	Work task based	System-output based
Incentives for the parties based on the contract	Parties are stimulated to work task based, don't think and work outside the scope of the project. Work in a direct line toward the goal/purpose of the project.	Incentives for the contract are based on system-output. Next to this, there should be a principle of faith, that is, although the outcome is not sure, actors should have faith in a positive result. The project would not get off the ground if not all actors would have a positive behaviour towards the success of the project. Achievement is to realize a project with a high level of appreciation from most or all stakeholders.

Change	Limit as much as possible	Facilitate as much as possible
Attitude towards change on the project	Changes need to be prevented or avoided. Emphasis on control and limit flexibility of the project. Put a strong focus on the front-end development to predict and avoid uncertainties on the project. Risks on the project are tried to be avoided or constrained	The organisation is prepared for changes on the project, changes need to be facilitated and the organisation ought to be flexible and open for adaptations. Rework and iterations are expected from the start of the project because uncertainty and complexity are accepted from the beginning. Risks are also seen as opportunities for the project and can therefore be exploited or purposely searched for.
Steer	Hierarchical	Network
How is the project organisation structured?	The structure of the project organisation is hierarchical. There is a focus on structure of the organisation and decisions are made at the top of the organisation. Working behaviour is governed by instruction. Superiors keep a holistic view of the project and make the decisions. The principle agent theory is applied.	The structure of the project organisation is more horizontal or in a network formation. There is a superior function of information and advice rather than instructions and decisions. The emphasis is on the social process, stimulating collaboration and participation of all actors. The stewardship theory is applied
Information exchange	Limited, standardized	Open, unstructured
How is information transferred within the organisation	Information is kept at the top of the organisation and if shared, the information transfer is limited and standardized. Information exchange is based on facts and figures and is only done via formal notifications. Project organisation makes use of standardized forms and ways of communication to formalize information transfer.	Information transfer is open and unstructured. Information can be located anywhere within the organisation and is shared through an open and transparent way. Importance and prestige of common knowledge and emphasis on shared learning. Most information and knowledge are shared via informal communication and is often demand driven. There is a certain level of trust that all information needed, for a good project execution, is present within the organisation.
Interface management	Project management task	Shared task
How are the interfaces between the different parties on the project managed?	The project manager of the organisation is in charge of the interface management. The project manager can be seen as expert and is therefore in control. (e.g. principle-agent). All decisions are presented to the project manager and regular reports on progress are submitted.	Interface management is a shared task for all the actors involved. Responsibility is therefore also transferred over every participant. The project manager in this case, act as facilitator in stat of superior. This collaboration is based on trust and self-control. (e.g. stewardship theory) there are no regular planned meeting to inform on progress or decisions.

table 4 Operationalized variables of project management approach in correlation with project complexity (Burns & Stalker, 1961; Eriksson et al.,2016, 2017; Geraldi, 2008; Koppenjan et al., 2011; Pollack, 2007).

A few of the variables above correlate with the collaboration of the project organisations and interest groups of the project. The variables "steer", "information exchange" and "interface management" are correlated to the stakeholder management approach selected by the project organisation. The project organisation decides if an interest group is involved in the project and to what extent. The mentioned variables emphasize the way the project team approaches and collaborates with the interest groups. These variables are, therefore, focus points in the case study research.

CASE STUDY

PART III

Part III of the research focusses on the case study. The first chapter will describe the case study approach, followed by the individual case analysis in chapter 5 and the cross-case analysis in chapter 6. The results of the literature study in the previous part are used the perform the individual case analysis as will be described in the analysis protocol.

4. Case study

A case study exists of 5 steps (Yin, 1994), (1) composing study questions for the research (see paragraph 1.3), (2) A proposition on how to approach these questions (paragraph 2.1), (3) units of analysis, which data needs the be collected (paragraph 3.6), (4) Linking the data with the propositions (chapter 5) and (5) interpretation of the findings of the study (chapter 6). The case study approach and selected cases are described in the following sections.

4.1 Case study approach

An explanatory case study with multiple cases was conducted to answer the research questions. The problem stated in Part I is not an unusual or rare case; for this reason, a multiple case study was more appropriate than a single case study. By researching multiple cases, the data collected is also more compelling and robust.

Eleven interviews were organised to gather the data from the cases. Multiple people were interviewed from the same project via a semi-structured interview and thereby generated different perspectives on the same project. As a result of this, conclusions drawn from possible subjective and opportunistic views from one person on the project could be prevented. All interviewees represented the client of the project.

For the case study a semi-structured interview was set-up, which consisted of five prescribed main questions to collect the minimum needed data. The rest of the interviews were guided by the interviewer and focused on receiving as much information on the project and research topic as possible. Part I of the interview focused on the project, the experiences of the interviewee and description of the moment in which an objective was added and thereby a new interest group was included on the project.

The second part of the interview focused on the influences of this expansion of the project and the changes that occurred during and directly after this decision. The main questions are supported by a list of sub-questions to identify project management activities. Hereby the interviewee was asked to provide examples from his experience to collect as much information as possible. The list of interview questions for the case study can be found in Appendix A

For an improved understanding of the decision-making process for the inclusion of an extra objective to the project, the perspective from Teisman (2003) was used. Teisman developed three models to describe and analyse complex decision making: the phase model, the stream model and the rounds model. The rounds model makes it possible to conceptualise decision making, to generate a useful insight for the understanding and analysis of the complexity in projects. The model is especially useful for projects with multiple actors and parties, which are all part of the decision-making process, as is the case in the researched projects. When a new interest group is included on the project, new solutions and problems are introduced. The rounds model illustrates that every interest group could contribute to the decision-making process. See figure 8 on p. 31, for the concept of the rounds model developed by Teisman (2003).

In the case study, the influence of new interest groups on the project was researched. For this reason, the rounds model was used to illustrate the various parties on the project and the interaction between those and the new parties during the decision-making process.

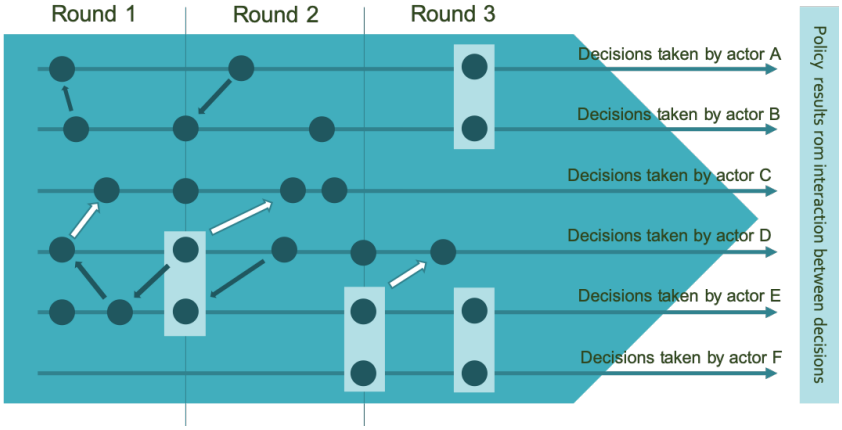


figure 8 Concept of the rounds model (Teisman, 2003), the blue arrow is decision-making, dark dots depict decisions taken by various actors (black arrows: building upon decision of others, white arrows anticipation upon future decisions, light blue blocks: a covenanting result)

The changes on the project due to an inclusion of a new objective do not only depend on the decisions made by one key party but, upon the interaction between decisions taken by the various interest groups. The model could assist in providing an insight into an understanding of the decision-making process and the consequences of the decision made. Figure 8 illustrates the, by Teisman developed, rounds-model. The large blue arrow illustrates the decision-making process consisting many smaller decisions made by various actors involved (the smaller dark blue dots). The dark blue and white arrows illustrate the relations between the various decision which are built upon earlier decisions or anticipated on a future decision. The light blue block illustrates decisions made as a covenanting result.

During the individual case analysis, the extra objectives are described, including the decision-making process. Thereby illustrating what decisions where taken, what the motivation was, and which parties were involved for the inclusion of an extra objective to the project.

The main focus of this research is put on the phases in which the most decision making with significant influences takes place. Because scope changes are most expected in the definition and design phase of the project, these are the moments of interest for the research, this definition of the phases is based on the theory of Koppenjan (2005), described in paragraph 3.2.

4.2 Case selection

For the case study, four cases could be selected, out of the network of APPM which fulfilled all requirements, and which were mostly similar but had some variations. Because the cases were identified for an in-depth analysis, the "most similar" approach was most suitable (Seawright, 2010). This approach offered the possibility for some variety of the cases to broaden the general analysis of the causal relationships, but the cases must be mostly similar. Due to their similarities, the variation in the object of research (or unit of analysis) was visible and could be compared between the cases to create the data needed. For this research, the four cases did all meet the following requirements:

- The project is an infrastructure construction project
- The project is in realisation or operation/maintenance phase according to the phase model of Koppenjan, (2005)(see figure 5)
- The project is a large-scale infrastructure construction project in the Netherlands; projects that cost more than 20 million euros (Cantarelli, Van Wee, Molin, & Flyvbjerg, 2012)
- The project has at least one complexity as defined by the dimensions of De Bruijn et al. (1996) and Hertogh (1997)
- The project purposefully added an extra objective to the project, during the definition or design phase (Koppenjan et al., 2011)

Proof needed to be gathered to make sure the inclusion of the new objective to the project was a conscious decision taken by the project organisation, thereby fulfilling the last case requirement. This means that the decision for inclusion was made during a decision-making process (as described by Teisman (2003)) and not forced by the client or contractor. More alternatives needed to be present, so a conscious consideration was to be made. This level of consciousness is needed to create awareness for the adjustments made in the project organisation as a consequence of the scope expansion.

Based on the requirements for the cases, the network of APPM was used to find a list of cases for the case study. The following four cases were the results of the selection process:

- HOV in 't Gooi
- Kooppunt N241/N242, Verlaat
- HOV Westtangent
- Rotterdamsebaan

Multiple members from the four project organisations were interviewed to gather the needed data for the research. See table 5 for an overview of the interviewees. A more extensive overview is illustrated in appendix B. The results and minutes of the conducted interviews can be found in appendix C and D.
On every project, the project manager was interviewed because of his holistic view on the project and the project organisation. Other interviewees were part of the project organisation, to receive their interpretation on the project, the project management activities, project success and project organisation. All interviews were conducted with members who represented the client on the project. The selected cases are analysed in chapter 5. The results from the performed cross-case analysis can be found in chapter 6.

Project	Code	Company	Function	years of experience	years on the project
HOV 't Gooi	G1	APPM Management Consultants	Project director	> 15 years	7 years
HOV 't Gooi	G2	Municipality of Hilversum	Project manager	> 35 years	4 years
HOV 't Gooi	G3	ProRail	Project manager	> 10 years	5 years
N241 / N242	V1	APPM Management Consultants	Project manager	> 25 years	3 years
N241 / N242	V2	Province of Noord-Holland	Project manager	> 40 years	3 years
HOV Westtangent	W1	APPM Management Consultants	Project manager	> 25 years	4 years
HOV Westtangent	W2	Gemeente Amsterdam Ingenieursbureau	Technical manager	> 20 years	4 years
HOV Westtangent	W3	Gemeente Amsterdam Ingenieursbureau	Project controller	> 15 years	4 years
HOV Westtangent	W4	Aratis	Contract manager	> 10 years	4 years
Rotterdamsebaan	R1	JCPM	Technical manager	> 20 years	8 years
Rotterdamsebaan	R2	Ponton Bouwconsultancy B.V.	Project director	> 30 years	8 years

table 5 Overview of the interviewees for the case study

5. Individual case analysis

In this chapter all four cases are described based on the information from project documentation, online sources and the results from the interviews. The cases are analysed on the general characteristics of the project, the project complexity, the extra objective, the project management approach and project success.

Some of the information on the cases was based on statements made by the interviewees. These sources are referred by their personal code and a row number of the tables in appendix C, in which the statement can be found.

For the analysis of the cases an analysis protocol was used, as will be described in the following section.

Analysis protocol

General description
A general description of the project including the characteristics of the project. All information is based on the available information, from the media, project documentation and interviewees.

Project complexity
A description of the most important project complexities. The complexities are determined on the basis of the complexity dimensions from (De Bruijn et al., 1996; Hertogh & Westerveld, 2010) and the complexity characteristics from the TOE-framework from (Bosch-Rekveldt et al., 2011) as elaborated in the literature study (section 3.1). The complexity dimensions provide an broad overview of the present complexities, where the complexity characteristics of the TOE-framework, provide a more specific source of project complexity.

Extra objective
The extra objective is described by mentioning four main subjects: [1] the characteristics of the extra objective, [2] the reason and motivation for the inclusion, [3] in which phase the inclusion was decided upon and included and [4] the impact on planning and cost of the project. The description does also include a definition of the type of stakeholder based on the power-interest grid (Ackermann & Eden, 2011).

Project management approach
On the basis of the interview results, the analysis of the extra objective and its process and the theoretical framework, the project management approach of the project organisations were determined. However, the theoretical framework from section 3.6 needed for this purpose to be elaborated. Therefore, the following steps were taken:

Step 1: The two identified project management approaches (described in paragraph 3.6) were put on a scale from 1 to 5. 1 is the approach focused on control and 5 is the approach focused on flexibility.
Step 2: The activities of the intermediate scales were operationalized on the basis of the activities of the two extreme project management approaches. The intermediate scales form a balance between the two extremes. See table 6 for the elaborated theoretical framework.
Step 3: On the basis of the interviews, the project management activities from the cases were identified.
Step 4: The identified activities were then compared with the operationalized activities from the in step 2 developed framework. Where the activities of the cases are most similar with the activities from the table, that specific score was given to the casus.
Step 5: Based on the assigned scores, the overall project management approach could be identified. The scores are illustrated in a graph, for example see figure 10 on p. 40. The blue line illustrates the project management approach before the inclusion

The following steps were taken to determine what the consequences and possible adaptations were to the project management activities and approach, during or directly after the inclusion of the extra objective to the project.

Step 6: On the basis of the interviews the changes in intensity and occurrence of activities were determined.
Step 7: The new activities were again compared with the developed framework to assign a score.

Step 8: On the basis of these findings the possible shift in project management approach was visualized. The green line illustrates the scores after the inclusion of the extra objective. If the blue line is not visible, the score for the variable was not changed.

Project success

The success of the project was determined on the basis of the interpretations of the interviewees. This could, for example, be in terms of appreciation by the organisation, client or external parties or, more objective, in numbers of delay or cost overruns. Because this research focussed on the involvement of an extra interest group, the level of success was focussed on the level of appreciation as described in section 3.3. Some nuance is applied on the interpretations of the interviewees to provide a more objective view on the project success.

	Focus on control				Focus on flexibility
	1	2	3	4	5
Terms of reference	Blueprint				Functional
The goal/purpose of the project as defined at the start and during the project.	The goal/purpose of the project is fixed as defined at the start of the project. There is a strong focus on front-end analysis and designed to overcome uncertainty and complexity. The front-end should predict expected outcomes accurately and as such produce a blue-print type scope. Budget and schedule of the project are frozen during the execution phase.	A large part of the goal/purpose of the project is fixed as defined from the start of the project. Some room for discussion of scope extension is possible but avoided. Most uncertainty on the project is prevented by a sufficient level of front-end analysis.	The main objective of the project is fixed, there is however some room for discussion on scope and budget. Some front-end analysis is executed to take away some of the uncertainty. Some level of uncertainty and complexity to the project to a certain extent accepted.	A significant part of the project objective is broad and ambiguous. Some details of the objective are fixed, however there is still room for discussion on scope and budget. Most uncertainty and complexity on the project are accepted.	The final goal for the project is broad and ambiguous and strives to fulfil a function. Scope and budget are still open for discussion and the project starts with only functional requirements. Uncertainty and complexity on the project are accepted.
Task definition	Narrow for best control				Broad for best cooperation
Definition of the tasks for the project based on the goal/purpose	Narrow definition of the tasks to keep control and overview of everything that needs to be done. Tasks are appointed to specific parties and participant, there is a strict role division within the project organisation and participation is discouraged.	The project organisation is strictly structured and task definitions are narrow for best control. There are some exceptions on shared roles or disciplines but participation with other disciplines is mostly discouraged.	The project organisation is structured via a strict task description. Tasks are appointed to specific parties and participant. Some collaboration is however stimulated. Multiple roles participate in decision-making process, even if decision is not fully their described task.	There is some task description of for the available disciplines. Member are however stimulated to fill in multiple roles or at have some level of affection with the other roles. Common knowledge is stimulated every team member feels the importance to participate in most decision-making processes.	Tasks of broadly defined to stimulate collaboration and cooperation between actors on the project. There is an importance and prestige of common knowledge. Roles on the team are shared and every team member feels the importance to participate in every decision-making process.
Contract	Task execution				Functional realization
The aim and purpose of the contracts on the project	The contact stimulates the executions of specific tasks, the contract includes objectifiable requirements. (e.g. Bid-Build, RDW-Bestek)	Fixed price contracts with some incentives of reimbursements. Mostly fixed specifications, fixed dates, target price.	Cost plus, target specifications, target date, the client pays the cost-plus profit margin.	Time or work based contracts. No complete specifications, price based on rate.	The contract focuses on the realization of functions, not specific objects. (e.g. Design team, D&C, Alliance, DBFM)
Incentives	Work task based				System-output based
Incentives for the parties based on the contract	Parties are stimulated to work task based, don't think and work outside the scope of the project. Work in a direct line toward the goal/purpose of the project.	Main focus of het project is the realization of the scope of the project. Parties and participants are stimulated to work directly towards this goal however, some broader approach is accepted.	There is a clear scope towards which the project organisation is working. There is however a strong focus on realizing a project with a high level of appreciation from most of the stakeholders. Participants have faith in the success of the project.	Participant and parties are stimulated to work system based and also think and work outside of the scope. There is some stimulation to work towards the goal of the project. Actors have a positive behaviour towards the success of the project and the achievement of a high level of appreciation from most stakeholders is a focus point.	Incentives for the contract are based on system-output. Next to this, there should be a principle of faith, that is, although the outcome is not sure, actors should have faith in a positive result. The project would not get off the ground if not all actors would have a positive behaviour towards the success of the project. Achievement is to realize a project with a high level of appreciation from most or all stakeholders.
Change	Limit as much as possible				Facilitate as much as possible
Attitude towards change on the project	Changes need to be prevented or avoided. Emphasis on control and limit flexibility of the project. Put a strong focus on the front-end development to predict and avoid uncertainties on the project. Risks on the project are tried to be avoided or constrained	Most changes need to be prevented or avoided. Most focus is on control and the limitation of flexibility on the project. Risks are extensively assessed and tried to be avoided or constrained. Some small changes are applied if the benefit for the project are significant.	Some level of uncertainty is accepted. Changes, rework and iterations are accepted, and actors have the possibility to search for opportunities to improve the project. There is however some emphasis on control and a focus is therefore put on some level of front-end development to avoid certain uncertainties.	The organisation is prepared for changes and ought to be flexible and open for adaptations. Uncertainty and complexity are accepted from the beginning. And some risks can also be seen as opportunities for the project to be exploited. There is however some limitation to the level and amount of changes and level of search for opportunities.	The organisation is prepared for changes on the project, changes need to be facilitated and the organisation ought to be flexible and open for adaptations. Rework and iterations are expected from the start of the project because uncertainty and complexity are accepted from the beginning. Risks are also seen as opportunities for the project and can therefore be exploited or purposely searched for.

Steer	Hierarchical				Network
How is the project organisation structured?	The structure of the project organisation is hierarchical. There is a focus on structure of the organisation and decisions are made at the top of the organisation. Working behaviour is governed by instruction. Superiors keep a holistic view of the project and make the decisions. The principle agent theory is applied.	The project organisation tend to be hierarchical. Most information is kept at the top of the organisation and most work is governed by instruction. There is however some emphasis on information transfer.	The structure of het project organisation is more strategic based. Main focus is on functioning of the organisation, focus on maximizing its performance. Not all actors have the same information available. Tasks are mainly delegated, certain level of autonomy of the manager but demanding maximizing share value. The strategic approach is applied.	The project organisation tend to be more network oriented. Main emphasis is still put on information and advice. Stimulation of instructions rather than decisions. Collaboration is stimulated between all actors. There is however a small level of autonomy within the organisation, not all decision are made by all actors.	The structure of the project organisation is more horizontal or in a network formation. There is a superior function of information and advice rather than instructions and decisions. The emphasis is on the social process, stimulating collaboration and participation of all actors. The stewardship theory is applied
Information exchange	Limited, standardized				Open, unstructured
How is information transferred within the organisation	Information is kept at the top of the organisation and if shared, the information transfer is limited and standardized. Information exchange is based on facts and figures and is only done via formal notifications. Project organisation makes use of standardized forms and ways of communication to formalize information transfer.	Most information is formalized and notified to the top of the organisation. Information transfer is mostly linked to facts and figures. Team members are forced to make use of standardized forms for agreements, notifications or significant changes.	There is a certain level of trust that some of the information is transferred openly within the organisation. However, most information transfer is formalized, and notifications are communicated via a standardized form.	Most of the shared information within the organisation is done informally. Most information is open and unstructured. And there is a significant level of trust that information needed is present within the organisation. Only significant changes in scope or large role overarching issues are formalized.	Information transfer is open and unstructured. Information can be located anywhere within the organisation and is shared through an open and transparent way. Importance and prestige of common knowledge and emphasis on shared learning. Most information and knowledge are shared via informal communication and is often demand driven. There is a certain level of trust that all information needed, for a good project execution, is present within the organisation.
Interface management	Project management task				Shared task
How are the interfaces between the different parties on the project managed?	The project manager of the organisation is in charge of the interface management. The project manager can be seen as expert and is therefore in control. (e.g. principle-agent). All decisions are presented to the project manager and regular reports on progress are submitted.	The project manager is the ultimately responsible for the interface management. He is in control and is regularly informed on progress and decisions. Based on some level of trust, the participants have some responsibilities for small tasks and decisions.	Interface management is mostly a shared task. Participant carry some level of responsibility. There is some level of trust and self-control. There are however regular meetings to discuss progress and decisions with the rest of the organisation.	All actors are in self-control, have some level of responsibility which is all based on a certain level of trust. The project manager facilitates this environment. The project manager is sometimes informed about progress or decisions made on an irregular basis.	Interface management is a shared task for all the actors involved. Responsibility is therefore also transferred over every participant. The project manager in this case, act as facilitator in stat of superior. This collaboration is based on trust and self-control. (e.g. stewardship theory) there are no regular planned meeting to inform on progress or decisions.

table 6 Framework to determine the project management approach. An elaboration of the theoretical framework (section 3.6), columns 1 and 5 are based on Burns & Stalker (1961), Eriksson et al. (2016 & 2017), Geraldi (2008), Koppenjan et al. (2011), Pollack (2007). Columns 2, 3 and 4 are own interpretations based on columns 1 and 5.

