DESIGNERS IN THE ALLIANCE

A study into the role, position and added value of external designers in Dutch infrastructure alliances

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Designers in the alliance
A study into the role, position and added value of external designers in Dutch infrastructure alliances

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This is the thesis for the master Construction Management & Engineering (CME), the final part of my education at the TU Delft. To make this thesis I performed research into the subject of project alliances and the role of the engineering firm. The research was performed in cooperation with the engineering and environmental consulting firm Antea Group (AG).

The relation between the technical field of civil engineering and the broader field of management is of vital importance for good project control. A positive project result can only be obtained with a well-functioning project team as it constitutes a crucial means to deal with unexpected problems that can occur in any construction project. Within Antea Group there was an interest into how collaboration in complex projects is performed, and what can be expected for engineering firms in a shifting market. New forms of cooperation like alliances are a good example of this trend. The objective is to show how this cooperation works now and in what way it could be improved in the near future.

While discussing the subject with experts in the field during the orientation phase I realised that the direct link between alliances and engineering firms could also be a useful research project for AG. From the literature there is some theory on the mechanics of alliances available, however this research goes further into the specific role, position and added value of designers from engineering firms in Dutch project alliances.

I spent eight months working on this research project, but I could not have done it all by myself. Therefore I would first like to thank my graduation committee for their guidance during the entire process. Marcel Hertogh, for your sharp comments and overview of the big picture. Jelle Koolwijk, for your extensive input and time to discuss the all critical points during the entire process. Jos Vrancken, for putting the research into perspective and keeping a critical view. Sander van der Togt, for your coaching and the opportunity you provided at Antea Group.

For the input of information and new views on the subject of designing and alliances I would like to thank all interviewees. A special thanks to Joris and other colleagues at Antea group for providing input and guidance during my research.

Thanks to my friends and fellow students for their input in the thesis and a very enjoyable time. Furthermore I would like to thank my family who provided this great opportunity for studying and always supporting me during my thesis and rest of my study. Nikkie, for your support. And many others who contributed to my thesis and study.

Ewoud Kroes
Delft, September 2015
SUMMARY

Introduction
In the past 15 years, some major changes have occurred in the Dutch project delivery models, leading to changing roles for the client, contractor and designer. The client has become less involved by outsourcing many aspects of infrastructure projects. Contractors have taken over many of those tasks and risks and expanded their business towards the design and engineering. The engineering firms are adapting to the changing market which is dominated by the larger contractors and clients. In this shifting market, there is struggle to find the right form of public private cooperation for increasingly complex projects. In the Anglo-Saxon world, Australia in particular, project alliancing has been the prime choice to deal with the largest and most complex infrastructure projects. Dutch project alliances are based on the Australian model, but have only been thus far used in a few medium sized projects. In this project alliance, the public client and a contractor cooperate on an equal basis, while the engineering firm is sub-contracted and has a smaller role. Simultaneously, the engineering firm does not share equally in the alliance. The main focus of the research is to determine how the external engineering firm works in the alliance and if its interests are aligned with the project and the other alliance partners. To provide recommendations for future alliances further research is done into what role the engineering firm can play in future alliances. Therefore, the main question is:

What is the role, position and added value of engineering firms in Dutch infrastructure project alliances currently and what should it be in the future?

To answer this question, several sub-questions were formulated to that cover all aspects.

1. What are the characteristics of infrastructure project alliances in the Netherlands?
2. What is the role, position and added value of the engineering firm in alliance projects?
3. What should the alliance organisation and incentives be for added value from an engineering perspective?

Phase 1: characteristics of the alliance
To determine the characteristics of project alliances and the construction market in the Netherlands initial research was done. The initial research consisted of a comparative literature study of project alliancing in Australia and in the Netherlands, a literature case study and various introductory interviews in the construction industry.

In general, project alliances in the Netherlands are not used to gain a significantly cheaper or more qualitative project, but to build highly complex projects without many cost overruns. Controlling risks is done by aligning the participants’ interests through risk sharing and extensive collaboration and hence putting their knowledge to optimal use. Project alliances are large and elaborate organisations and are therefore only used in projects which are very complex because of high time pressure, involvement of many (powerful) stakeholders or risks or a combination of these factors. The procurement according to the Australian model is based on a qualitative selection of the participating parties. After the selection of the participants, a design and target price for the project is developed in consultation between public and private parties. In the Netherlands, there is not a single procurement model; participants in the Dutch alliances are selected based on qualitative or price aspects.

In Australia, all essential parties that participate in the project share the risks, opportunities and the final result of the alliance. In the Netherlands only the client and contractor share the risks and opportunities of the project alliance. External engineering firms are often involved in a more conservative model and without gaining a share in the risks or decision making process. The decisions in the alliance are made by the alliance management which consists of persons from the alliance participants (contractor and client).
Phase 2: Designers in current alliances
To determine the current role, position and the added value, three case studies were conducted on Dutch project alliances. The chosen cases are all infrastructure alliance projects, two rail (re)construction projects and one highway construction project that have been performed recently. The projects were studied by performing multiple interviews with experts that had experience with the design in different parts of the alliance organisation.