5.1 HOV in 't Gooi

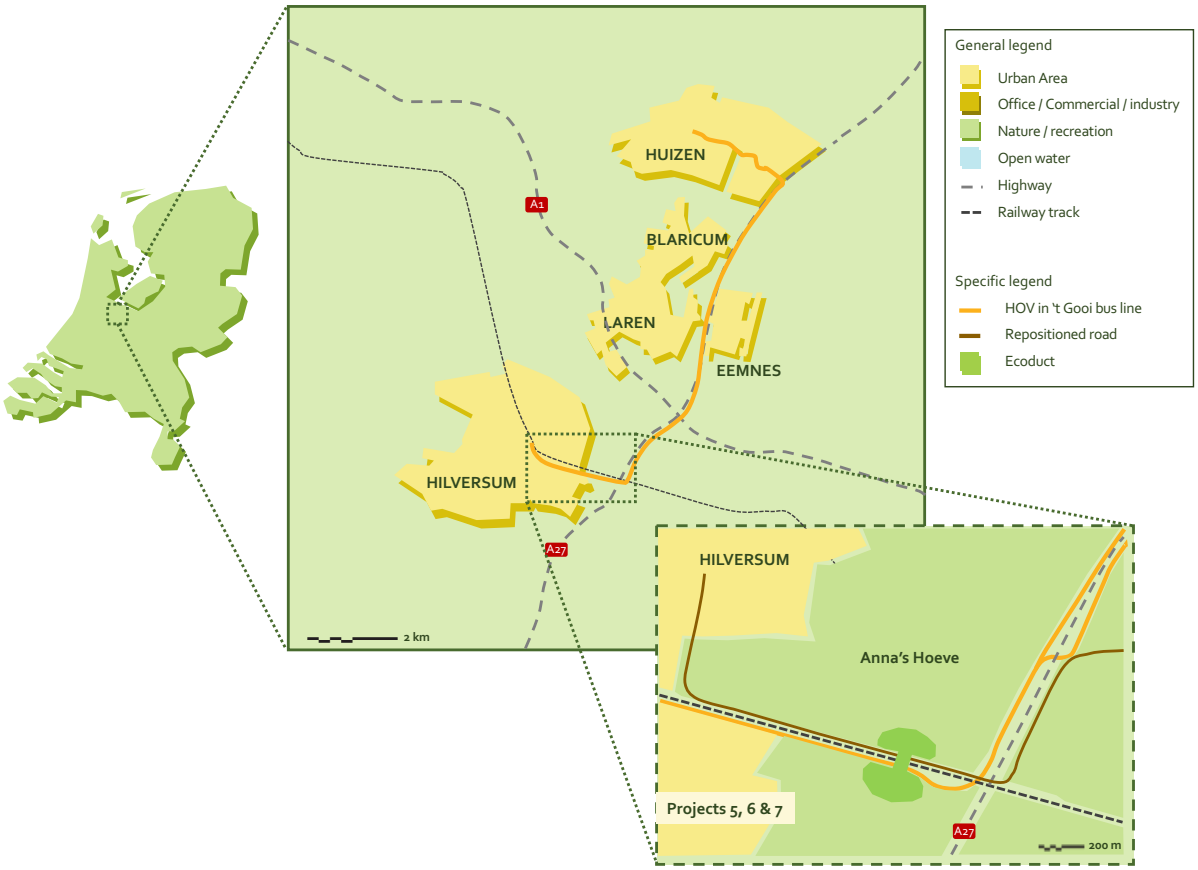


figure 9 Overview of the project HOV in 't Gooi. Expanded project 5, 6 & 7 (own illustration)

5.1.1 General description

Name of the project:	HOV in 't Gooi
Main objective:	Realization of a high-performance bus connection between Huizen and Hilversum (Noord-Holland)
Main Client:	Province of Noord-Holland
Total budget:	± €130 million
Initiation date:	2008
Start execution:	September 2017
Date of completion:	February 2022

HOV stands for "Hoogwaardig Openbaar Vervoer" which can be translated into "High performing public transport". This particular construction project has the objective to realize a high-performance bus connection between Huizen and Hilversum. This project initiated by the province of Noord-Holland is executed in close collaboration with the municipalities of Huizen, Blaricum, Eemnes, Laren and Hilversum and the national track manager: ProRail (Van Dijk, 2019). There are several measures needed to create a reliable, quick and comfortable bus connection between the two cities. The project of approximately €130 million (Projectorganisatie HOV in 't Gooi, 2019) includes next to a long stretch of disengaged bus lanes, a fly-over, a wild-life overpass, a temporary and a new rail crossing and a double layered tunnelling in the city of Hilversum.

In 2014 the involved municipalities signed a co-operation agreement which was the start of the project. After realization of the preliminary designs, zoning-plans and procedures for public participation, the project was

specified at the end of 2017 which was the start of the tender procedure. This procedure was however delayed by an objection of one of the tenderers. Difficulties with land purchases also caused the project to be delayed (NH Nieuws, 2018b). The tender phase for the sub-project Laren-Hilversum was 9 months delayed and was initiated in September 2017 (Projectorganisatie HOV in 't Gooi, 2017). In April 2019 the contractor started the execution work and the project is estimated to be finished by February 2022 (Projectorganisatie HOV in 't Gooi, 2019).

The overall project is divided into 7 areas of which parts 5 to 7 are the projects in and between the cities of Hilversum and Laren. These projects cover most of the construction works and budget of the overall project. According to the estimations, project 5 to 7 will cost around €74 million of the €130 million needed for the total project (Projectorganisatie HOV in 't Gooi, 2019). See figure 9 for the overview of the project and the location of projects 5 to 7.

Although the municipality of Hilversum is only a small financer in the project, the impact on the area and image for this municipality is significant. For this reason, the municipality is highly involved in the project organisation and the project office is situated in the centre of Hilversum. Main partners in the organisation are the province of Noord-Holland, largest financer and initiator of the project, and ProRail, owner of the rail tracks who needs to be involved in all construction works involving rail tracks.

5.1.2 Complexities

According to the dimensions of project complexity by De Bruijn et al. (1996) and Hertogh (1997) this project could be characterized as:

- Socially complex; the number of involved actors on the project is significant. The project organisation exists of the Province of Noord-Holland, ProRail and 5 different municipalities. Next to this, there is a large number of external stakeholders to the project. The project is realized in highly dense urban areas and therefore has multiple interfaces with local residents, local companies, nature reserves and emergency services (interviewee G2-2).
- Organisational complex; In this project the clients act complexifying. The project has a broad variety of tasks of which a larger part is focused on improving the living environment. This ambition and the significant number of intercorrelation, are the cause for extra complexity on the project.
- Law and regulation complex; The project is realized in co-operation with multiple municipalities and the province, which all have their own and connecting zoning-plans. Large plots of ground needed to be purchased to realize the project, which finally led to objections from ground owners and the province (Projectorganisatie HOV in 't Gooi, 2018). There is also a significant set of regulations for public participation procedures (Provincie Noord-Holland, 2016). The project must also adhere to a set of rules and regulations for flora and fauna preservation because the project crosses some nature reserves (NH Nieuws, 2018a).
- Time complex; Project HOV in 't Gooi was initiated in 2008, During this long period, changes on rules and regulations, the environment, wishes and requirements of the actors were expected. Because of the long duration of the project, the project progress and project requirements were affected by changes in attitudes and interest of the different municipal councils, as a consequence of several municipal elections.

Based on the interviews and project documentation the project could also be characterized as complex, on the basis of the TOE-framework (Bosch-Rekveldt et al., 2011), due too

- The number of contracts; 9 different main contracts on the project. Which results in a significant number of interfaces between those contracts, which all need to be controlled.
- Size of the project team; the project team was purposefully complexified by combining all project teams into one organisation (interviewee G3 – 25). By doing so, prioritizing of the main objective of the project above each other's personal or organisational interests. Whereas some project participants are used to projects and organisation of this scale, local organisations and actors are new to this approach.
- Political influence; A significant number of governmental authorities is involved in the project. Not all participating municipalities were as pleased with the plans as initiated and designed by the province (NH Nieuws, 2018c; Projectorganisatie HOV in 't Gooi, 2017; Walters, 2014)(Walters, 2014). Aligning all

political authorities can be complex, especially with projects with a longer time span, political authorities are dynamic and usually affected by the opinion of its inhabitants.

- Dependencies on external stakeholders; For the project, some plots of land needed to be purchased from local businesses and a foundation for the nature reserves. The province and residents could not agree on a price and the cases were taken to court (NH Nieuws, 2018c; Projectorganisatie HOV in 't Gooi, 2017). Influencing the cost, planning and appreciation from the stakeholders of the project.
- Number of external stakeholders; The number of stakeholders on the project is significant. Not only is the project realized in 5 different municipalities, the project affects multiple nature reserves, business parks, access roads and residential areas, and has therefore a significant number of interfaces and stakeholders on the project.

5.1.3 Extra objective

Extra objective:	Development of a design vision including public participation for an area adjacent to the bus line.
Phase:	During the design phase
Motivation:	To create certainty to the placement of a road, improve project appreciation through participation and shift focus away from construction of the bus line.
Impact on the project:	Extra cost between €100.000 and €150.000 (covered by multiple parties), planning could continue because placement of the road was decided upon.
Involved stakeholders:	- Goois Natuurreservaat, local organisation for the preservation of the nature reserves, partly owner of most of the plots of nature surrounding the project (stakeholder type: context setters) - local inhabitants, surrounding the area of Anna's Hoeve and users of the road (stakeholder type: subjects)

Part of the project scope is the replacement of a road which currently crosses right through nature reserve Anna's Hoeve. During the design phase a set of 4 variants was developed for a new location of this road. With public participation the variants would be evaluated, after which the best variant would be selected. However, during these public participations, no unambiguous preference was agreed upon. Multiple different interests were present in the area, of which some are contradicting (Goudappel, 2013).

To improve this decision-making process and create some certainty in the location of the road, to prevent project delays, the project organisation of HOV in 't Gooi decided to assist and partly finance the process for the development of a design vision for the whole Anna's Hoeve (interviewee G1 - 3). This was not part of the project scope and therefore an addition to the project's objective. Not only could this design vision create more certainty in the placement of the road, more support by local resident and organisations could be generated. Another benefit was that a negative focus was shifted away from the construction of the bus line, by creating a solution for another challenge to improve and preserve a nature reserve (interviewee G1 - 3).

The scope expansion meant that the project organisation needed to initiate, facilitate and monitor the process of the development of a design vision for the area. The municipality of Hilversum was appointed to organize and guide the public participation sessions in collaboration with the interest groups "vereniging voor behoud van Anna's Hoeve" (society for preservation of Anna's Hoeve) and Goois Natuurreservaat (owner of most of the nature reserves surrounding Hilversum) (interviewee G1 - 5). Cost for this process were between €100.000 and €150.000 financed by the project organisation (reference G1).

For the project organisation it is critical to monitor and steer the participation process. The final results of the process was not of importance for this project, the road needed to be replaced and/or renovated in all variants. The progress and vibe from the process, however, could affect the main objective of the HOV project. This process is a form of Co-management stakeholder involvement.

5.1.4 Project management approach

The scores of the project management approach are illustrated in figure 10, see page 42.

Terms of reference (score 3)
The objective included to the project was only small of scale and not significant to the total budget of the project (interviewee G1 – 8). As described, all scope expansions of possible new objectives were elaborately discussed with the project organisation before inclusion (interviewee G1 – 9). The main objective of the project, the realization of a high performing public transport route between Huizen and Hilversum, was fixed throughout the whole project (interviewee G3 – 22). However, a scope extension was not avoided but used to take away uncertainty, on the location of the road, and improve support on the project (interviewee G1 – 3, G3 – 15). There is no clear evidence that this attitude towards the terms of reference changed after the inclusion (interviewee G1 – 13, G3 – 13, G1 – 14)

Task definition (score 4)
As will also be described in "change" the project organisation decided to develop a large project organisation including multiple disciplines and project teams for the different contracts. And although the tasks were described, the project participants were motivated to collaborate, share knowledge and include each other in the decision-making processes.

"I believe that having the ability to look beyond the interests of your own organisation, you're capable to centralize the project's objective and thereby achieve the best possible result for the project." (interviewee G3)

Contract (score 5): A D&C contract was used for the project (Interviewee G1)

Incentives (score 2)
One of the interviewees felt a strong incentive to focus on the main project. In his interpretation, "changes to the project happen because as project organisation, you have to collaborate with your environment" (interviewee G3 – 10), he describes that only a small amount of the extra work was added to the project (interviewee G3-13), every opportunity needs to be evaluated to determine the risks and benefits for the main goal of the project (interviewee G3-14). This was supported by interviewee G1: "If a challenge occurs, you and the project organisation have to balance the risks and benefits of including/solving the challenge. Every resistance towards the project can turn into risks for budget and planning, make an analysis what the challenge is behind the resistance and what taking up the challenge could resolve". And although this interviewee describes that the project organisation always has to be open and responsive to challenges, risks and opportunities, every possible scope expansion was discussed in the administrative dialogue to be examined before inclusion. The incentive of the work did not significantly change after the inclusion. There was still a strong focus on the main objective of the project.

Change (before 4, became score 3)
The Project organisation started off by making the organisation more complex and preparing for uncertainties (Interviewee G3 – 8). The project organisation described "Doing things different" as one of their focal points in their manifest (Projectorganisatie HOV in 't Gooi, 2017). Further along the project, less focus was put on change and more on the main goal of the project and creating clarity for the project. As for example one of the motivations to include the extra project objective was to improve the decision-making process for the exact location of the road that needed to be replaced (interviewee G1 – 3). For these reasons the opinion to "changes" shifted a bit towards a more focus on control. This was also due to some difficulties on other parts of the project, as for example the land purchasing and difficulties during the tender phase of the project (NH Nieuws, 2018b; Projectorganisatie HOV in 't Gooi, 2017).

Steer (score 4)
The project organisation was organized according to a typical project organisational structure. The project director was the overall manager of the project organisation including multiple project managers for the 7 sub-projects. Main focus point of the organisation was collaboration, most decisions were submitted for the entire organisation, to involve all actors in the decision-making processes (interviewees G1 – 17, G2 – 4, G3 – 16). There was some hierarchy in the organisation, some decisions were made only with the specific role owners and if a

decision could not be concluded the project director was brought in (interviewees G1 – 16, G2 – 20, G3 – 17). First collaborations with Goois natuurreservaat were very strict in their negotiations (interviewee G2 – 10), at the start of the project the party was not included in the organisation because of the attitude and behaviour (G3 – 4). Their attitude and thereby position to the project improved after the collaboration during the realization of the extra objective. And although the way of steering within the project organisation did not change significantly, the approach towards the Goois Natuur Reservaat and their new position on the project could be seen as a small shift in the project management approach. The score however stays the same: 4.

Information exchange (before 3, became score 4)
More information was transferred to participants and other stakeholders to the project by for example some organized participation meeting and the half year report (Projectorganisatie HOV in 't Gooi, 2017, 2019; Provincie Noord-Holland, n.d.). Also, the level of trust increased within the organisation which makes transfer of information in most cases more informal (interviewee G3 – 1, G3 - 20).

Interface management (score 3)
Not all inclusions or changes to the project were formalized and distributed to all project participants (interviewee G3 – 21). The organisation structure however stimulated to share knowledge and decisions in an informal manner. The relation with GNR before the collaboration, however, could be described as strict and formal. This changed after both parties were aware of each other's interest and willingness.

5.1.5 Project success

The interviewees described the project as pretty successful (interviewees G2 – 1, G3 – 1). The project organisation faced some difficulties in for example the purchasing of land, but despite the complexity and size of the project the interviewees are pleased with the progress of the project and the collaboration and level of trust within the project organisation and with the other parties involved.

The inclusion of the extra objective did not negatively impact the budget or planning of the project. Complexity of the project was barely increased, only social complexity could be divined as slightly increased because of the increase in involvement of the participants of the participation process and the Goois Natuurreservaat. Collaboration with the Goois natuurreservaat and the inhabitants improved, including their attitude to the project. As described in section 3.3, project success can be identified by level of appreciation by the parties involved, the level of success is determined by how much their interest is fulfilled in the project. With the extra objective an interest from two interest groups is (partly) fulfilled, therefore their appreciation is improved, and project success could be described as improved.

Next to a slight increase in the complexity dimension, the extra objective did impact two present project complexity characteristics: "interference with external side" and "dependencies on external parties. The first complexity was increased due to the facts, the project organisation decided to expand the area of the project for the creation of the design vision. By doing so, a vision could be created for the whole Anna's Hoeve, including the new situation of the road. This expansion did increase the area of interference slightly.

The second complexity: "dependencies on external site", was slightly increase by the decision to develop the design vision in co-management with local inhabitants and organisation and the Goois Natuurreservaat. Were support was transferred to other parties and organisations, a good execution of the process would benefit the project and its progress. For this reason, the process needed to be monitored and steered to guarantee a successful outcome.

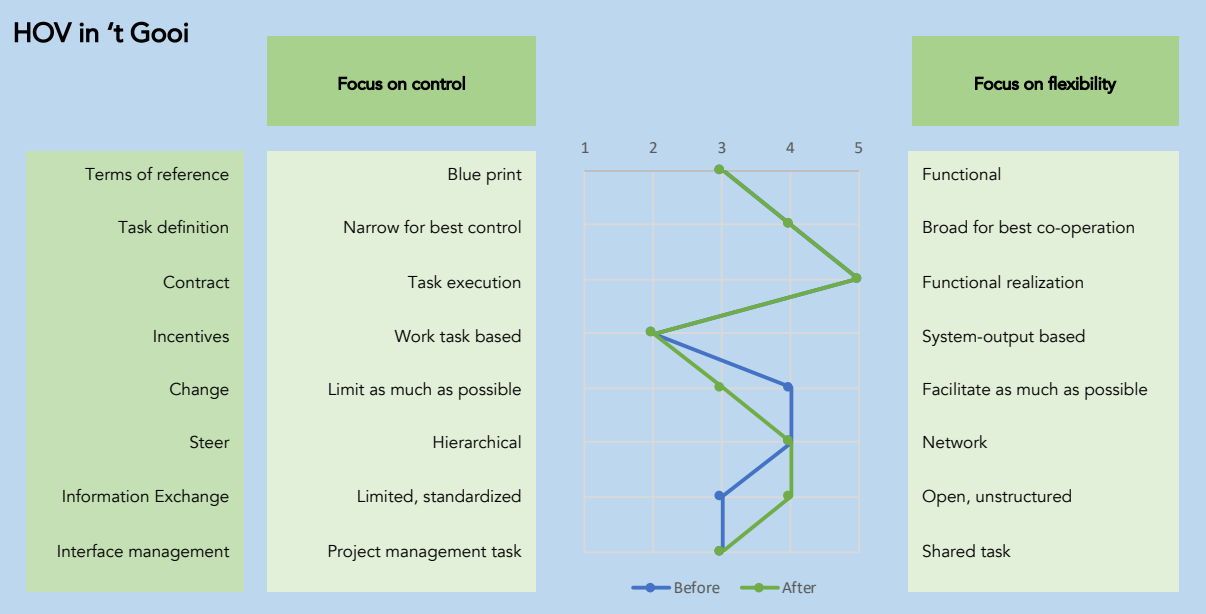


figure 10 Identification of the project management approach before and after the inclusion of the extra objective for HOV in 't Gooi

5.2 Verlaat

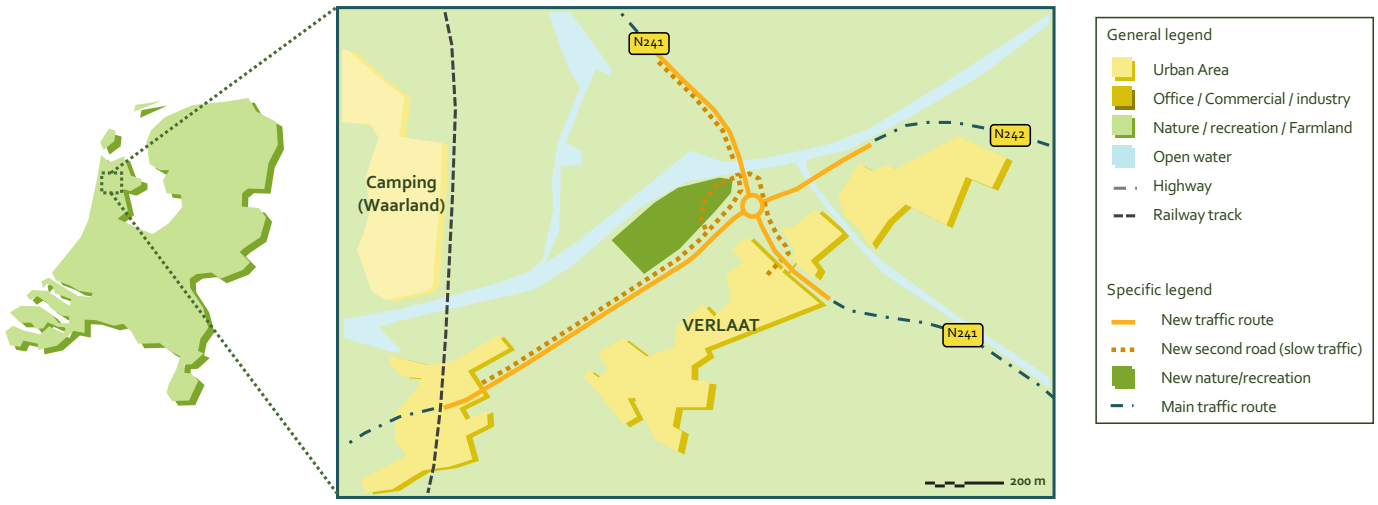


figure 11 Overview of the new situation of the intersection near Verlaat (own illustration)

5.2.1 General description

Name of the project:	Verlaat
Main objective:	Redesign of a junction and separation of slow & fast traffic near Verlaat (Noord-Holland)
Main Client:	Province of Noord-Holland
Total budget:	± €23 million
Initiation date:	2006
Start execution:	2011
Date of completion:	2013

Knooppunt N241/N242 was an infrastructure construction project near the village of Verlaat in the province of Noord-Holland. This project was part of a larger project for the renovation and improvement of the N241 and N242 provincial roads. Knooppunt N241/N242 included a realization of a turbo-roundabout and two regular roundabouts, a bridge over the canal, some smaller viaducts for slow traffic, cyclists and pedestrians and the road network connecting all this (Grontmij BV, 2009). The project was initiated in 2006 to start the execution in 2011 which was completed in 2013. Total cost of the project was around €23 million, which was mainly financed by the province of Noord-Holland (Grontmij BV, 2009).

Continuous congestion of the junction and an expected growth of the traffic numbers on both the N241 and the N242 were the main reasons for this construction project. Objective of the project is to separate the fast (>80km/h) and slow traffic (tractors, cyclist, pedestrians etc.) and thereby improving the capacity and safety of the junction. To compensate for the addition of new paved areas, the project included some development of the nature areas, surrounding the project. See figure 11 for the new situation of the area.

5.2.2 Complexities

Based on the dimension of De Bruijn et al. (1996) this project could be identified as:

- Organisational complexity; The project initiated by the province of Noord-Holland needed to be constructed in collaboration with the municipalities of Heerhugowaard and Niedorp. In realization of the project these three authorities, zoning-plans, regional plans and mobility plans needed to be aligned. The presence of this complexity was the reason for the solution chosen. A solution by taking most requirements from different institutes into account.

Based on the TOE-framework, the project could be characterized with:

- Interference with the external side; The main reason for the reconstruction of the junction was the continues congestion, which meant that closing this junction for maintenance or construction work would have a significant impact on the roads in the surrounding area. To limit this nuisance for the local residents and users of the roads, the execution of the turbo-roundabout was executed within 72 hours. The contractor was evaluated on the lost traffic hours (Voertuig Verlies Uren) to stimulate him to think of control measures to minimize this value (interviewee V1 - 1).

5.2.3 Extra objective

Extra objective:	The realization of a nature and recreation area, including an art project in participation with the local politics and inhabitants.
Phase:	Design and participation during the design phase, realization during the execution phase
Motivation:	An opportunity to satisfy a landowner, thereby reducing risks for land purchasing. Secondly, realize multiple goals of the client with one project and thereby improve the client's appreciation.
Impact on the project:	Extra cost not significant, mostly paid for by the special funds. No impact on the planning however, reduction of the risks on land purchasing and therefore the planning.
Involved stakeholders:	- local inhabitants (stakeholder type: crowd) were involved in the process through public participation - Provincial employees responsible for nature and recreation (stakeholder type: context setters), support and responsibility for the design, finance and realization of the park was transferred to this organisation.

During the design phase of the project the project organisation decided to purchase extra land to realize an area for nature and recreation. There were two main reasons for this decision:

1. Every infrastructure construction project is obliged to compensate the realization of pavement with open water. This open water needs to be realized in the same gauge area as the road construction, to ensure a sufficient water storage (interviewee V1 -3).
2. For the realization of the road construction some plots of land needed to be purchased. However, the owner of the land that needed to be purchased was not eager to sell only a small part of his land (interviewee V1 -4).

Because of these two reasons the project organisation tried to look for opportunities and possible solutions to satisfy the seller, realize the goals and improve the project. The idea was initiated to purchase a larger strip of land and realize a park for nature and recreation. By doing so, an extra objective was added to the project, plus it gave the project organisation the opportunity to realize another goal of the province: conservation and improvement of nature in the province.

When the project organisation discovered the opportunity to include this extra objective, the first thing they did was finding a partner who could support. In this case the provincial employees responsible for the nature and recreation were included to the project to support and develop the idea. In collaboration with this group of people and the project organisation an attractive plan was developed which was presented to the province. They agreed with the idea and supplied the organisation with the needed budget to realize the plan (interviewee V1 -7). This form of stakeholder involvement can be characterized as co-management (Timothy Lynam et al., 2007). The cost of this extra objective was not significant. Land purchases for example is not paid for by the project organisation but special funds from the province were appointed for these purposes (interviewee V1 -9).

To improve this plot of nature the organisation decided to initiate a competition for artists to submit an idea for the area, after which the local inhabitants could debate and finally decide on which idea would be developed and constructed. This inclusion to the project can be seen as an expansion to the scope of the project which does not contribute to the main objective of the project. Next to the involvement of the artist and local inhabitants,

some landowners needed to be included on the project. For the realization of the road network and nature reserve some neighbouring land needed to be purchased by the province and municipality. With this scope expansion, more external stakeholders were included to the project. Idea behind the inclusion was to increase participation and in the end appreciation for the project result, as emphasized by Voinov & Bousquet (2010). The chosen design was "Geheugenspoor" by Paul de Kort, a sculpture indicating a former road for horses used to pull ships in the early 1850's, (De Kort, 2013).

5.2.4 Project management approach

Terms of reference (before 3, became score 2)
A large part of the scope was already fixed before the start of the project. There was however some room to use opportunities to improve the project. This room was especially created because of some uncertainties in the design of the project. These uncertainties and room for flexibility created the opportunity to expand the scope of the project and incorporate an extra objective from the province to the project (interviewee V1 – 3, V1 – 4). Other motivation was the momentum of the project. If the project is initiated an find itself in a momentum, key is to maintain its progress (interviewee V1 – 6). Maintaining its progress could for example be done by avoiding potential risks for the project. In many cases land purchasing can be significant for the project with consequences of delays on the planning if land needs to be expropriated. When the extra objective was included to the project, most uncertainties on the project were taken away. For these reasons the terms of reference shifted from a score 3 to a 2, which is illustrated in figure 12.

"You must organize the collaboration in such a way that the main objective of the project can continue autonomously without disturbance of the added objective." (interviewee V1)

Task definition (score 2)
Task definition on the project was pretty narrow for best control. Due to the size of the project not much overlap between the different tasks was needed or motivated. After the decision for the scope expansion other actors were made responsible for the support, finance and realization of the project. No change was visible in the task definition as a consequence of the inclusion. "They develop and realized the idea, we only assisted" (interviewee V1 – 12). This results in a score of 2 for the scaling table

Contract (score 5)
A D&C contract was used for the project. There was some room for the contractor to improve the project execution to reduce impact on the traffic flow (interviewee V1 – 1, V1 – 13).

Incentives (score 2)
There was a focus on the importance of the main objective of the project by all participant. This main objective was not affected by the realization of the nature and recreation park. The inclusion did not bring extra risks to the project. The potential risks of difficulties of land purchasing and resistance from local inhabitants was reduced by the expansion of the scope (interviewee V1 – 14). Expected resistance and difficulties resulted in the motivation to look for opportunities to avoid or reduce these potential risks (interviewee V1 – 17). The main focus on scope remained, but the attitude to look for opportunities when potential risks are present was present during the whole project (interviewee V1 – 15). Incentives were determined as a focus on "work task based" and therefore received a score of 2, before and after the extra objective.

Change (score 3)
Related to "incentives", there was no strict focus on limiting the flexibility and uncertainties. Some level of uncertainty for the project was expected (realization of sufficient amount of open water, for example). "All additions have to be in line with the main goal of the project" (interviewee V1 – 16). Changes are only facilitated when a trigger was present, in this case the combination of the land purchasing and objective for the open water. Interviewee V2 emphasised that: "changes and scope expansions grow during the project and should therefore in most case be facilitated" (interviewee V2 – 16)

Steer (score 3)
The relatively small project organisation worked in good collaboration, where tasks were separated, new ideas for the extra objective were discussed with the group, who supported the idea. Collaboration with this party was

organized in a way that the main objective of the project could continue autonomously without any disturbance of the added objective. (interviewee V1 – 21). The extra objective needs to be realized as devised to reduce the resistance and improve the project without any significant risks for the main goal.

Information exchange (score 4):
There was a connection between the contractors and the project organisation, as described by interviewee V2. The organisation invested some time at the start of the project to improve the collaboration within the project team and with the contractor. This creates a sufficient level of trust between the project participants to transfer most of its information in an open and transparent manner (interviewee V2 – 22). The relation with the external stakeholders improved over duration of the project. Agreements with the parties of the extra objective were formally registered, but collaboration was good and mostly based on trust.

Interface management (score 4):
In relation to information transfer, there was some level of trust which motivates participants and participating parties to have some self-control. This was the same for the party and inhabitants involved for the extra objective. Responsibility was mostly transferred to these actors. There was some form of control to maintain progress on the project and the extra objective.

5.2.5 Project success

The project organisation decided to involve the inhabitants to the extra project. An art project was initiated to which artist could submit ideas for the realization of a sculpture in the nature and recreation area. The inhabitants participated in the development of the list of wishes and in the final selection of the to be realized sculpture. The number of participants and level of interest in the project increased. This increases the level of appreciation and therefore the level of project success. The interviewees supported this statement and named their project and the project organisation successful. Besides this, the planning and budget of the project were not affected by the extra objective. Most of the extra costs were paid by funds from the province.

By the involvement of the extra participants the number of external stakeholders on the project increased, and thereby its complexity, as emphasized in the TOE-framework. This increase in project participants is also related to the social complexity dimensions. Besides this, the present complexity characteristics: "political influence" and interference with external site" were slightly increased.

Because the extra objective was supported, financed and executed by the province, the political influence on the project was slightly increased. Increase in this complexity, implies and increase in requirements and possible interlinkages between objectives for the project.

Interference with external site was increased as a consequence of the purchase of a larger plot of land than needed for the realization of the main objective of the project.

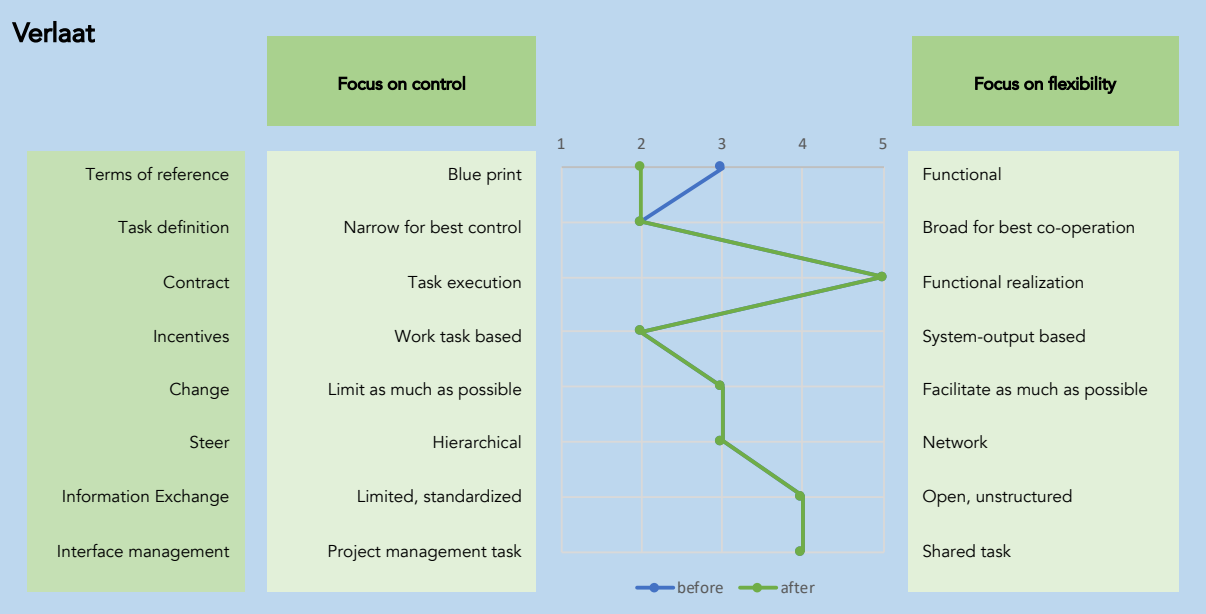


figure 12 Identification of the project management approach before and after the inclusion of the extra objective for Verlaat

5.3 HOV Westtangent

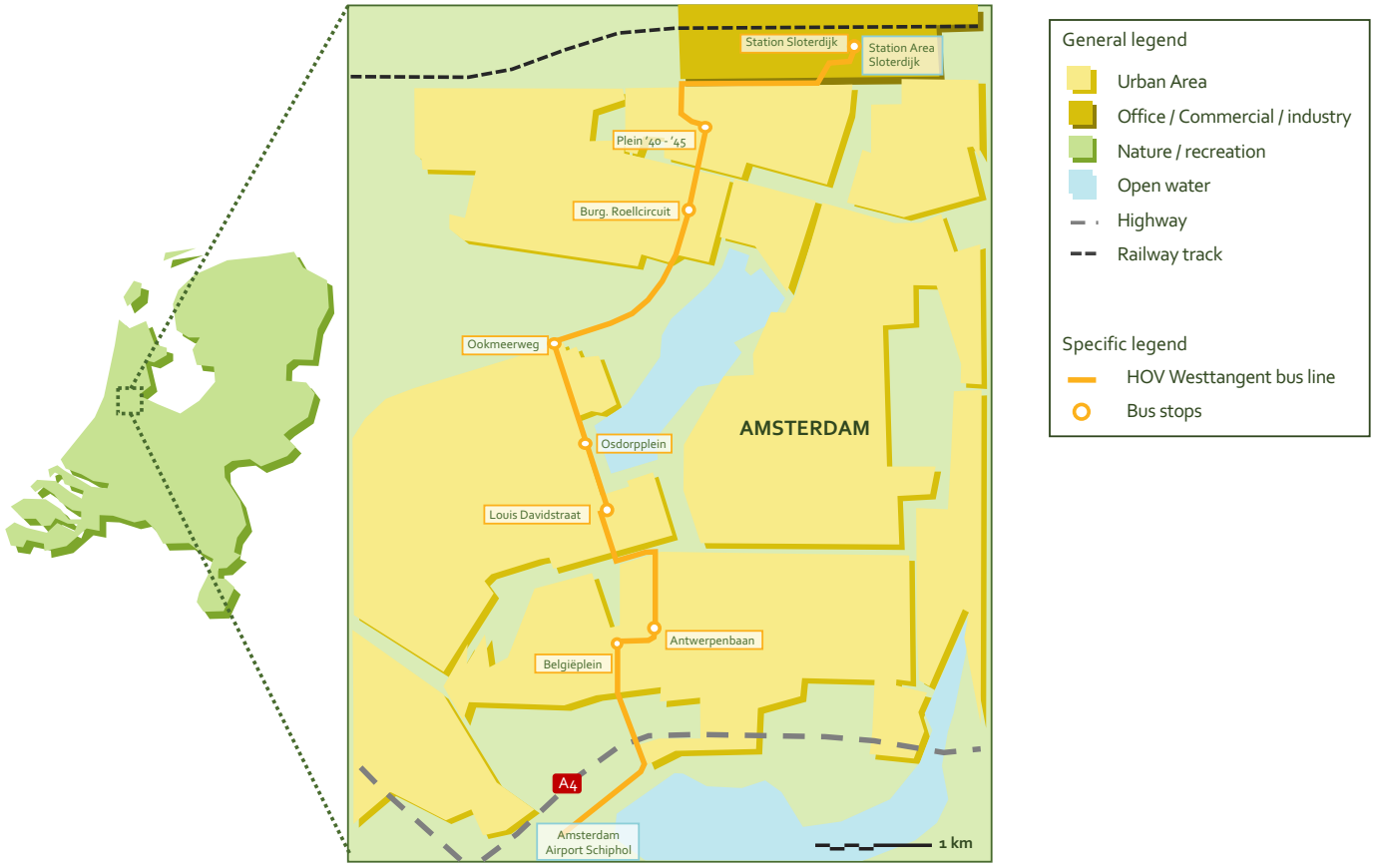


figure 13 Overview of the new busline HOV Westtangent, including the future bus stops (own illustration)

5.3.1 General description

Name of the project:	HOV Westtangent
Main objective:	Realization of a high-performance bus connection between station Sloterdijk (Amsterdam) and Schiphol airport (Hoofddorp)
Main Client:	Vervoersregio Amsterdam & Verkeer en openbare orde
Total budget:	± €28 million
Initiation date:	2016
Start execution:	2018
Date of completion:	2020

This project in Amsterdam has some similarities with the case HOV in 't Gooi. HOV Westtangent is an infrastructure construction project for the realization of a "High performing public transport" line between Amsterdam Sloterdijk station and Schiphol Airport. The project initiated by Vervoersregio Amsterdam (transport region Amsterdam) and Verkeer en Openbare Ruimte (traffic and public space Amsterdam) has to improve the current bus line to a more frequent, reliable and comfortable bus line for the city district Amsterdam West. The project includes multiple separated bus lanes, new bus stations and a new bus parking location. The budget of the project is estimated at €28 million (Drunen, 2019). Main objective of the project is to optimize the route between Station Sloterdijk and Schiphol Airport to reduce the travel time by 10 minutes. Next to this, the frequency and reliability of the line needs to be increased.

In comparison to HOV in 't Gooi, this project is largely realized in one city. 9,1 km of the 15,5 km bus line is situated in Amsterdam. Most of the measures needed for optimization of the route needed to be done on the 9,1 km stretch in Amsterdam (DRO, 2015).

The project is split into 10 smaller projects of which most are executed by the same contractor. The project is executed by Amsterdam's own engineering firm: Ingenieursbureau Amsterdam in corporation with GVB (tram operator) and a contractor. Other parties involved in the project organisation are the municipality of Amsterdam and Haarlemmermeer, province of Noord-Holland and Schiphol. See figure 13 for the new route of the HOV Westtangent and its new bus stations.

Main objective of the project were the measures that needed to be taken to realize the bus line. Some extra objectives were added to the project which were a set of activities for cables and sewage companies, the tram operator and public space refurbishments. All infrastructure projects executed in Amsterdam have to ask asset owners or operators if any renovation work needs to be done to their assets, located in the building areas. If so, the asset owners or operation have the opportunity to combine their activities with the infrastructure construction project. For example, GVB (the tram operator) was included in the project organisation because they had some maintenance works that needed to be done to their crossings and tram rails, situated on some part of the HOV Westtangent route (interviewee W3 – 1)

The project execution started in 2018 and the project needs to be finished in 2020. The project team was set-up according the IPM-model (Rijkswaterstaat, 2014) (interviewees W1 – 19 & w3 – 19). An extra challenge for the project was the decision to use a design team model for the project. In this model the engineering firm, client and contractor are all included from the design phase of the project. This was an unusual model for most of the project participants and required some extra attention in the beginning of the project. Main reason for the decision to use this type of contract was a shortage of qualified personnel on the client's side. By using this model, the client and contractor could collaborate and combine knowledge to realize the design for the project (Interviewee W3 – 14 & W4 – 6).

5.3.2 Complexities

According to the dimensions of project complexity by De Bruijn et al. (1996) and Hertogh (1997) this project could be identified as:

- Socially complex; The project is being realized in an area with a high population density. Therefore, the project has a large number of interfaces between the building site and its surrounding. Next to this, to optimize the route of the bus line, the bus sometimes needs priority above other modes of transportation, creating tensions on some of the interfaces. Other complexifying factor is the involvement of extra stakeholders due to the inclusion of the extra activities to the project, like the participation of GVB.

According to the TOE-framework (Bosch-Rekveldt et al., 2011) the project complexity could also be characterized by:

- Uncertainties on the scope; although most infrastructure project in Amsterdam are aware of the fact that scope could be added to the project, the number of scope extensions on this project was not anticipated (interviewee W3 – 2).
- High project schedule drive; because the project is realized in an urban area with multiple ongoing building projects, strict time spans for construction activities were agreed upon in advance of the project. All execution work needed to be done in the agreed time spans, every delay or misalignment has an effect on other activities on the project. For example, project execution started before all designs were completed and agreed upon, otherwise work had to be postponed and the whole project would be delayed (interviewee W3 – 18)
- Lack of Recourses and Skills available; As mentioned earlier, the project organisation decided to use a design team construction to use the knowledge and experience of both the client and contractor during the design and realization of the project, because both parties experienced a shortage of sufficient qualified personal. The contractor faced difficulties to organize a sufficiently experienced and qualified team for the project, for one reason because the contractor was involved in 3 other projects in

Amsterdam at the same time. Because both parties were incapable to arrange a sufficient team the project organisation lacked recourses and skills in the organisation (interviewee W2 – 25)

- Interference with the existing site; because the project is realized in busy and dense area, there is a significant level of interference with the existing site. All execution work interfered with some mode of transportation and had an effect on the traffic flow in the area. All design plans needed to be submitted and asses by a committee from the municipality to guaranty a sufficient level of traffic flow in the city, during and after the execution of the project.
- Number of external stakeholders; similar to the other cases of the case study is the large number of external stakeholders on the project. The project has a significant impact on the direct and indirect surroundings. Next to nuisances of the construction work is the effect on traffic flow, diversion for public transport lines and stops and interventions in the public spaces.

5.3.3 Extra objective

Extra objective:	Inclusion of renovation works for the water sewage systems
Phase:	Inclusion at the end of the design phase, realization during the execution phase
Motivation:	Request for inclusion by the asset owner of the sewage system, thereby realizing multiple objectives with one project, improve client's appreciation.
Impact on the project:	Estimated extra cost of €1.7 million and +3 months on the planning
Involved stakeholder:	Asset owner of the water sewage system (stakeholder type: subjects)

The project faced some difficulties within the project organisation and with the complexities of the project delaying the project for at least a year (R. Koops, 2019a). As mentioned, due to time pressure some of the construction work started before the designs were finalized. This and changes to the design led to friction between the project organisation and contractor, who demanded extra time and budget for the needed changes. This was one of the arguments to separate one of the sub-projects from the main contract. This last part of the work is now tendered to find a new contractor who can execute this construction work.

The biggest objective expansion to the project was the inclusion of renovation works of a sewage system. The asset owner of the sewage system requested to be included on the project shortly before the execution phase of the project (interviewee W3 – 5). As mentioned, the client requests the project organisation to inform asset owners and operators to include their maintenance or construction work on the infrastructure project. After a submitted request, the project organisation evaluates and determines if and how the requests can be included on the project. In the case of the renovation work of the tram rails, requested by GVB, the project organisation decided to include this actor on the project organisation and combine the work that needed to be done. However, in case of the sewage renovation the project organisation determined to include the work but not include the actor onto the organisation. The decision to not include the asset owner of the sewage system on to the project organisation was their moment for a request for inclusion. The request was submitted only a half year before the start of the execution work. The project organisation has the possibility to evaluate if an inclusion to the project is possible, based on the effects it has on the planning, budget and execution of the project. Next to the evaluation is the negotiation with the requesting party on the amount and sort of construction works that need to be done and the distribution of the costs for the activity. This stakeholder involvement methodology can be described as "extractive use" (Timothy Lynam et al., 2007).

The inclusion of this extra work had a significant effect on the planning and budget of the overall project. The project organisation estimated the extra costs at €1,7 million for the project (6,1% of the total budget), the planning had to be extended with at least 3 months (interviewee W1 – 4).

5.3.4 Project management approach

The results and overview of the provided score of the project management approach for this case can be found in figure 14.

Terms of reference (score 3, became 2)
The project was a collection of smaller projects with as main goal the improvement of the speed of the bus line between Sloterdijk and Schiphol (Interviewee W2 – 1). The exact solution to improve the traffic flow and speed of the bus line had to be defined in the design phase in collaboration between the contractor and the project organisation. Every design had to be checked and approved by the central traffic committee before implementation (interviewee W2 – 2). The exact scope of the project was defined during the design and tender phase of the project, during these phases third parties had the opportunity to request their participation on the project (interviewees W1 - 3, W3 – 3, W3 - 18, W4 – 3). Because the main goal of the project was fixed but there was some room for discussion for a scope extension, a score of 3 was given..

Task definition (score 2)
The project organisation was structured via an IPM model (interviewee W1 – 19, W3 – 19). The project manager selected their project members to be capable of fulfilling multiple roles or at least have some level of affection with the other disciplines on the project (interviewee W1 – 19). The project members were stimulated to work in collaboration, some decisions were therefore made by the whole project organisation (interviewee W2 – 19). However, most member focussed on their own discipline, due to the pressure on the schedule which forced some decisions to be made quickly and only with the involved actors (interviewees W3 – 19 & W4 – 19).

Contract (was 4, became score 2)
For the project a design team set-up was used to in collaboration with a contractor develop a RAW-bestek for the project. The reason for this set up was partly because of a limitation of sufficient qualified personal for the project organisation (interviewee W3 – 14) and partly because this method provides the opportunity the use the knowledge of the contractor to develop the appropriate RAW-bestek and plan of approach for the project (interviewee W4 – 14, W4 – 15). The project was split up in two parts, both starting with a design team phase and continued to an execution phase. The execution phase of the first part would overlap with the design team phase of the second part. Friction due to the tight schedule and disagreement on the costs for the project, caused the good collaboration in the first phase to fade away. This insufficient collaboration and extra work in the execution of part one had a negative effect on the cooperation from part two. Both parties decided to end their collaboration for the second part. The project organisation finished the RAW-bestek for part two by them self and a new tender is initiated for this second phase. The project organisation is looking for a contractor that can execute this work under a fixed contract (interviewee W4).

Incentives (before 3, became score 2)
Eventually during and after the tender phase the attitude towards scope expansion changed to more focus on fixation, scope expansion could be discussed but were avoided (interviewee W2 – 14, W4 – 9). As described by interviewee W3: "from now on, every change request should be formalized and critically assessed before inclusion, extra work will only be included after a clear agreement with the third party". This change in attitude towards scope expansions was mainly caused by the unexpected difficulties caused by the inclusions of other extra work and especially of that of extra work for the sewage renovation works. This inclusion was not critically assessed and no clear agreement on the payment was made with the third party (interviewee W1 – 3, W3 – 3, W3 – 22, W3 – 23). The pressure on the time forced the project member to more task based. The project organisation was determined to use the already planned deactivations for the tram, because if not met, more delays were expected. The driver of time forced the variable "incentives" to shift from 3 to 2.

"As project manager you desire your team members to only focus on their own role or task description, especially in projects with a significant number of interfaces" (interviewee W1)

Change (before 4, became score 2)
The project organisation was open for changes, weekly changes with the organisation were planned to discuss the changes and progress of the project (interviewee W1 – 17). "However, after the inclusion and problems during the execution, as project organisation, we decided to be strictly against further expansions and inclusions. At the same time, some inclusions were needed, some requests cannot be undermined" (interviewees W2 – 17 & W4). Changes and expansion were not properly assessed before inclusion, "We should have performed a better assessment on the request by the sewage owner. This would deliver a more adequate assessment on the corresponding risks, impact on planning and costs". (interviewee W3 – 22) Interviewee W3 also suggests that the organisation should have been more alert to possible extra work. We could have foreseen

the request by this party and build in time for a proper assessment on the risks and cost for the extra work. Because of these factors the variable "change" shifted from 4 to 2.

Steer (score 3)
As mentioned for "task definition", main focus for the project was on functioning of the organisation, and therefore strategic based. Not all actors had the same information while corporation and sharing of knowledge was in some way stimulated. If parties could not come to an agreement, the problems were escalated to project management level (interviewees W2 – 19 & W3 – 20). These project management activities did not change after the inclusion, "steering" scores.

Information exchange (from 4, to score 2)
Most of the information within the organisation was transferred informally, even agreements with third parties were sometimes based on trust (interviewee W1 – 6, W1 – 22). There was a focus on good collaboration and cooperation between the project participants (interviewee W2 – 19). The communication between the owner o the sewage works was mostly done informal. This changed after a reorganisation of the actors in this organisation. The new asset owner demanded everything to be formalized (interviewee W1 – 7). Agreement which were not formally documented were invalid. The level of trust within the organisation decreases which caused the information transfer to be stricter and more formal (W2 – 19).

Interface management (score 3)
There was some level of trust within the organisation. The project management tried to select a team with people which are capable of doing their own tasks but also understand what the rest of the team is doing (interviewee W1 – 12, W1 – 21, W3 - 19). Regular meetings were scheduled to keep each other and the project manager up to date.

5.3.5 Project success

The project started off good. The interviewees described the first design team phase as successful (interviewee W4). However, some challenges on the project and friction between different project parties started occurring during the execution phase. All interviewees agreed that during this phase the project was in some way unsuccessful. The estimated extra cost of €1,7 million (+6%) and a delay of a least a year are the mean reasons for these interpretations. When looking at the project, multiple factors or events could be appointed as possible cause to these problems.

No proper analysis was executed on the request by the sewage water company. No formal agreement with the sewage water company on the allocation of the costs and risks were made. Some interviewees mentioned the level of trust within the project organisation and between the project organisation and the sewage water company as reason for this (interviewee W1 – 5, W3 – 6).

The extra complexity, high schedule drive, could be appointed as reason for the insufficient analysis of the extra work. Fixt milestones, not sufficient number of qualified personal in the organisation and the late request for the extra work, made the project organisation decide to continue with the work instead of taking the time for a proper analysis and consideration.

By the inclusion of the extra interest group to the project an extra dependency with an external party was created. The progress of the project was heavily dependent on the execution of the renovation works on the sewage system. Although both parties agreed on a planning for the execution work, the project organisation was dependent on the newly involved participant.

As a consequence of these problems the project organisation tried to gain more control and grip on the project and shifted towards a project management approach with a focus on control. The project organisation was not prepared for the large number of scope changes to the project (Interviewee W3 – 14).

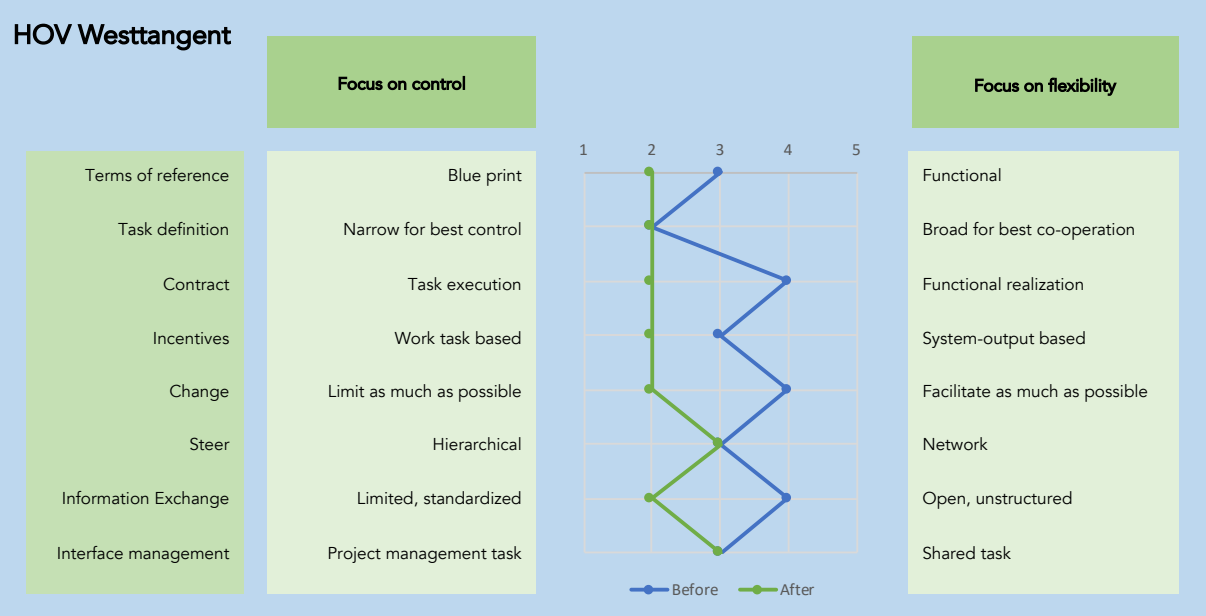


figure 14 Identification of the project management approach before and after the inclusion of the extra objective for HOV Westtangent

5.4 Rotterdamsebaan

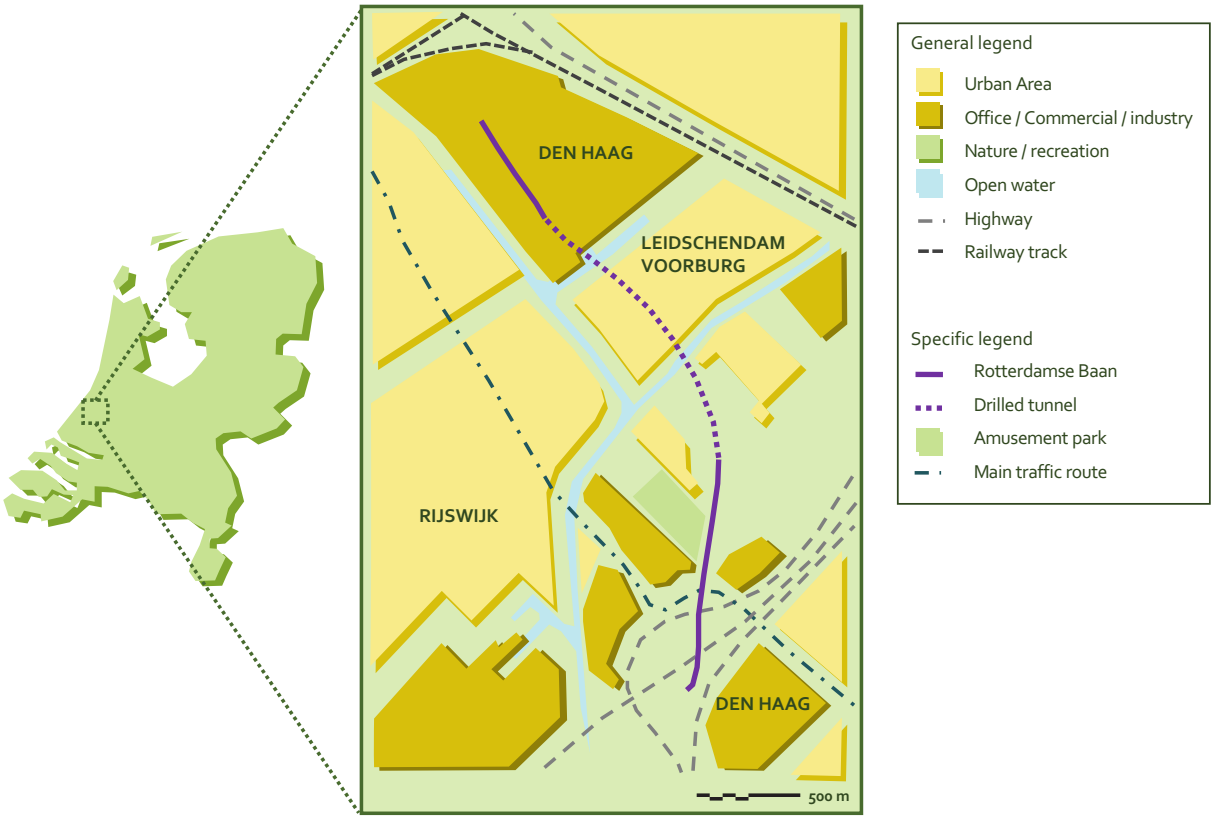


figure 15 Overview of the Rotterdamsebaan (own illustration)

5.4.1 General description

Name of the project:	Rotterdamsebaan
Main objective:	Realization of a 3,8 km long road into the city of The Hague (Zuid-Holland) including a drilled tunnel
Main Client:	Metropoolregio Rotterdam Den Haag
Total budget:	± €670 million
Initiation date:	2012
Start execution	2016
Date of completion:	July 2020

This case study is the largest project of the analysed cases in this research. The Rotterdamsebaan is an infrastructure construction project for the realization of a 3,8 km long road into the city of The Hague. The new road, including a 1.6 km long drilled tunnel, runs from the highways A4/A13 to the centre ring road of The Hague (COB, 2016). See figure 15 for the route of the new road and tunnel. The construction of the road and tunnel started in 2016, the first cars are expected to make use of the tunnel in July 2020 (Kaaij, 2018). Total budget for the construction is estimated at €670 million largely financed by the municipality of The Hague (25%) and Ministry of Infrastructure and Environment (50%) (COB, 2016). Other important partners to the project are the municipalities of Leidschendam-Voorburg and Rijswijk, Metropole region Rotterdam Den Haag, Rijkswaterstaat and Waterboard Delfland.

The Rotterdamsebaan is the largest construction project of the municipality of the Hague ever (interviewee R2 – 1).

5.4.2 Complexities

According to the dimensions of project complexity by De Bruijn et al. (1996) and Hertogh (1997) this project could be identified as:

- Technical complex; The Rotterdamsebaan is a technically complex construction project, next to the large number of traffic control systems and tunnel safety systems, the tunnel is realized using a tunnel drilling machine. This technique is uncommon in the Netherlands, only a handful of contractors, project organisations and especially municipalities are familiar with this construction method.
- Socially complex; Due to the scale of the project, the impact on its surrounding is significant. The project has a large number of interfaces with it surrounding. The realization impacts for example the surrounding road network, the accessibility of the surrounding neighbourhoods and the water level in the area. The project crosses three municipalities, is directly linked with 2 highways, crosses a parking lot and golf course and end up in an industrial area with multiple small industries, offices and shops. This large number of internal and external stakeholders makes the project complex (interviewee R2 - 2)
- Organisational complex; There was a significant amount of intercorrelations between the road and tunnel construction project and other requirements from the client. Because the project has a large impact on the area the project organisation decided to execute almost all construction projects present within the boundaries and within the time span of the project (interviewee R1 – 3). This coupling of project and extra set of requirements, complexified the project.
- Financially complex; Due to the large expenses and duration of the project, the project could be identified as financially complex. Large numbers of public and private investment were needed to realize this project. Due to the uncertainties, large reserves are budgeted in case of unexpected events or expenditures. The construction is also realized under a DBFM contract which means that the contractors are responsible for the finance of the construction costs (interviewee R1 – 14).
- Time complex; Total duration of the project from initiation till realization and completion is around 8 to 10 years. During this long period, changes on rules and regulations, the environment, wishes and requirements of the actors are expected. The variations and uncertainties complexify the project. Also for this reason, the project organisation was stimulated to realize the project to a "point of no return" before the next election of the municipal board, to prevent the project being cancelled or delayed (interviewee R1 – 2 & 15).

Most important project complexities according to the TOE-framework (Bosch-Rekveldt et al., 2011) could be characterized by:

- Strict quality requirements; there are many strict requirements on tunnel and traffic safety, demanded by both the client but also the government. Next to these requirements, the client and project organisation put a heavy emphasis on sustainability. The tunnel needs to be the example of sustainable infrastructure in the Netherlands. To realize this goal, strict requirements need to be fulfilled (COB, 2016).
- High project schedule drive; as mentioned earlier, the client requested to speed up the process for the design and realization of the tunnel to create a point-of-no-return before the next election. This pressure on planning acts as extra complexity characteristic to the project.
- Political influence; multiple governmental bodies were involved on the project: multiple municipalities, the water board of the area, the ministry of infrastructure and environment and Rijkswaterstaat. All of these bodies have their own interest on the project and have sufficient power to influence the decision-making process of the project organisation.
- Number of external stakeholders; in addition to the participants just described, there is a significant number of stakeholders who are affected by the project. Stakeholder engagement was by the interviewees emphasized as one of the most important tasks of the project organisation (interviewees R2 – 2 and R1 – 22 & 23).

5.4.3 Extra objective

Extra objective:	Realization of a large water storage in Molenvlietpark
Phase:	During the design phase, realization during the execution phase
Motivation:	Organisation felt responsible for all work that needs to be done in their project area. Beside this, improve collaboration with the waterboard.
Impact on the project:	Balancing extra cost with cost savings for transport of materials from the tunnel realization. No impact on the planning.
Involved stakeholder:	Waterboard of Delfland (stakeholder type: player)

During the design phase and execution phase of the project the organisation felt responsible for all the work that needed to be done within the physical boundaries of the project and within the time the organisation was present in the area. Multiple actors and project participants used this opportunity to request work that needed to be done. But also, the organisation members were motivated to actively search for opportunities to improve the project or involve the interest groups on to the project.

An important partner on the project was the waterboard of Delfland, responsible for the water level, the water quality, maintenance of dikes and conservation of nature in and next to open water in the area. The route of the Rotterdamsebaan has multiple interfaces with water related objects, for example the Zuidvliet. For this reason, the waterboard was included in the project decision from the start of the project. The waterboard was however not included in the project organisation. In almost all construction projects the waterboard acts as interest group, because their main priority to protect the water quality and guarantee the water levels in the area.

To improve the relation between the project organisation and the waterboard and realize one of their requests, the project organisation decided to include an extra objective to the realization of the Molenvlietpark and thus to the Rotterdamsebaan project. The waterboard requested to improve the water storage in the area, which could be realized in the Molenvlietpark. The reorganisation and improvement of the Molenvlietpark was already part of the scope of the project. During the construction of the tunnel, this area was mainly used for temporary storage for building equipment and permanent storage of the excavated materials of the tunnel realization. See figure 18 for the new lay-out of Molenvlietpark with significant space for open water.

One of the interviewees described the main reason for this inclusion by the motto: "If you do something for me, I will do something for you" (interviewee R1 – 5). It's a game of giving and taking, by giving something to the water board, extra water storage for the area, the project organisation could expect something from them, for example support, knowledge, relations etc. This type of stakeholder management could also be defined as co-learning (Timothy Lynam et al., 2007). The waterboard really wanted the extra water storage, the project organisation accepted the idea and took on the effort to realize this project. Extra benefit of the solution was that the relationship with the waterboard was improved and they assisted with the request of some permits.

5.4.4 Project management approach

Terms of reference (score 4)
Although the main objective of the project was clear, a road connection between the city ring op The Hague and the highways A13 and A4, the exact position and building method had to be decided upon in the design phase of the project. Besides the main goal of the project was sufficient room for scope expansion and extra objectives to improve the project, improve collaboration and support by third parties, local inhabitants and organisations. The project organisation felt the responsibility for all work that needed to be done within the project boundaries and within the time they were present (interviewee R1 – 3). As described by interviewee R2: "As project organisation you're facing, an integral problem with a large impact on its environment. This requires an integral solution. Just focusing on the main problem and not it's surrounding is just silly". The attitude of the project organisation did not change overtime, "As project organisation we are the best party to do the work on the project side, with all our knowledge on the local situations and parties" (interviewee W1 – 17 & W1 – 18). The scores are illustrated in figure 16.

"We have our project boundaries, but everything within those boundaries is part of the integral approach and solution of the project." (interviewee R2)

Task definition (score 4)
For the project an IPM-structure was used to create the backbone of the organisation. The interviewees emphasized the importance of the continuity of this backbone (Interviewees R1 – 19 & R2 – 19). The project organisation wanted the best people for the disciplines and keep them involved over the whole duration of the project. Only the implementation of the roles varied overtime, stakeholder engagement is for example an important and time-consuming task in the early phases of the project, whereas contract management requires most focus in the tender phase of the project (interviewee R2 – 19). Some of the roles were combined to stimulate an integral solution for the project (interviewee R2 – 22), this description fits a score of 4 for variable "task definition".

Contract (score 5)
A DBFM contract is used between the project organisation and the contractor (Interviewee R1). The contractor is for 15 years responsible for the maintenance of the road connection ((COB, 2016). The contract is based on functional requirements and stimulates the contractor to develop the most suitable solution. Uncertainty and complexity of the project are accepted.

Incentives (score 4)
Based on this contract most tasks are system output driven. The participants of the project were stimulated to think outside the scope, and as described, feel the responsibility for the projects or opportunities that arise in the project area. And some projects were denied because the risks did not balance the benefits or because the project characteristics were too far outside the system boundaries (interviewee R2 – 16).

Change (score 3)
Significant changes on the main goal and its design were not emphasized, the project organisation described their attitude towards change and seeking of opportunities for the surrounding areas for the project for which a score of 3 was given for variable "change".

Steer (score 3)
Due to the size of the project not participants have the same information within the organisation. The project organisation puts a heavy focus on collaboration and communication, for example by creating one location for all project actors. Score of 3 fits the description for the variable "steer".

"Do not focus only of the opponent of your project. Focus also on the proponents, they form the ambassadors of your project." (interviewee R1)

Information exchange (score 3)
As mentioned by interviewee R1: "Our strength was the constant communication on our role specific progress, issues and goals. One of the pitfalls of the IPM-model is that roles or columns work fine but there is not much communication with the other IPM-roles. For this reason it is important to repeatedly connect the different columns to maintain and improve the collaboration. For example, by emphasizing on formal and informal transfer of progress and tasks". Because the project organisation shared one office, most information transfer was done informal. Most informal information was towards the third parties, but also important decision within the organisation were formalized (interviewee R1 – 21). The role on the project organisation of the water board was not significantly affected by the inclusion of the extra objective (interviewee R1 – 11). They see themselves as guard of the quality and quantity of the water and not as participant on construction projects. During the project the informal contact developed and improved some (interviewee W1 – 12). Score of 4 for variable "information exchange" was not affected.

Interface management (score 4)
Interfaces are a shared responsibility. A vision for het project and personal development was created together from the start of the project with all project participants (interviewee R2 – 22). This prevented difficulties, managing the interfaces between the different disciplines. Physical barriers were avoided by creating one project office for all project team members. Thereby stimulating formal and informal communication to manage the interfaces on the project. This also creates an environment for quick decision making to ensure and

improve progress, which is also realized by ensuring that all relevant/needed knowledge is present in the project organisation.

5.4.5 Project success

Despite the size and complexity of the project, the interviewees were pleased with the success and progress of the project. The project faces no significant delays or costs overruns. The collaboration with the stakeholders and the waterboards was sufficient and thus the project success could for these aspects be described as successful. The extra object had no significant impact on the project, only complexity characteristic "dependencies on external stakeholders", was increased by the involvement of the waterboard in the realization of the extra water storage. Besides, the complexity dimension "social complexity" was slightly increased by the intensified relation with the waterboard and the collaboration with this party on multiple objectives.
The collaboration with the waterboard on multiple objectives did, however, improve the collaboration between the waterboard and the project organisation. There were also no visible changes in project management activities or the project management approach, which could mean the approach is the preferred approach for the project. The interviewees emphasised that they were pleased with their developed organisational structure and management approach.

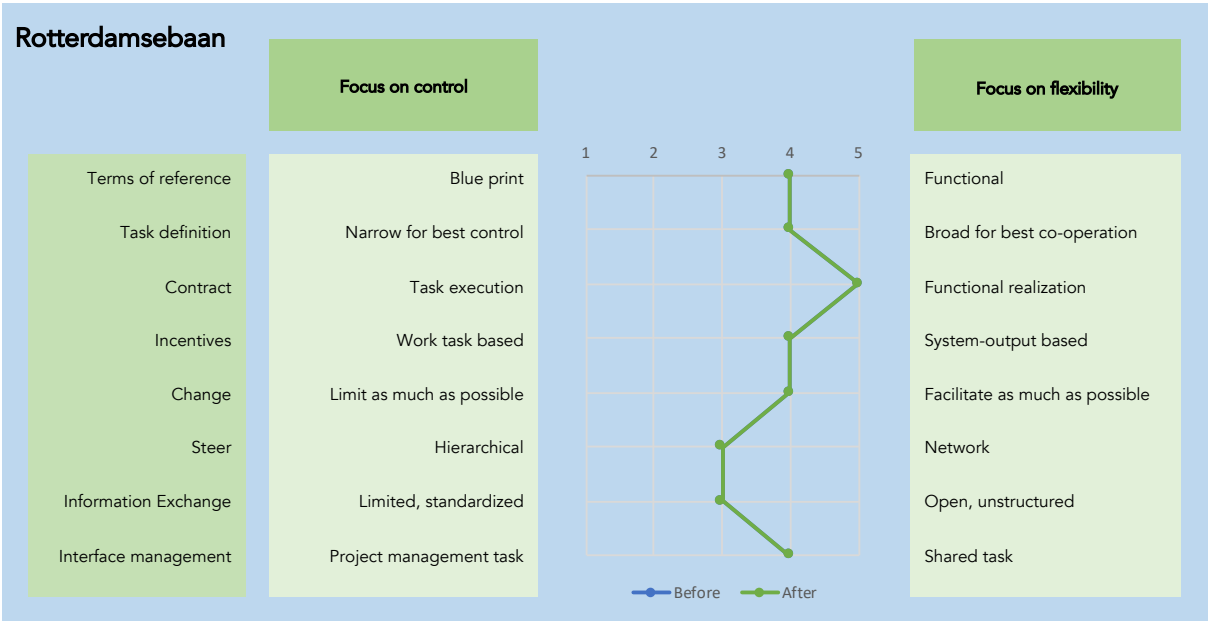


figure 16 Identification of the project management approach before and after the inclusion of the extra objective for Rotterdamsebaan

6. Cross case analysis

The cross-case analysis is divided into two parts. The first part looks into the differences and similarities of the five discussed subjects from the individual case analysis: project characteristics, project complexity, the extra objective, project management approach and project success. The second part of the analyses describes the comparison between the five subjects to illustrate the visible relations and correspondence between the cases and the subjects. The chapter ends with a conclusion of the finding from the cross-case analysis and thereby answering the 3th research sub-question, which adaptation were visible in the project after an inclusion of an extra objective which increases the number of involved interest groups.

6.1 Comparison of the five subjects

6.1.1 Project characteristics

There are significant differences in some of the characteristics of the projects, the smallest of the four cases is project Verlaat, which is the smallest in all properties: budget, scale, duration and project organisation. The €23 million project was managed by a project organisation of 7 actors and a single contractor.

A bit larger was the project HOV Westtangent with a budget of €28 million and execution time of at least two years. This project, however, has multiple clients and parties involved, compared to project Verlaat with only one client.

Project HOV in 't Gooi was with a budget of €130 million the second largest project of the four cases. Because of the scale of the project, the project was divided into 7 sub-contracts. Estimated execution time for the project was ± 4,5 years.

The largest of the four is Rotterdamsebaan, for the realisation of a 3,8 km long road including a drilled tunnel, €670 million was budgeted. The project is still in progress and is estimated to be opened in July 2020, after ± 4,5 years of construction. An overview of the budget and duration of the cases can be found in table 7.

	Budget (million)	Duration execution
1. HOV in 't Gooi	€ 130	4,5 years
2.Verlaat	€ 23	2 years
3.HOV Westtangent	€ 28	>2 years
4.Rotterdamsebaan	€ 670	4,5 years

table 7 Overview of budget and duration of the case projects

6.1.2 Complexities

For the cross case analysis the broadly divined complexity dimensions of De Bruijn et al. (1996) and Hertogh & Westerveld (2010) were used the determine the overall differences and correspondence between the present complexities on the different cases. The complexity characteristics from the TOE-framework (Bosch-Rekveldt et al., 2011) are more specific and used to determine where the complexity of the project is most intense and therefore, mostly affecting the project.

Two of the complexity dimensions from De Bruijn et al. (1996) and Hertogh & Westerveld (2010) were present in 3 of the 4 case projects, as illustrated in table 8. The table also illustrates that projects HOV in 't Gooi and Rotterdamsebaan had significantly more complexity dimensions present than the other too projects. These projects could however not be described as simple, as these projects have multiple complexities characteristics present, as illustrated in table 9. HOV Westtangent, for example, was faces with complexities: "high schedule drive" and "uncertainties in the scope".

In 3 of the 4 cases, the complexity dimension: socially complex was present. The complexity related to the number of involved interest groups and the large variety between these interest groups. Rotterdamsebaan, HOV in 't Gooi and Westtangent are realised in urban areas, causing multiple interfaces with inhabitants, local industry and retail, next to a large number of involved parties in the project organisation.
Project Verlaat, which was situated in a rural area near a small village, did therefore not include the dimension of socially complex.

Because of this complexity, stakeholder engagement management was an important activity for three project organisations facing "social complexity". For all four projects, a stakeholder engagement manager was appointed to inform and cooperate with the external stakeholders of the project. Verlaat, Rotterdamsebaan and HOV in 't Gooi organised objects of participation and collaboration to improve stakeholder involvement and appreciation. Despite the fact that Verlaat was not socially complex.

When looking at the complexity characteristics as described in the TOE-framework, the complexities for "number of external stakeholders" and "interference with the existing site" were present in most or all cases. Where "interference with the external site" was the most important complexity characteristic for Verlaat, Rotterdamsebaan and HOV in 't Gooi had more dominant complexity characteristics, as can be seen in table 9.

	Technical complexity	Social complexity	Organisational complexity	Financial complexity	Law and regulation complexity	Time complexity
1.HOV in 't Gooi		■	■		■	■
2.Verlaat			■			
3.HOV Westtangent		■				
4.Rotterdamsebaan	■	■	■	■		■

table 8 Present complexity dimensions in the case projects, based on the researches of De Bruijn et al. (1996) and Hertogh & Westerveld (2010)

	Strict quality requirements	High project schedule drive	Political influence	Number of external stakeholders	Uncertainties on the scope	Lack of resources and skills available	Interference with existing site	The number of contracts	Size of the project team	Dependencies on external stakeholders
1.HOV in 't Gooi			■	■	■		■	■	■	■
2.Verlaat							■			
3.HOV Westtangent		■		■	■	■	■			
4.Rotterdamsebaan	■	■	■	■			■		■	■

table 9 Most important complexities based on the TOE-framework (dark blue), light blue blocks are less important but present complexities. Based on the research of Bosch-Rekveldt et al. (2011)

6.1.3 Extra objectives

The description of the extra objective is divided into four subjects: [1] the scale of the extra objective, [2] the complexity of the objective, [3] the moment for the inclusion and lastly [4] the motivation to include the extra objective.

The scale of the extra objective

In all cases, the scale of the extra objective was relatively small, based on their budget, size and duration, in comparison with the primary objective of the project. Westtangent had the objective with the largest impact. The estimated extra cost of €1,7 million was 6% of the total budget of the project. For the projects Rotterdamsebaan and Westtangent, the extra work was executed within their contract. Whereas for project HOV in 't Gooi and Verlaat, the extra objective was supported and executed by other parties/participants in support of or in collaboration with the project organisation. These organisations acted as a facilitator for the extra objective.

The complexity of the objective

In three of the cases, the extra objective was relatively simple and did not significantly affect the planning or budget of the projects. In all cases, the extra objective included an extra interest group to the project (Verlaat, HOV in 't Gooi, HOV Westtangent) or intensified the relation with an already known interest group (Rotterdamsebaan). The extra objectives were not technically complex and could all be executed alongside the other project activities. Westtangent is, however, an exception, even though the work was not technical complex, the extra objective had a significant effect on the budget and planning of the project. The number of external stakeholders was one of the causes of the subsequent delays and extra costs. The extra objective was not property analysed, and the collaboration with the new interest group was not properly and thoroughly executed.

The moment for inclusion and execution

All the extra objectives were decided upon in the design phase of the projects. In three of the four projects, the work of the extra objective had to be done during the execution phase of the project.

The motivation for the extra objective

For two of the four projects, the reduction of the potential risk to planning, progress and budget, motivated the project organisations to include the extra objective. This was the case for Verlaat, who thereby reduced the risk for problems in land purchasing and for the case HOV in 't Gooi, who thereby created certainty on the location of the new road and thereby prevented the risk a discussion in the design for this area. An overview of the motivations to include the extra objective of the project is provided in table 10, on the next page.

For all of the cases, the extra objective was included on the project due to their interpretation that objectives within their physical project boundaries should be part of the project. The project organisation of Rotterdamsebaan was straight forward, "everything that needs to be done within our project boundaries at the moment we are present, will be done by us" (interviewee R1). The project organisation of Westtangent announced their construction plans, with the idea that other organisations could be included. The project organisation of Verlaat took the opportunity to incorporate multiple objectives from the client in the project, as long as it did not affect the main objective of the project. The project organisation of HOV in 't Gooi felt the responsibility to support the municipality and the community to develop a suitable plan for the Anna's Hoeve area and therefore guided the process towards a redesign plan.

For project Verlaat, the extra objectives made in possible to realise multiple objectives from the client in one project and thereby improve the client's appreciation. Which was also a motivator for the project organisation of Westtangent, where the client motivated the project organisation to include construction works from multiple construction orders into one project. Appreciation from external stakeholders was one of the motivators for HOV in 't Gooi and Verlaat.

For three of the projects, the continuation of the project was an extra motivator for the inclusion of the extra objective. Inclusion of the extra objective made sure the project could continue. Which was the case for HOV in 't Gooi and Verlaat. For the project HOV Westtangent, a high schedule drive motivated the project organisation include the extra objective to guarantee a continuation of the project.

	Clients appreciation	External stakeholders' appreciation	Feeling of responsibility	Reduction of potential risk	Continuation of the project	Improving relationship with project partner
1.HOV in 't Gooi		■	■	■	■	
2.Verlaat	■	■	■	■	■	
3.HOV Westtangent	■		■		■	
4.Rotterdamsebaan			■			■

table 10 Overview of motivations to include the extra objective of the project.

6.1.4 Project management approaches

Figures 17 and 18 provide an overview of the determined scores for the project management approaches of the project organisation, before and after the inclusion of the extra objective.

Before

The project management approach as determined before the inclusion of the extra objectives show a similar project management approach for the four cases. On average, the projects tend to have an approach focusing on flexibility. Only the project Verlaat also tends to have a focus on control, especially in terms of task definition and the objective of the project. The most significant differences appear in the "task definition" and "incentives". None of the project management approaches of the cases are exactly similar. From all cases, Rotterdamsebaan has the strongest focus on flexibility.

Worth noticing is the fact that the contracts used for projects have a strong focus on flexibility and the realisation of functions instead of a fixed objective, whereas the variable "incentives" in most projects is given a score of 2 (HOV in 't Gooi, Verlaat) or 3 (Westtangent). An incentive focusing on control puts the main focus of the project on the realisation of the scope and less on the stimulation of working outside of the scope. The organisations tend to motivate the contractor to develop solutions to realise a function, whereas the project organisations themselves work directly towards the main objective of the project.

After

The graphs are further apart in the situation after the extra objective was included in the projects. This is primarily caused by the changes in the project management approach on the project Westtangent. As discussed in section 5.3.4 and 5.3.5, the problems on the project made the project organisation shift some of its project management activities towards more focus on control.

Project Verlaat saw a change in the variable "change of reference" towards a more fixed project goal. The project organisation of HOV in 't Gooi changed his attitude towards change to more emphasis on control and therefore avoided some uncertainty. Information exchange within their organisation and toward project participants shifted towards a more informal and transparent approach.

For the project Rotterdamsebaan, no significant changes in the project management approach were visible.

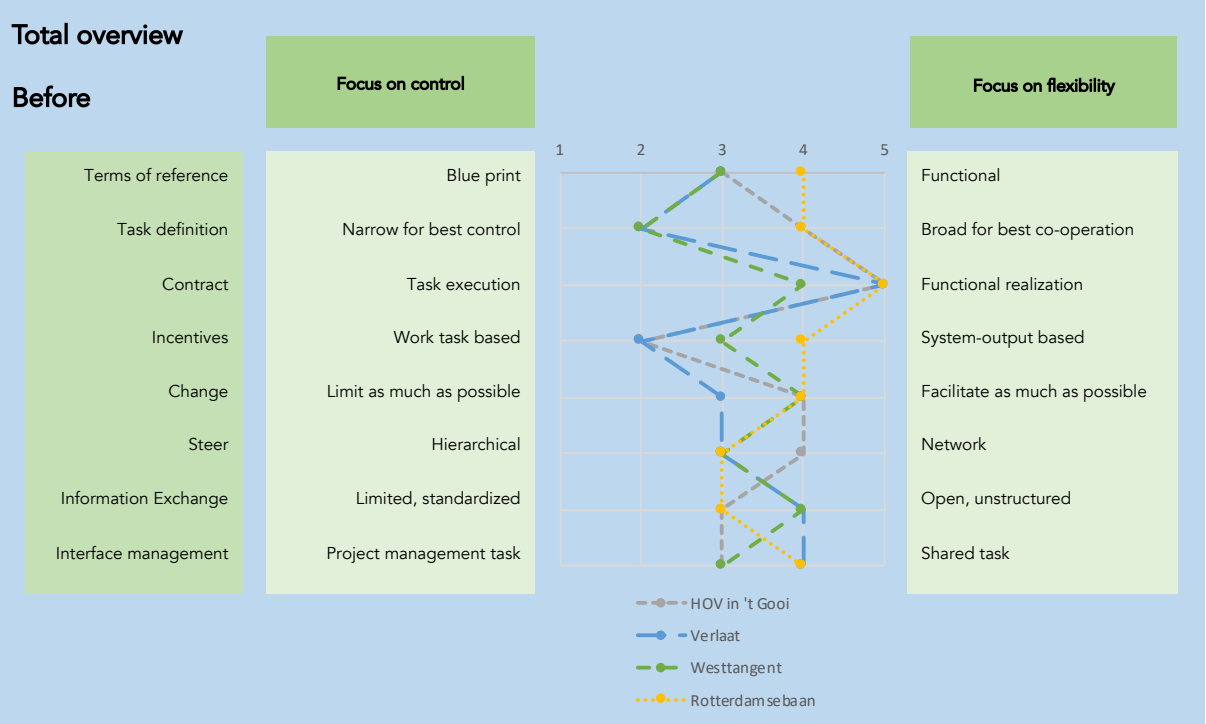


figure 17 Overview of the project management approaches of the four cases before the extra objective was included.

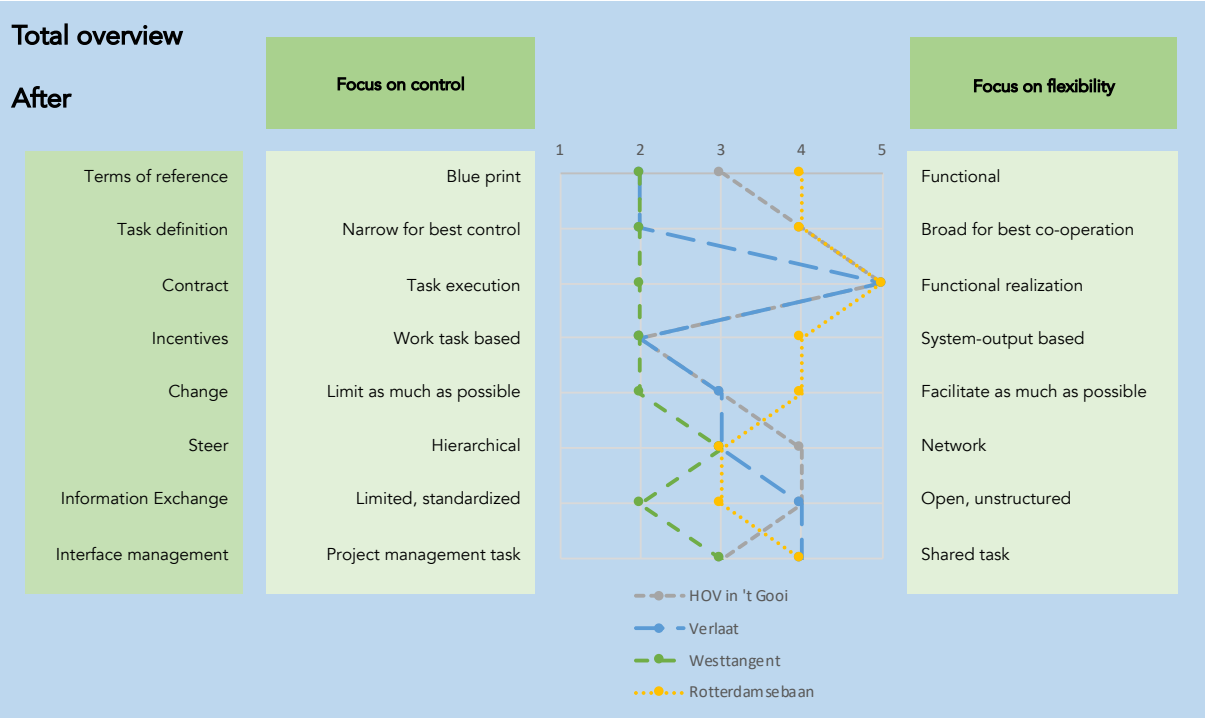


figure 18 Overview of the project management approaches of the four cases after the extra objective was included.

6.1.5 Project success

Three of the projects were described as successful and expected also their end results to be successful. In case of HOV Westtangent, the first phases of the project were described as successful, by the project organisational members. This interpretation changed after some issues on the project and disagreement with the contractor and sewage water company. An under capacity in both teams, project organisation and the contractor, and discussions on the accountability of the costs of the renovation project of the sewage system, did not improve

the collaboration and level of trust within the project organisation. These factors caused the decrease in interpretation of the project's success by the organisation.

Budget and planning in these three projects were not negatively affected by the extra objective, in contrast to project HOV Westtangent.

6.2 Comparison between the five subjects

In this paragraph a comparison is made, not only between the 5 subjects, but also including the relations between the subjects. Some of the subjects have an influence on each other and are for this reason of value to analyse and compare between the cases. For example, whether the determined project management approaches are related to the characteristics and complexities of the projects (see section 6.2.1.). Section 6.2.1 describes and compares the impact of the various additional objectives on the project complexity. In addition, the visible changes in the project management approaches are described in relation to the present project complexities (section 6.2.3).

Section 6.2.4 describes the relationship between the executed extra objective and the change in project management activities. The last paragraph describes whether and how project success is related to the visible changes in the project management approaches.

In the cases no relation was found between the properties of the extra goal and it's the motivation to add the extra objective, and the properties of the project itself. The size, complexity and structure of the project organisation do not seem to influence the decision to expand the project with an extra interest group. It seems that the choice for the extra goal and its elaboration, depend on the attitude of the project organisation itself or a person from the project organisation and not so much on the construction project.

6.2.1 Project management approach based on project characteristics and complexity

Of the four analyses cases, Rotterdamsebaan was the largest case which also included the greatest variety of project complexities. The project management approach of this project had a stronger focus for flexibility. However, the Rotterdamsebaan did not receive all the highest scores, for example, HOV in 't Gooi scored higher for the variables: "steer" and "information exchange". The project organisation of Rotterdamsebaan emphasised that informal transfer of information was of great importance, but all agreements needed to be formalised. It is probably due to the significant size of the project organisation, which forced agreements to be formalised to keep track of all decisions made.

The smallest project with the least number of complexities, project Verlaat, has a project management approach more focused on control. There are however two exceptions: variable "contract" scored 5, because of their D&C contract with the contractor, and "interface management" which is appointed score 4. This was due to their level of trust within the organisation and the focus on self-control also toward the actors responsible for the extra objective.

In all three socially complex projects (HOV Westtangent, Rotterdamsebaan, HOV in 't Gooi), the variable "change" was scored 4. In which the organisations are prepared for changes and ought to be flexible and open for adaptations. The project organisations have some limit to the level and amount of changes and level of search for opportunities.

In the three cases with organisational complexity, the variable "contract" is for all projects scored 5, which is given for contract with a focus on the realisation of functions and not specific objects. The other similarity for project HOV in 't Gooi and Verlaat is a score of 2 for "incentives", which means that these project organisations mainly focus on the realisation of the scope of the project, and parties and project participants are stimulated to work directly towards the goal.

In the project with a higher intensity of the organisational complexity, HOV in 't Gooi and Rotterdamsebaan, a score of 4 was given for "task description" (stimulation of common knowledge, shared tasks and participation

to most decision-making processes), which in the smaller and less complex projects (Verlaat and HOV Westtangent) was scored 2 (stricter task distribution).

In general, the project management approaches, as determined seem to match the expectations that larger and more complex projects have an approach with more focus on flexibility and projects with less complexity have a focus on control. Although the differences in project characteristics between the cases are more significant than the differences in project management approaches. The size and number of complexities does not seem to heavily influence the project management approach structured by the project organisation.

6.2.2 Impact of the extra objective to project complexity

In three of the case projects, HOV in 't Gooi, HOV Westtangent and Rotterdamsebaan, the complexity: "number of external stakeholders" and "social complexity" was present before the project organisation decided to include an extra interest group to the project via an extra objective. These projects already had a significant number of external stakeholders involved in their construction projects. Although complexity increases when new interest groups are added to the project, for the projects Rotterdamsebaan and HOV in 't Gooi this effect was negligible.

As a consequence of the extra objective, some other present complexities were slightly increased. For projects HOV in 't Gooi, HOV Westtangent and Rotterdamsebaan, the inclusion of the extra objective to their project caused the project organizations to have an extra dependency to an external party.

For the project Verlaat, the extra interest group meant an added complexity to the project in the form of "social complexity" and an increase in complexity "political influence". However, the extra objective did not interfere with the main objective of the project. The work of the extra objective was transferred to other parties, who were made responsible for the support and execution of the project.

In two of the projects (Rotterdamsebaan and HOV Westtangent), the project organisations were responsible for the execution of the extra objective. Nevertheless, these extra objectives were relatively simple and did, therefore, not impact the technical complexity of these projects. The decision to execute the work themselves could be because of the presence of the complexity "high project schedule drive" which was the case in both these projects.

6.2.3 Changes in activities based on project complexities

For the project with the most complexities, Rotterdamsebaan, no significant changes in the project management activities were visible. Verlaat, the smallest of the four projects with the least number of complexities, only the variable "terms of reference" shifted towards an approach for more control.

For the project HOV in 't Gooi, a change in variables "change" (4 -> 3) and "Information exchange" (score 4 -> 3) was visible. This project is also complex due to the "law and regulations" which maybe endorsed the project organisation to reduce the number of changes on the project. The project is also complex because of the size of the project organisation, which could have moved the variable information exchange towards a more formal approach for information transfer.

6.2.4 Relation between the extra objective and changes in activities

To most significant changes in activities as a consequence of the inclusion of an extra objective are visible at case project HOV Westtangent. As mentioned earlier, the extra objective for HOV Westtangent had an impact on how the project organisation structured their project management approach. As a consequence, to the occurring problems, also as a consequence of the extra work for the renovation of the sewage system, the project organisation focused more on the controlling of the project than the flexibility. The extra objective is, however, not the only reason for the visible changes in the project management activities as described in section 5·3·5·

The project organisations of HOV in 't Gooi and Verlaat acted as a facilitator for the extra objectives to the project. This prevents the extra objective to significantly influence the project management activities, as long as the extra objective is properly analysed to determine the cost and benefits and the consequences to the project, as was done for HOV in 't Gooi, Verlaat and Rotterdamsebaan. It seems that the extra objectives in these three cases were decision with a relative save outcome. The project organisation do not show much flexibility by the inclusion of these extra objectives.

6.2.5 Changes in approach and project success

The case with them most significant changes in approach, HOV Westtangent, started successfully according to the interviewees but faced difficulties with keeping the project on budget and progress. Multiple factors could be appointed as a consequence of these problems. One of them is the extra work from the sewage company, that was included on the project. As a consequence, to the lowered project success, the project organisation adapted its project management approach towards an approach with a stronger focus on control. The level of trust within the organisation decreased; as a consequence, most decisions were to be formalised and be made in agreement with the project management. The organisation started to work more task-based, and there was a stronger focus on the main objective.

It looks like the extra objective to the project was not the direct consequence for the project organisation to adapt their project management approach. The consequences of improper management of the project complexity "social complexity" from the start of the project, affecting the project success, made the project organisation change their project management activities. In the other three cases, which were all described as successful by the interviewees (see section 6.1.5) no significant changes were visible.

6.3 Conclusions cross-case analysis

The case study was used to provide an answer to the sub-question: What are the observable changes to the project management activities when a new interest group is included in an infrastructure construction project?

The results illustrate that in only one of the four projects, significant changes were visible to the project management approach after the inclusion of an extra objective to the project. Project HOV Westtangent changed its project management activities in 5 of the eight variables. Their approach shifted from an approach with a slight focus on flexibility toward an approach with more focus on control, especially in terms of the project goal, the contract, attitude towards changes and ways of information transfer. The project organisations of project Verlaat and HOV in 't Gooi adapted their approaches on respectively one and two variables. Project Verlaat adapted the attitude towards "terms of reference" to a stricter definition of the objective of the project. Project HOV in 't Gooi, adapted its approach on the variables: "change" and "information exchange". The project organisation of the final case, Rotterdamsebaan, applied no changes to its project management approach as a consequence of the extra objective.

The results also illustrate that in three of the four cases, social complexity was already present on the projects. The inclusion of extra interest groups increases the level of this complexity by increasing the variety and the number of external stakeholders to the project.

Project Verlaat, despite the fact of their lack of social complexity, behaves well to the inclusion of the extra objective and extra interest group. The project organisation decided to act as a facilitator for the extra objective. By doing so, the planning and budget of the project were not affected by the work related to the realisation of this extra objective. As a result, their project was kept on progress, a potential risk was reduced, and the appreciation for the project was increased, without extra risks for the main objective of the project.
It could be that their approach towards variables change, information exchange, contract and interface management contributed to the success of this extra objective. More flexibility in the contract, sufficient level of trust on the project and acceptance of changes and uncertainties on the project would, in this case, be appointed as contributing factors for successful execution of an extra objective to the project.

A site-note must be added to this statement; the extra objective to the project was significantly small compared to the main objective of the project as was also the case for the projects Rotterdamsebaan and HOV in 't Gooi. None of these extra objectives were complex to execute nor negatively impacting the planning or budget of the project.

Most interviewees were not consciously aware of the present complexities on the project, based on the answers given to the question, if they could point out the project complexities. However, the project organisations were aware of the number of external stakeholders in the project. This would have contributed to their decision to involve an extra stakeholder group to the project. Nevertheless, the unawareness that the extra involved interest group would increase their social complexity dimension could be the reason that the project management approaches were not adapted. Only when the level of project success was affected, something visible to all project participants, the project organisation attempted to change and adjust their approach, which was visible at the case HOV Westtangent. As a consequence of the decrease in project success, this organisation responded by restricting, formalising and controlling their project management organisation and approach.

IV EXPERT SESSION & CONCLUSION

PART IV

Part IV of the report includes the final chapters, starting with the results of the expert session in chapter 7. Followed by the discussion of the findings and limitations of the method used for the research, described in chapter 8. Chapter 9, the final chapter of the report, includes the conclusion of the research and the recommendation for the company and further research. Chapter 9 in finalized by a personal reflection of the process and research results followed by the lessons learned.

7. Expert session

The results of the case and cross-case analysis supplied the research with some additional questions. Are project managers prepared to change their approach? Are some of the variables from the theoretical framework more important than others, and is there a difference for complex and simple projects? For this reason, an expert session was organised to answer some of the questions, broaden the research and provide extra data to support the discussion and the conclusion of the research.

The protocol will describe how the expert session was structured and who the participants were; the results will elaborate on the answers provided by the experts. An overview of the expert session and the answers will be described in this chapter. The list of all the questions and results can be found in Appendix E and F.

7.1 Protocol expert session

After the case study, an expert session was organisation to discuss some of the questions which arose from the results of the case study. Sixteen experts from APPM participated in the session; all experts are active in the field of project management. The experts were asked to submit their most practised role within the construction projects and the number of years of experience in that role. See table 11 for the overview of the participants, their role and years of experience.

During the session, the experts were presented with a set of questions, of which the answers could be submitted via their cell phones. The experts were asked to answer the questions individually. All participants were first introduced to the definitions of project complexity and project management approach from the literature, to align their interpretations on these subjects.

#	Most practised project role	Years of experience in that role
1	Program manager	5 - 10 years
2	Program manager	< 5 years
3	Technical manager	< 5 years
4	Project manager	5 - 10 years
5	stakeholder engagement manager	5 - 10 years
6	Project manager	10 - 15 years
7	Contract manager	< 5 years
8	Process manager	10 - 15 years
9	Project manager	10 - 15 years
10	Project manager	< 5 years
11	Project manager	> 15 years
12	Advisor market strategy	5 - 10 years
13	Process manager	10 - 15 years
14	Project manager	10 - 15 years
15	Project manager	5 - 10 years
16	unknown	unknown

table 11 Overview of the participants of the validation process

In the case study, a conclusion was made that the largest case, including the most complexities, was organised with a project management approach more focussed on flexibility. Whereas the smaller project, with fewer complexities, tended to have a project management approach focussing on control. On this basis, the experts were asked to identify the project management approach of their current project, on a scale from 1 to 10. In which 1 is a project management approach with a strong focus on control, and a score of 10 describes an approach focussed on flexibility. After which the experts were asked to determine the most suitable project management for an infrastructure construction project with a large number of complexities.

Another observation from the case study is that no significant changes in the project management approaches are visible as a direct consequence of the included extra objective. For this reason, the experts were asked if they ever changed their project management approach on one of the earlier projects. Followed by the question if the experts were willing to change the project management approach when the characteristics of their project significantly change, by for example, a significant scope expansion or a new objective.

Finally, the expert session was used to determine which of the variables from the theoretical framework were identified as most important in the development of the right project management approach. For this question, a distinction was made between a "simple" and "complex" infrastructure construction project. The group of experts were challenged to, in collaboration, select a simple and a complex infrastructure construction project for this question.

7.2 Results expert session

Part 1 – current and ideal project management approach

The experts identified their project management approach with a slight focus on flexibility. An average score of 7.2 on a scale of 1 to 10, with scores varying from 4 to 9. This high average score could be substantiated that most of the experts of APPM are hired to assist or guide more complex projects, because of their experience.

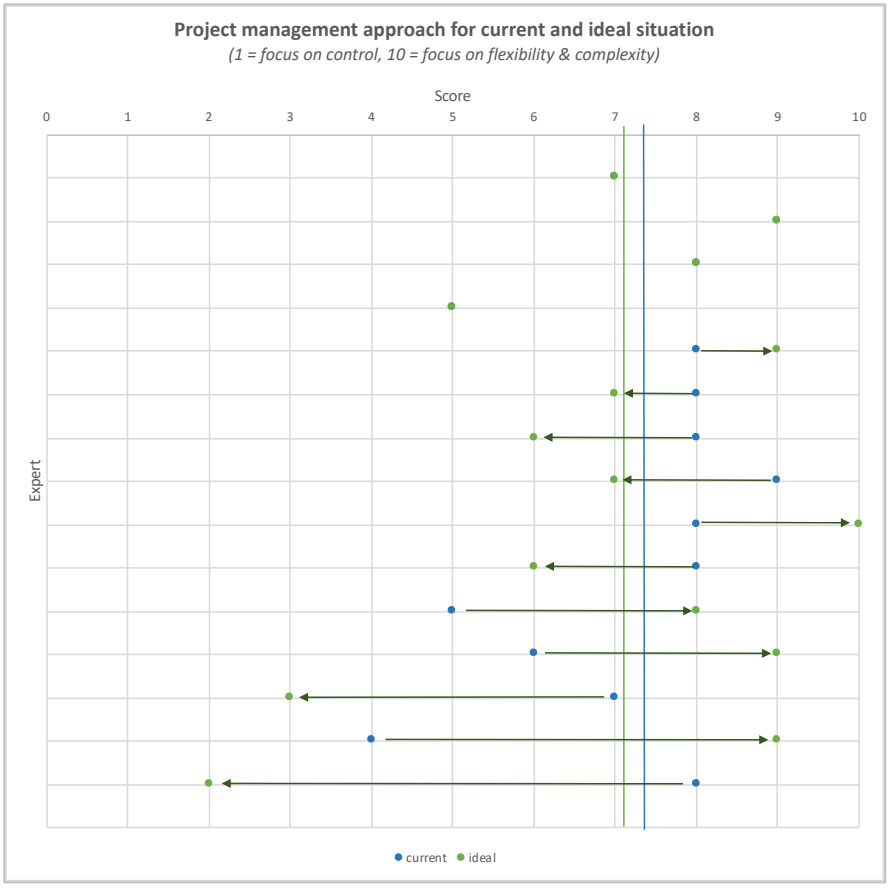


figure 19 Graded project management approaches in current and ideal situation

On the question, what would be the most suitable project management approach for complex project in their opinion, an average score of 7,0 was given — also describing a project management approach with a slight focus on flexibility. In this case, the scores varied between 2 and 10; this suggests that there are some different interpretations of the ideal project management approach for complex projects. The scores of this question are illustrated in figure 19.

The figure also illustrated differences between the current and ideal scores and the direction of change. Of the five experts with the most significant differences between the scores, the experts who scored their current project management approach relatively high, scored the ideal situation significant more focussed on control. Where the two experts who scored their current project as relatively focussing on control, describe the ideal approach with a strong focus on flexibility. This could suggest that, in their opinion, their current approach is not suitable for their project. Or according to their interpretation, their project is relatively simple, and a complex project should therefore use a contrary management approach. In both situations, the experts acknowledge that the project management approach is related with the complexity of the project.

Part 2 – change to the project management approach

All participants agreed to the question of whether participants were willing to change their project management approach in case of a significant change on the project affecting its complexity. Scores of 1 to 10 could be appointed in which 1 was "no, totally disagree" and a score of 10 meant "yes, totally agree". All scores were above 6 and on average, 8.9. Which would suggest that project managers are willing to adapt their project management approach to the current project characteristics and project complexity.

However, to the question, if someone ever changed their project management approach, the answer varied between "no or little" (score 1) and "yes, totally adjusted" (score 10), with an average of 6.5. Significant lower compared to the average score of 8.9 from the question above. However, some experts answered that they once changed their project management approach, which would suggest that purposeful adjustments can be done to the project management approach when projects are significantly changed. The scores for these questions are illustrated in table 12.

Following these questions, the experts were asked to appoint in which project documentation changes to the project management approach or project organisation would be formalised. These answers are also illustrated in table 12.

Part 3 – prioritisation of variables

After a short explanation of the eight variables from the theoretical framework, the participants were asked to allocate a total of 100 points to the variables they described as most important in structuring of the appropriate project management approach for a simple and a complex construction project.

Change to the project management approach			
#	willing to	done before	formalized in which documentation
1	9	5	Sometimes a new project description, but usually not that well documented
2	10	3	No, do not have any project that fit your description
3	9	8	Request of change (Verzoek tot wijziging = VTW)
4	8	8	Yes, progress reports, risk profiles, scope changes
5	10	3	Should be in the project management plan, but does not happen in my projects, happens implicit
6	10	8	Yes, revision project management plan or progress report
7	6	3	Yes, in progress reports, defined and approved by the administrative client
8	10	8	Yes, progress report and revisional plan of approach
9	9	7	Yes, revisional plan of approach, determined by the project team/steer group
10	8	5	-
11	7	9	Progress report
12	8	5	Plan of approach
13	10	8	-
14	10	5	Progress report
15	10	10	Yes, revisional plan of approach
16	8	8	Yes, revisional plan of approach or contract
average	**8,9**	**6,4**	

table 12 Overview of the answers to the questions of part 2 of the expert session

In the case of a simple infrastructure construction project, the group emphasised that variable "terms of reference" was most important, followed by "tasks description" and "steering". Simpler projects have, in most cases, smaller project organisations in which the description of the terms of references and tasks definition are more important than for example "interface management", "incentives" and "change", which were appointed as least important (see figure 20, p. 74).

On the other hand, for a complex infrastructure construction project, "interface management" was prioritised. Especially for large project organisations, rules and regulation of how "interface management" should be structured could be of great importance for a good start and execution of the project. Just behind "interface management" were variables "terms of reference" and "change". Least important in the development of a suitable project management approach for complex projects were "task description", "contract" and "incentives". The scores are graphically illustrated in figure 21 on page 74.

7.3 Conclusion of the expert session

The cross-case analysis illustrates that the selected cases saw no to only small changes to their project management approach. To exclude the option that changes to the project management approach on construction projects do not happen at all, an expert session was organized. According to the results of the expert session, project managers are willing to change their project management approach when the project is substantially changed, due to for example, a significant change in the project complexity. Nevertheless, the results do also illustrate that this measure does not happen very often.

Based on the results from part 1, there can be concluded that most experts work with and strive for a project management approach with a focus on flexibility. The expert session does however not illustrate what the differences are between the interpretation of the experts on the approach compared with the actual approach based on the theory from the theoretical framework. The difference between the interpretation and the actual situation, would be interesting to research. The projects from the case study do also illustrate that those projects tend to have an approach focused on flexibility. The case study does however also illustrate that the smaller project of the four, has a project management approach slightly more focused on control, compared to the other three cases.

The expert session does also illustrate that multiple experts with a flexible approach on their current project, see an approach with control as the ideal situation for complex projects. Experts with a focus on control approach see the more flexible approach as the ideal situation for complex projects. Were 11 of the 16 experts describe the ideal situation to be different to the current situation, changes to the approach are not made, as can also be seen in the cases and in the results of the second question of part 2 of the expert session. This second part illustrates that the experts are willing to change the project management approach, but in most cases never applied significant changes to their approach. This could suggest that the project organisations are not as flexible as the experts suggest, or most construction project do not see significant changes in scope or increased complexity which motivates project organisation to change their project management approach. This last statement corresponds with the results of the cases, where only small objectives were added to the project and did therefore not motivate or forced the project organisations to adapt their project management approach.

The variable "terms of reference" was by the experts appointed as most of highly important in structuring of the appropriate project management approach, in both "simple" and "complex" construction projects. In the case study, this variable was adapted in two of the four cases as a consequence of the inclusion of an extra objective. which could suggest that this variable would also be important when the project management is adapted to new project characteristics. However, the variable appointed as most import for complex projects: "interface management" was in none of the cases adapted after the inclusion of the extra objective, which invalidated the earlier statement.

These additional results were taken into account in the realization of the discussion and conclusion in the following chapters.

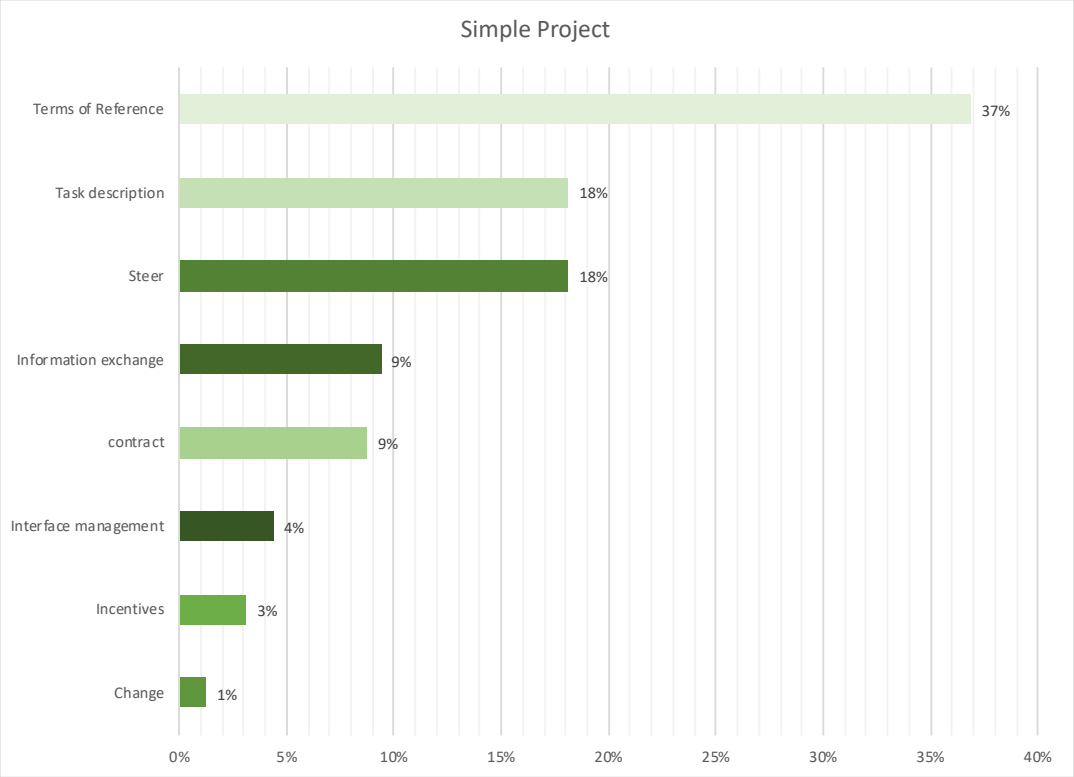


figure 20 Prioritization of variables when setting up a project management approach for a simple project

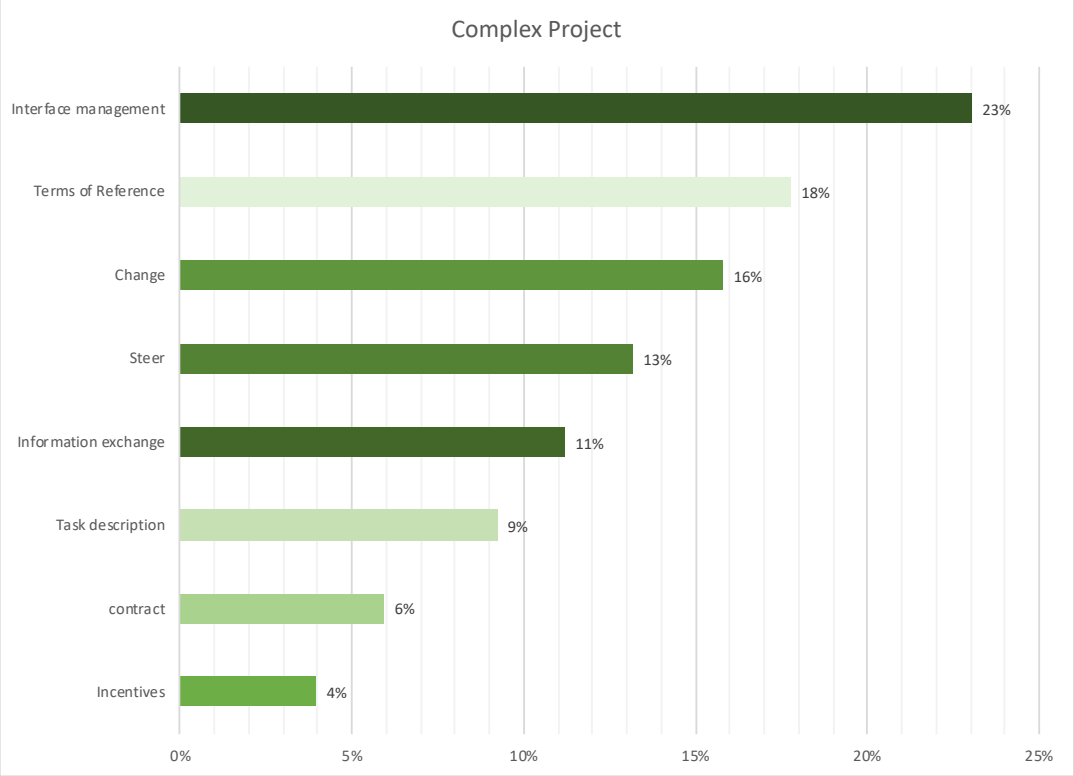


figure 21 Prioritization of variables when setting up a project management approach for a complex project

8. Discussion

In this chapter some of the arisen points for discussion will be elaborated. These subjects of interest are based on the results of the research but do not directly contribute to the conclusion. The chapter will end with a description of the limitations of the research.

8.1 Stakeholder engagement: "Involve your ambassadors!"

Multiple interviewees of the cases emphasized the importance of stakeholder engagement management. "Stakeholder engagement means that every possible interest group needs to be included to the project from the preparatory phases." (interviewee R1). Not every interest groups can be predicted, and interests and attitudes of interest groups can evolve. For this reason, it is important to establish your project office on the project site, this is the best way to collect all the information from your interest groups. "Take all interest groups serious and listen to them all". (Interviewee R1). Focus on proponents, keep them involved on your project and be transparent and open with all information and focus on opponents, they form the ambassador of your project. Especially for projects with "social complexity", good stakeholder engagement management could positively contribute to the level of success for the project.

8.2 Collaboration and project management approach

The project management approaches as described in the literature, make a distinction between an approach suitable for simple projects and for complex projects. The cases illustrate that the approaches in these project organisations correspond with the literature. The more complex and larger project had an approach more focussed on flexibility, whereas the relatively simple project included a project management approach with a slight focus on control. However, the differences in scale and number of complexities between those projects was more significant than the difference in project management approach. Based on the complexities and scale of the Rotterdamsebaan, their project management approach could be expected to be more focussed on flexibility. Whereas project Verlaat, with only one identified project complexity and a significantly smaller scale, would be expected to have an approach with a stronger focus on control. The cross-case analysis illustrates that their approaches were not that far apart. So, despite the presence of complexities, the project management approach tends to be determined by other factors.

The project management approach seems to be strongly affected by how organisations collaborate. For example, the level of trust, informal transfer of information and sharing of knowledge could only be achieved in situations where project participants can work together in good collaboration. The interviewees of Verlaat described the collaboration within the project organisation and between them and the contractor as very good. As a consequence, there was a certain level of trust, tasks were executed and decided upon in collaboration and most information was transferred informally. There was a greater importance in the main objective of the project, then the personal interest of the contractor of project participants. These activities tend to describe a project management approach with more focus on flexibility, despite the characteristics of the project or the presence of certain project complexities.

In case of HOV Westtangent the level of trust decreased after some discussions and disagreements within the project organisation. When the level of trust between participant decreases, in most cases the form of collaboration changes to and more formal and limited approach. Information transferred will mostly be linked to facts and figures and decisions will be presented to the project manager before execution. These activities describe a project management approach focussed on control. If a sufficient level of trust within the organisation and towards the contractor is not achieved, it will be difficult to structure an approach focussed on flexibility, prepared for complexity and uncertainty.

8.3 Critics on adaptive project management

The conclusion of the research answers the main question what adaptations have to be made in the project management approach, when the complexity on the project is increased. This evolvement in project management approach could be described as adaptive project management, in which the project organisation adapts their project management approach to the current project characteristics. And where interviewees have slightly different interpretations on the definition of adaptive project management, all interviewees agreed that this style of project management motivates the project organisation to search for opportunities to improve the project, instead of avoiding and reducing potential risks, as is done in the traditional forms of project management.

However, some interviewees emphasized that adaptive project management is not new and not the solution for all construction projects. The more traditional project management approach is also capable of adapting to the circumstances of the project. Adding extra objectives to the project does not improve every project. Project organisations should critically review all requests for extra objectives and perform a proper analysis to determine the costs and benefits for the main objective of the project. Besides this, project organisations should determine the appropriate approach for the project, based on its characteristics and complexities.

Although the project organisations of the cases describe their project management approach to have a focus on flexibility, and they emphasize the importance the addition of extra objectives to improve the project, the objectives added to the project were in 3 of the 4 cases, small compared the main objective. The extra objectives were not significant enough to impact the project or project management approach. It seems that these additions don't need a flexible approach to cope with the consequences. The extra objective could in all cases (besides HOV Westtangent) easily be integrated in the project and controlled by the project organisation. So, for the case projects, adaptive project management seems a bit overrated based on the objectives these organisations included to the project.

8.4 Limitations of the research

The chosen method, case studies, provides the ability to gain a large amount of knowledge on the personal experiences of the project team participant. However, this method has also some limitations.

- In continuation to the discussion from section 8.2, the project management approaches on the case projects were determined on the basis of the description of two project management approaches. And although the framework was expanded to 5 different project management activities to identify the project management approach, the scale is limited. The differences in the illustrated project management approaches are relatively small, which could suggest that the approaches should differentiate on other aspects, not described in the theoretical framework. However, due to the limited duration of the research, the composed theoretical framework was the right method to provide a quick review on the project management approaches on the cases. If the framework would be used for further research a more thorough review of the literature should be executed to include all variables for the identification of the project management approaches. There is a knowledge gap on the exact practical elaboration of the project management approaches, a more elaborate case study on project management approaches could provide a better description of the approaches used in practise. Besides this, a more elaborate research on project management approaches in practise should analyse all activities executed by the project organisation and incorporate a distinction in intensity of the activities executed. By making this distinction, a more elaborate description of the used project management approach could be developed.
- All participants of the expert session were employees of APPM. APPM is a management consultancy firm active in the field of project and process management. Most employees are active on projects with an above average size or complexity, and in most cases on the client's side of the project organisation. This could mean that the results of the expert session could be organisational and perspective biased. A similar session with employees from a contractor's perspective could resolve in different results.
- This research used a qualitative research methodology, not a quantitative approach. The scores provided to quantify the project management approaches, for example, are based on the interviews

with 2 to 4 project participants. The tables provide an indication of the present and changed project management approaches.

- The entire research was conducted from a client's perspective, this could be considered as a limitation of the research. The research aimed at providing an analysis of the project management approaches on complex infrastructure construction project and its changes when the project becomes more complex. All expansion in the project complexity were initiated by the project organisation and not the contractor.

9 Conclusion

This last chapter of the report elaborates on the answers to the research questions and final conclusion of the research. Followed by a set of recommendation for practical implementations and further research. The chapter concludes with a reflection of the research process and overall results.

9.1 Final conclusion

A significant number of project organisations in the infrastructure construction sector have difficulties coping with the complexities at their project. In 2019, more than 20% of all infrastructure construction projects in the Netherlands were delayed (EIB, 2019). Reduction in complexity is mentioned as possible solution to the cost overruns and delays these projects face (Rijkswaterstaat, 2019). This is contradicting to what the literature states. Complexity could create opportunities to provide new solutions for the project and improve a project by creating more support and appreciation from the client, project participants and external parties.

Sub-question 1 - What are the consequences for project complexity when increasing the number of interest groups on the project?

A complex project can be defined by a large number of systems and large number of relations between these systems. The result of the high complexity of projects is a high degree of uncertainty on the project (Sapolsky, 1972). Most large infrastructure construction project are faced with "social complexity", as a consequence of their sheer size and significant number of interfaces with its surroundings (Hertogh, 1997). "Social complexity" can be identified by a large number of actors involved in the construction project De Bruijn et al. (1996). This complexity is caused by the fact that this large and diverse number of actors all have their own interests, resources and attitude towards the project. Next to this, an action or decision taken by one of the stakeholders could influence the position or interest of multiple other stakeholders on the project (Ackermann & Eden, 2011). This phenomenon is also recognized as complexity characteristic: "the variety of external stakeholders on the project" by Bosch-Rekveldt et al. (2011).

To answer the first sub-question: An increase in number of interest groups would lead to an increase in variety and relations and therefore an increase in project complexity. Which can be described as "social complexity" or complexity as a consequence of "the variety of external stakeholders on the project"

To determine which project management approaches are described in the literature the following research question was composed:

Sub-question 2 - What project management approaches suitable for simple and complex infrastructure construction projects are defined in literature?

There are multiple project characteristics which determine the most suitable approach for the project of which project complexity is one of them. This tailoring of the project management approach to the project characteristics is important because complex construction projects need the right approach for a successful project execution (Eriksson, 2017). The literature defines multiple project management approaches suitable for simpler and complex projects.

In conclusion of the second sub-question: On the basis of five concepts from the literature, two project management approaches were defined: an approach with a focus on control and a project management approach with a focus on flexibility.

The first approach has a focus on control, in which the goal is strictly defined with a strong focus on front-end analysis to avoid uncertainties and changes to the project. In this approach the project manager is control and on top of the hierarchical structured organisation. The second approach has a focus on flexibility. In this approach the goal is broadly defined and ambiguous to prepare and accept uncertainty and changes. The project organisational members are stimulated to participate and collaborate, tasks are shared and there is a focus on trust, personal learning and personal responsibility. This approach is most suitable for projects with a large number of complexities and significant amount of uncertainties. However, the most suitable or fit-for-

purpose project management approach is a balance between these two approaches, depending on the characteristics of the project (Larsson et al., 2015).

Sub-question 3 - What changes in the project management activities can be observed, when an extra objective is included to an infrastructure construction project?

To analyse the practical elaboration of the project management approaches in the current infrastructure construction projects an explanatory case study was performed. For the case study, four infrastructure construction projects were analysed and 11 management professionals from these projects were interviewed. On the basis of the literature study a theoretical framework was developed to determine the project management approaches on the four case projects. This way the changes in project management activities and the project management approaches were analysed to answer sub-question 3.

The project management approaches for the four cases were nearly similar. Most projects had a slight orientation towards an approach focused on flexibility. Only the smaller project tended to have a small focus on control. Where the projects show similarities in their approach, none of the projects had the same project management approach (see figure 17, p. 63).

In all of the selected cases the project organisations decided to include an extra objective to their project and thereby involving an extra interest group. For all organisations, this decision was done in the design phase of the project. All four project organisations felt the responsibility for the surroundings of their project and therefore included this extra objective. In two of the projects, the project organisation acted as facilitator for the work of the extra objective and thereby tried to improve the external stakeholders' appreciation and reduce potential risk to the project. The other two projects decided to execute the extra objective themselves and included the work in the execution phase of the project.

After the inclusion some small changes in the project management approaches were apparent. Project Verlaat saw a change in the variable "change of reference" towards a more fixed project goal. The project organisation of HOV in 't Gooi changed the attitude towards "change" to more emphasis on control to therefore avoid some uncertainty. Information exchange within their organisation and toward project participants shifted towards a more informal and transparent approach. Project Rotterdamsebaan saw no changes in its project management approach after the inclusion of the extra objective.

Most significant changes were visible in the project HOV Westtangent. This organisation decided to include renovation works of a sewage pipes system in their project site on request of the owner of the system. This extra complexity made the project organisation shift their approach towards more focus on control. Especially in terms of the project goal, the contract, attitude towards changes and ways of information transfer.

In conclusion: In three of the four projects, changes in de project management activities could be observed. In only one of the projects the changes were significant, the other two projects only some small changes were applied. In the project organisation of the largest and most complex case project, no adaptations were made to the project management approach. There are no visible similarities in the adaptation to the approaches as a consequence of the inclusion of an extra objective.

Sub-question 4 - What is the preparedness of project managers to adapt their project management approach?

Beside the significant changes on project HOV Westtangent, the changes on the other four projects as a consequence of the inclusion of an extra objective were small or not present. Mainly on this basis an expert session with sixteen management professionals from APPM was organized to answer the last sub-question.

All of the sixteen experts indicated that they were willing to change the project management approach if the project requires it, due to, for example, significant scope changes or an increase in project complexity. However, only a small number of participants have ever adapted their approach substantially after a large scope change or inclusion of an extra objective. The results do also illustrate that this measure, of changing the approach to the new project characteristics, does not happen very often. These results correspond to the results of the case study, where almost no changes to the approaches were visible.

The extra objective which were included in the cases were small and almost neglectable compared to the main objective of the projects. This could be a part of the reason why no adaptations were made to the project management approaches. The results of the expert session do however illustrate that even if these objectives were more significant, the approaches would not guaranteed be adapted.

Main research question and final conclusion

Where the literature extensively discusses project complexity and project management approaches, a knowledge gap could be identified on the analysis of the practical elaborations of the management approaches and increasing project complexities on large infrastructure construction projects. For this reason, the goal for the research was to analyse how project organisations cope with present project complexities and how project organisations respond to an increase in complexity. The goal was also to illustrate how project organisations increase their complexity, what their motivation was to include an extra objective and what the impact was on the project.

To contribute to the understanding of the subject and analyse the practical elaboration of project complexity and project management approaches, the following research question was used for this research:

What adaptations in the project management approach have to be made when a new objective is purposefully included in the project thereby increasing the number of involved interest groups?

On the basis of the literature review, case study and expert session the following conclusion to the research question was formulated:

FINAL CONCLUSION

The cases investigated showed limited flexibility; the new included objectives did not significantly impact project planning, budget or the primary objective. As a consequence, no or limited adaptations to the project management approaches needed to be made by the project organisations.

No conclusion could be drawn on the needed adaptations, because the project organisations showed limited flexibility by only including an extra objective in which the effect on the project were neglectable. This conclusion does however illustrate that project organisations could include and extra objective to their project and thereby increase the number of involved interest groups, without any needed adaptation to the project management approach, provided that the following conditions are met:

1. The extra objective is **small of scale**, compared to the main objective of the project. The extra objective does not add a new complexity dimension or complexity characteristic to the project. In three of the four cases, the extra objectives were not significant enough to impact the project or project management approach. The extra objectives were small of scale and could, in three of the cases, easily be integrated in the project and controlled by the project organization. All without negatively impacting the planning, budget or the primary objective of the project.
2. The project organisation acts as a **facilitator**. In two of the cases, the project organisation acted as a facilitator for the execution of the extra objective. As a consequence, their planning and budget were not affected by the extra work. In the case Rotterdamsebaan, the extra work was executed by themselves, but could easily be included in the activities and had for this research no significant impact on the planning or budget of the project.
3. The objective is included during the **design phase** of the project. In all cases, the decision to include an extra objective to the project was done in the design phase of the project. This project phase provides the opportunity to adjust the plans and add objectives, without too significantly impacting the budget and planning of the project.
4. Complexity dimension: **social complexity** is already present at the project, or the project organisation is prepared for this complexity. In three of the cases from the case study, the complexity dimension: social complexity, as described by De Bruijn et al. (1996) was present. Adding an extra objective, which increased the already present project complexity, does not cause the project organisation to adapt their project management approach. The fourth case did not include this complexity, nevertheless they

were prepared for the inclusions of new interest groups to the project. Being prepared for the complexity, means the project organisation is aware of the complexity dimensions, its characteristics and effects on the project. The project management approach can be prepared for complexities (as for example Rotterdamsebaan) and the project organisation can appoint project organisational members to the specific task of stakeholder engagement management and management of difficulties resolving from this complexity. This does also apply to the complexity characteristics divined by the TOE-framework (Bosch-Rekveldt et al., 2011). The extra objectives on the case project did not create any new complexity characteristics, only slightly increased some already present complexities.

5. The extra objective is **properly analysed** before inclusion and the objective is appointed to a **supporter** who feels the responsibility for a successful outcome. The supporter can be a project participant or an external party. For all case projects, an organisation was appointed to support the objective and feel the responsibility for a successful execution of the project. Without the support from a party or participant, the extra objective could form an extra risk to the project with possible negative effects on the budget or planning.

Adding more flexibility to the project and the project management approach provides the opportunity to add more significant objectives to the project which could benefit the project results and its level of success. Including a diverse group that represents a variety of interests in the project, increases the level of support, acceptance and respect for the final results. An increase in the number and variety of external stakeholder does however increases the level of complexity of the project. However, if stakeholder involvement is an exclusive process, the results might be rejected by key stakeholders and decision-making communities, a greater variety of stakeholders therefore benefits the project.

By increasing the complexity related to the number and variety of interest groups (defined as social complexity by De Bruijn et al. (1996) and "number of external stakeholders" by Bosch-Rekveldt et al. (2011)) in the design phase of a large infrastructure construction project, the level of support and appreciation for the project could be increased. An increase in appreciation by the client and external stakeholders, increases the level of project success.

9.2 Recommendations

On the basis of the conclusions the following recommendations could be made, in which a distinction was made between the theoretical recommendations for further research and practical recommendation.

Recommendations for practise

A set of three practical recommendations were developed for project organisations, the interviewees and the colleagues of APPM:

1. Following the conclusion, project organisations should look for opportunities to include extra objectives to the project and thereby involving more and a greater variety of interest groups to the project, as long as this procedure is executing following the five described conditions. If the project organisations succeed in fulfilling these conditions and including a greater variety of interests to the project, the level of project success as a consequence of external stakeholder appreciation will improve.
2. Project organisations should in collaboration with all its participants determine and describe the present and expected complexities for the project. This creates awareness on the present complexities and provides a better understanding on the characteristics and consequences of these complexities.
   Besides this, these complexities could easily be expanded to improve the project as was done in the case projects. Projects which are already socially complex, the project organisation is aware of this complexity and is prepared to cope with this complexity, the complexity could easily be expanded. Use the dimensions De Bruijn et al. (1996) and Hertogh & Westerveld (2010) to identify the project complexity dimensions, and use the TOE-framework developed by Bosch-Rekveldt et al. (2011) to characterize the expected project complexities. Using these concepts makes it possible to assess the complexities and subsequently structure a project management approach better capable of managing the complexities of the project.
3. Use the theoretical framework to structure and identify the project management approach of your project organisation. Understand how your project organisation should be determined on the basis of the project characteristics and the complexities present. Together with your project organisation

develop the most appropriate approach for the project. This should improve the overall project but also develops the awareness on why certain processes are as they are. If the project organisation of HOV Westtangent would have adapted its approach to the project characteristics, the project organisation would have developed a more appropriate approach for the project. At the moment the project faced difficulties coping with the complexities, the project organisation would have shifted towards a project management approach focused on flexibility and thereby creating more opportunities for solutions and shared knowledge to improve the project. Instead, the project organisation limited the solutions, created islands of disciplines within the organisation and fully relied on the capabilities and expertise of the project manager, who was already busy with solving earlier occurred problems.

Recommendations for future research

1. The project manager has a significant impact on the selection of the project management approach. Would this be different if the project management approach was developed by the project organisation; would the understanding of the project management approach and the foundation for the structure of the approach, positively affects the project?
2. In this research only a small part of the analysis was executed on the selection, elaboration and development of a project management approach within project organisations of infrastructure construction projects. A more elaborate case study on project management approaches should provide a better description of the applied project management approaches in practice. All project activities executed by the project organisation should be taken into account. The researches should incorporate a distinction in intensity of the activities executed. By making this distinction, a more elaborate description of the used project management approach could be developed.
3. Further research could analyse the limits of the extra objective to a project to improve the project success without risking the planning, budget and main goal of the project. What are the project boundaries for the inclusion, do these boundaries depend on the project phases and the project organisation?
4. In line with the number of interest groups is the number of participants on a project. The larger the number of participants in the project organisation the larger the complexity of interactions (Geraldi & Adlbrecht, 2007). Consortia and alliances are examples of project organisational structures with multiple participating organisations. Consortia formation takes place for all construction project sizes. However, their occurrence is higher when the project size increases. From 2014 till 2018 on average 81% of GWW (ground, water and road construction) projects in the Netherlands are executed by consortia (Rijkswaterstaat, 2019). How should the development of the most suitable project management approach be constructed for these types of organisations?

9.3 Reflection

The conclusion forms the end result of this thesis research of 7 months. For this reason, its valuable to reflect on the outcomes of the research, the process and the lessons learned. The chapter describes a personal reflection on the research.

9.3.1 Process

The research was kept too broad for too long; it took much time to select the specific points of research. I postponed many decisions on what to specifically research and what theories to use to analyze the cases and draw any conclusions. As can be seen by the lack of a proper use of the rounds model. A more in-depth use of the model would resolve in a better understanding of the actual decision-making process for the inclusion. Instead, I tried to focus on multiple phases on the project, tried to analyze all present complexities, and all variables from the theoretical framework. The duration of the thesis is too short to keep a broad overview for too long. Even though is difficult to select the most important point of research in an early stage, in collaboration with the expertise and knowledge off others, the research should have narrowed down sooner. One solution would be to organize an expert session in an earlier phase of the research to define the actual problem and make a selection on, for example, the most important variables from the theoretical framework.

To continue on the use of the rounds model, for all the cases, the extra objective was included to the project in the design phase. During my case study I did not investigate the actual moment of the decision-making process more than the five phases for construction projects as described by Koppenjan (2005). If I had been more persuasive in the determination and the reconstruction of the decision-making process, the research would provide a better insight and possible understanding of this process.

If, prior to the cases, I had known what the decision-making process had looked like and when it had taken place, I would have been able to better explain what the motivations of the parties involved were and what the exact roles of the participants were. In addition, I could have better described how flexible the project organisations really are and how much the appreciation for the project really increases due to the extra objective. In short, with better preparation and more prior knowledge, I could have worked in a much more targeted way.

Because of the broad focus of the research, much time pressure evolved in the later phases of the research. As a consequence, decisions needed to be rushed and not much time was used to create an overview of the research an reconfigure the actual problem, goal and research question. Not receiving a green light at the first time and a second postponement of the second green light meeting, felt as a failure. But this extra time provided the opportunity to rethink the purpose of this research and create a new red line through the research.

The time pressure also affected the expert meeting. For this meeting I had the opportunity the collect information based on the knowledge and experiences of 16 management professionals. This great opportunity was unfortunately, not fully taken advantage off. Due to a short preparation and little time to execute the session, not much room for discussions and follow-up question could be organized. Follow-up questions and discussions can be of great value for the problems that need to be solved and should therefore always be integrated in future situations.

Finally, a critical note should be made to the case selection procedure. The cases selected were probably not the most suitable cases for the research. The cases were probably not the most suitable cases because of the significant differences in project characteristics. Also, the fact that the extra objectives were relatively small compared to the main goal of the construction project, made the cases less suitable for a research in which adaptation to the project management approach needed to be analyzed as a consequence of the extra added objective. It would have been helpful to invest more time in the case selection procedure to determine the most appropriate cases for the research. Organizing an expert session could be a solution to determine or discover the most appropriate projects. Via the results of the expert session organized for this research, cases could have been selected based on the interpretations of the approaches by the experts. But also, on the results if experts ever changed their approach or were willing to change their approach. For example, if expert scored their current project with a focus on control, and in an ideal situation a complex project with much flexibility, how do

they apply this opinion in practice. The outcomes of the executed expert session could have provided more suitable projects for the research and thereby improving the results and conclusions.

9.3.2 Research results

Looking at the research results I expected more significant changes in project management approaches as a consequence to the expansions to the scope and number of involved interest groups to the project. On other words: I expected more flexibility by the project organisations. On the contrary, the objectives included to the projects could in 3 of the 4 projects be described as save decisions. These extra objectives do not illustrate much flexibility of the project organisation to significantly change or expand the scope to improve the project. I'm curious if this is only the case for the projects research or this is how most construction projects incorporate extra objectives.

In my interpretation, adaptive project management and the "focus on flexibility" approach was the new thing and the solution for complex projects. However, after the interviews and the expert session, it looks like the approaches seem not that flexible and the attitudes towards adaptability and change do not differ much from the more classical and traditional approaches. Some of the variables from the theoretical framework are an indirect consequence of good collaboration within the team and with the external stakeholders. Good collaboration improves information exchange between project participant, tasks are more broadly defined, and interface management is a shared task by all participants. These project management activities provide the opportunity for project organisation to respond more flexible to changes and uncertainties. Improving collaboration is maybe as or more important than structuring the appropriate project management approach. Where I expected the selection of the approach to be most important after which flexibility was achieved.

9.3.3 Lessons learned

As motivated by interviewee V2: "why should we finish a 5-month project in 2 months?". The developed planning for the thesis project was on some moments too tight and ambitious. Besides this, a planning should include room for errors, feedback and time to take a step back of the research and re-evaluate and restructure the project. Use re-evaluation and restructuring at the moments when pressure is most high. This overview of the tasks and structure improves the process and assists in setting up a framework to get the project on focus. It also assists in the closure of certain subjects and objectives.

In addition, I should have used the overview of the research to inform others to use their experiences, lessons learned and knowledge. I should have tried to present the research or a specific subject in a way that the person understands the proposition. Set-up specific questions, based on the presentation to gather feedback, new insights and personal experiences to expand or improve the project. Be critical and evaluate the answers given to select what to use.

Third, is the importance of expectation management. An important part of every project and therefore also the thesis. This includes personal expectations, the expectation of the university, the committee to which the thesis is presented and the company where the thesis project is executed. It's important to analyse the expectation of these partners and keep track of how the expectations evolve during the project. This seems similar to the stakeholder engagement method as described by interviewee W1: "Always be open and transparent to all stakeholders and keep track of their interest and attitudes. Continue this process throughout the project and publish the final list of requirements to your stakeholders and describe why some wishes are included where others are excluded". This was one of the processes not well executed during the thesis and a lesson for future projects.

If I would redo the research I would start with an expert session and make use of the knowledge of experts. Take the time for the expert session to question them and start the discussion. Their knowledge is valuable for your research, on determining the actual problems and creating a better focus point for the research. My research was in some fields to broad, which made some parts of the research too time consuming. Besides this, the expert session would be a good opportunity the determine and select the most suitable cases for the research.

9.3.4 Overall opinion

Overall, even though the research is lengthy and extensive and sometimes demotivating, the overall results are satisfactory. The research gave a great opportunity to meet new people with al lot of experience, knowledge and expertise in the field of infrastructure construction projects. Besides this, the case study gave an insight in the reality in comparison to the theory gathered during the study and literature review. It's fulfilling to possess more knowledge on the subject related too most current difficulties, challenges and opportunities of large infrastructure construction projects. In addition to the lessons learned, the thesis research provides an interesting and useful step towards the practise.

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APPENDIX

Appendix

A. Interview protocol

This appendix includes the list of interview question for the explanatory case study. The interview is set up as semi-structured, this means the interviewee has the freedom to elaborate on personal experiences on the project and further personal knowledge. The interview however includes five question and a list of minimum required data for the research. The interview consists of two part of which the first part focusses on the personal experience of the interviewee about the project and the activity of the project. The second part focusses on the activity itself and the possible changes to the project organisation during of directly after the occurrence of this activity. Result and conclusion of the interviews can be found in part III of this report.

PART I

1. Could you give me a short introduction about yourself and your role on the project?

Minimum needed data:
- *Role on the project and duration active on the project*
- *Gender of the interviewee*
- *Age*
- *Years in the industry*
- *consultant/client/contractor/employee and for which company or organisation*

2. Could you give me a short overview of the project and the project organisation according to your experiences?

Minimum needed data:
- *The interpretation of the size of the project*
- *The interpretation of the complexity of the project*
- *The interpretation of the success of the project until now*
- *The interpretation of the collaboration of the project organisation*
- *Overview of the project and the project organisation to his interpretation, this includes*
    - *Terms of Reference*
    - *Task definition*
    - *Incentives for the project participant*
    - *Attitude towards changes on the scope of the project*
    - *Structure of the organisation*
    - *Information transfer, internally and externally*
    - *Interface management*

3. Could you describe the situation where a new objective was purposefully included on the project and thereby increasing the number of involved interest groups?

Supporting questions:
- Which interest groups were added to the project when the new objective was included?
- Was this inclusion of the objective needed to make the project feasible of to increase the support of the project?

Minimum needed data:
- *The specifics of the new objective, including the scale, budget and moment of initiation*
- *The reason for the inclusion of the objective*
- *The initiator for the inclusion of the objective*
- *The interest groups of the objective*

PART II

4. Could you describe how the decision for the inclusion was made?

Supporting questions:

- Which parties took place in the decision-making?
- Who made the final call for the decision?
- How long did the decision-making process take?

Minimum needed Data:
- *Involved parties and the interaction between those parties*
- *Duration of the decision-making process*
- *The structure of the organisation in the decision-making process and it's changes*
- *What of who made the organisation come to a final decision?*

5. Did you experience any changes to the project organisation during or directly after the inclusion of the new objective to the project?

Supporting questions:
- Could you give an example?
- How was the change communicated to the internal and external parties?
- How was the inclusion formalized?
- Were there any changes to the procedures of the project organisation?
- Were there needed changes to structure of the organisation?
- Do you personally experience any changes to the project in any field?

Minimum needed data:
- *Which management approach variables changed due to the activity?*
- *What was the change, compare old to new situation?*
- *Could the change be linked to a direct of in-direct activity?*
- *How did the interviewee experience the change?*
- *How did the interviewee discover the change in the management approach?*

Supporting questions per variable:

Terms of Reference
- How does the new objective contribute, support or hinder the main objective of the project?
- How was the newly formulated goal formalized and communicated?

Task definition
- Did the new included interest group get a role in the project organisation?
- What was their new role and corresponding tasks?
- What was the attitude of the project organisation towards the new interest group and the other way around?

Contract:
- Was there a change in contract during the execution of the project?

Incentives
- Did the perspective of the final goal change with the participants?
- Where there any other scope expansion after the activity?
- What wat the main focus for the project organisation after the scope inclusion?
- How did the organisation keep focus on the first initiated objective of the project?

Change
- After the activity, was there a change in prioritizing of planning and budget?
- Was the organisation still open for more alternatives and "meekoppelkansen"

Steer
- Who made the final decision?
- Did the interest group receive a role on the project?
- Could you give me an insight in the decision-making process?
- Did the size or roles of the organisation change after the inclusion?

Information exchange
- How was everything formalized and distributed?
- What would be the difference if more or less information or decision would be formalized?

Interface management
- Was the new interest group part of the project organisation?
- How wat the communication with the new interest group?
- Did the attitude towards each other change after the activity?
- How regular is/was the contact with the interest group?

B. Overview of interviewees

This appendix includes an overview of the participant of the interview including information about their role on the project, years of experience, years on the project and information of the specifics of the interview.

Project	Code	Company	Function	years of experience	years on the project	Date of interview	Location of interview
HOV 't Gooi	G1	APPM Management Consultants	Project director	> 15 years	7 years	24-07-2019	APPM-office, Hoofddorp
HOV 't Gooi	G2	Gemeente Hilversum	Project manager	> 35 years	4 years	16-07-2019	Project office HOV in 't Gooi, Hilversum
HOV 't Gooi	G3	ProRail	Project manager	> 10 years	5 years	23-07-2019	ProRail Office, Utrecht
N241 / N242	N1	APPM Management Consultants	Project manager	> 25 years	3 years	23-08-2019	APPM-office, Hoofddorp
N241 / N242	N2	Provincie Noord-Holland	Project manager			20-08-2019	APPM-office
HOV Westtangent	W1	APPM Management Consultants	Project manager	> 25 years	4 years	15-08-2019	APPM-office, Hoofddorp
HOV Westtangent	W2	Gemeente Amsterdam Ingenieursbureau	Technical manager	> 20 years	4 years	30-07-019	IB, Amsterdam
HOV Westtangent	W3	Gemeente Amsterdam Ingenieursbureau	Project controller	> 15 years	4 years	20-08-2019	IB, Amsterdam
HOV Westtangent	W4	Aratis	Contract manager	> 10 years	4 years	03-09-2019	IB, Amsterdam
Rotterdamsebaan	R1	JCPM	Technical manager	> 20 years	8 years	28-08-2019	Project office Rotterdamsebaan
Rotterdamsebaan	R2	Ponton Bouwconsultancy B.V.	Project director	> 30 years	8 years	28-08-2019	Project office Rotterdamsebaan

table 13 Overview of the interviewees of the research

C. Overview of interview results

This appendix includes 4 tables including the results of the interviews. The minutes of the interviews, which can be found in appendix D, we translated and allocated into different subjects. These tables were used to determine the project management approaches as is described in part III of this report.

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D. Minutes of the interviews

In this chapter, the minutes of all conducted interview can be found. All the minutes are in Dutch, but their translation and allocation of the subjects can be found in appendix C. The minutes are orders corresponding the list in table 13 in appendix B.

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E. Validation Questions

This appendix provides an overview of the validation questions, the results can be found in appendix G.

Questions:

1. What role do you most often fulfil in most of your projects?

2. For how many years have you fulfilled this role?
    a. < 5 years
    b. 5 – 10 years
    c. 10 – 15 years
    d. > 15 years

3. Could we in collaboration decide on a simple infrastructure construction project?

4. Could we in collaboration decide on a complex infrastructure construction project?

5. Taking in mind the earlier discussed simple construction project, which variables have your focus when constructing a suitable project management approach? (A total of 100 point can be distributed over multiple variables).

6. Now taking in mind the complex construction project, which variables would no have your focus in the set-up of a suitable project management approach? (Again 100 point can be distributed of multiple answers).

7. Looking at you own current construction project, where would you scale your project management approach. (Scale from 1 to 10, 1 is "predict and control", 10 is "prepare and commit")

8. Where would you position you project management approach in an ideal situation. What is the ideal balance in project management approach for a complex infrastructure construction project? (Scale from 1 to 10, 1 is "predict and control", 10 is "prepare and commit")

9. Is your project management approach formally documented?
    a. No
    b. Not or barely
    c. Yes, partially or somewhere not very formally
    d. Yes, everything is formalized and documented

10. Are you prepared/willing to change or adapt your project management approach as a consequence of a significant change on the project or the project complexity? (Scale from 1 to 10, 1 is "totally disagree", 10 is "totally agree")

11. Have you ever changed or adapted your project management approach as a consequence of or significant change in complexity on the project? (scale from 1 to 10, 1 is "not or barely" and 10 is "yes, total modification")

12. In what formal documentation would you describe and/or formalize changes to the project management approach?

F. Validation Results

This appendix includes an overview of the validation results. The question of the validation process can be found appendix F. A description of the validation process and its results are described in chapter 5 of the report.

Questions 1 and 2:

General information		
#	**Role**	**years**
1	Program manager	5 - 10 years
2	Program manager	< 5 years
3	Technical manager	< 5 years
4	Project manager	5 - 10 years
5	stakeholder engagement manager	5 - 10 years
6	Project manager	10 - 15 years
7	Contract manager	< 5 years
8	Process manager	10 - 15 years
9	Project manager	10 - 15 years
10	Project manager	< 5 years
11	Project manager	> 15 years
12	Advisor market strategy	5 - 10 years
13	Process manager	10 - 15 years
14	Project manager	10 - 15 years
15	Project manager	5 - 10 years
16	?	?

table 15 Answers validation questions 1 & 2

Question 3:
The realization of a bicycle path for a small municipality

Question 4:
Zuidasdok in Amsterdam or Rotterdamsebaan in The Hague

Question 5:
Table in blue to the right ->

Question 6:
Table in green to the right ->

Priotizing of variables when setting up a project management approach															
Simple project								Complex project							
ToR	**Tasks**	**contract**	**Incentives**	**Change**	**Steer**	**Interface**	**Information**	**ToR**	**Tasks**	**contract**	**Incentives**	**Change**	**Steer**	**Interface**	**Information**
40	20	0	0	0	20	0	20	30	20	0	0	30	0	10	10
30	20	10	20	20	0	0	0	30	10	10	10	20	0	0	20
50	0	0	0	0	30	20	0	50	0	0	0	0	30	20	0
40	30	0	0	0	0	0	30	0	0	0	20	30	0	50	0
40	0	0	0	0	30	30	0	0	0	0	0	0	0	20	0
30	40	0	0	0	30	0	0	20	0	0	20	10	0	20	30
40	0	30	0	0	30	0	0	0	0	20	0	30	30	40	0
40	0	30	0	0	20	10	0	0	0	0	0	0	20	40	20
50	30	0	0	0	20	0	0	50	0	0	0	30	20	0	0
40	30	0	10	0	10	0	10	30	30	0	0	10	30	0	0
30	10	10	0	0	30	10	10	20	20	0	0	0	0	30	30
50	50	0	0	0	0	0	0	20	0	20	0	20	20	20	20
20	30	0	20	0	0	0	30	0	0	30	0	30	0	30	20
20	0	10	0	0	40	0	30	0	10	0	0	20	10	20	10
30	0	50	0	0	0	0	20	0	30	0	0	0	30	40	0
40	30	0	0	0	30	0	0	20	20	10	10	10	10	10	10
590	290	140	50	20	290	70	150	270	140	90	60	240	200	350	170
37%	18%	9%	3%	1%	18%	4%	9%	18%	9%	6%	4%	16%	13%	23%	11%

table 14 Answers validation questions 5 & 6

Question 7, 8 and 9:

project management approach			
current	**ideal**	**Difference**	**formalized?**
8	9	1	no or little
8	6	-2	Yes, some
7	7	0	Yes, some
5	8	3	Yes, some
7	3	-4	Yes, totally
9	7	-2	no or little
6	9	3	Yes, totally
9	9	0	Yes, some
8	8	0	?
?	?		?
8	10	2	Yes, totally
5	5	0	no or little
8	6	-2	no or little
8	2	-6	no or little
4	9	5	no or little
8	7	-1	Yes, some
7,2	7	-0,2	

table 16 Answers validation questions 7, 8 & 9

Question 10, 11 and 12:

Adaptations		
willing to	**done before**	**formalized in which documentation**
9	5	Sometimes a new project describtion, but usually not that well documented
10	3	No, do not have any project that fit your describtion
9	8	Request of change (Verzoek tot wijziging = VTW)
8	8	Yes, progress reports, risk profiles, scope changes
10	3	Should be in the project management plan, but does not happin in my projects, happens implicit
10	8	Yes, revision project managment plan or progress report
6	3	Yes in progress reports, defined and approved by the administrive client (ambtelijk opdrachtgever)
10	8	Yes, progress report and revisioned plan of approach
9	7	Yes, revisioned plan of approach, determined by the projectteam/steer group
8	5	-
7	9	Progress report
8	5	Plan of approach
10	8	-
10	5	Progress report
10	10	Yes, revisioned plan of approach
8	8	Yes, revisioned plan of approach or contract
8,9	6,4	

table 17 Answers question 10, 11 & 12

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