In recent projects, up until 2010 the External Engineering Firms (EEF) had a large role in alliance projects as main designers in the project organisation. The EEF contributed significantly to the management of the alliance and added value by providing an integral design and specialised engineering. The formal position of the external designers is outside the alliance organisation, contracted with an Engineering Service Agreement (ESA) (Dutch: ‘regiecontract’) without bearing significant risks or opportunities in the alliance. In the current projects, the EEF’s have no direct interest in a positive alliance result and do not have a contractual incentive to perform better than average.

Around 2010 a shift in the market can be seen as the Internal Engineering Firms (IEF) of the contractors are starting to grow and take on more tasks and responsibilities. This trend also occurred in the studied project alliances, as the IEF’s took over tasks from the EEF’s in the design phase when control over the costs was lost. Other measures, like stricter management were taken to regain control of the design and engineering. Currently the EEF’s have a smaller role, as specialised engineers or as providers of capacity for the alliance participants.

The choice by the client for the current method of involving the external designers is based on traditional relations and methods, in order to simplify the new form of cooperation and avoid new interfaces.

Phase 3: Designers in future alliances
The possibilities for future roles and involvement of the EEF in the alliance are explored by performing further interviews with alliance experts who are involved in the establishment of project alliances. The outcomes of the case studies are combined with the outcomes of the last round of interviews. From the outcomes of phase 1 and 2 and the interviews, the conditions for the involvement of an external engineering firm in the alliance in the Dutch construction industry are identified:

- Clear role and cooperation with the contractor
- More simple organisation
- Option to share and profit from the opportunities
- Limit the (consequences) of the risks

There are two main models for the position of the EEF in the alliance: either traditional or risk bearing. With the conditions and requirements from the research in mind, two theoretical models for improvement in future alliance projects are constructed.

In the first model, with the EEF in a traditional position, the EEF is not an alliance participant and has less interest in a positive alliance result. The organisation in the alliance is simpler as there is one party and interface less in the decision making process. It is in the interest of the EEF if many engineering hours are spent and there is no direct incentive to obtain a positive project result for the alliance. The interests of the EEF are thus not aligned with the alliance participants’ interests. This is not a good option if a high level of integration and independence is required to create the design. This position is suitable in a project in which the role and added value of the EEF are limited.

The interests of the EEF the traditional model (as a sub-contractor of the alliance) can be aligned with the project by changing the positions and providing contractual incentives. A simple organisation can be obtained by directly hiring the EEF in the alliance, this reduces the complexity. An incentive in the cost reimbursement contract can be added in the form of a bonus which depends on a positive alliance result. By combining the traditional cost reimbursement with a bonus without a penalty, the flexibility and focus on quality are maintained, while the risk is limited.

In the second model, risks and opportunities are shared with the external engineering firm; this aligns the interests and provides the EEF with the ability to profit from any optimisations. However, in this model an extra
interface is added to the alliance organisation and management, which complicates the organisation and dilutes the influence of the alliance participants. Significant added value and a clear role by the EEF is required to make this model worth the extra effort.

To minimise the impact of an extra party and interface the alliance, the EEF will join the consortium. By adding the EEF to the consortium, impact of an extra interface will be limited for the client. The main conditions for this collaboration are a minimal added value from the EEF, a good cooperation between the IEF and EEF and the capability by the EEF to bear the consequences of the risks.

**Conclusions: growing towards collaboration**

From the perspective of the external engineering firms, it is clear that their environment is changing and they somehow have to find their new role and provide added value that suits the new role, the project and the parties they are working with. There are several models in which the new role can have a position, which could provide added value for the project and the alliance (organisation).

From a client or contractor’s perspective, there is a certain dependency on the (added value of the) external engineering firm. To align the interests of the EEF, those parties should provide the EEF with the opportunity to profit from the optimisations and opportunities in the project. And prevent internal competition in the alliance/consortium by cooperating more closely with the EEF or even participate in a strategic partnership.
SPECIAL THANKS TO THE INTERVIEWEES:

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<td>David de Rooij</td>
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1. RESEARCH DEFINITION

1.1. CONTRACTING IN A CHANGING CONSTRUCTION MARKET

The construction industry in the Netherlands has experienced significant changes in the last 20 years. Liberal views introduced in the 90's in combination with the parliamentary inquiry into the building fraud in the early 00's were the reason for major changes in the way the Dutch government acted as a client in construction projects.

This change in policy also led to major changes on the market side of the building industry, which had to deal with the shift from the traditional design-bid-build (DBB) to new project delivery methods (PDM) like D&C, DBFM and alliances. In the traditional PDM, the client was the link between the designer and the contractor. Clear tasks and relations (see Figure 1) are set between the client and the market parties, which are established in the contracts. Therefore much of the responsibility for design choices lay with the client. The client in this scenario is required to have enough technical knowledge in order to be able to make well informed choices.

![Figure 1 Traditional Relations (DBB) in the Dutch Construction Industry](image)

This conflicted with the trends in government and construction to transfer as much risk as possible to the market. First trend is the government policy is more aimed at providing main services (transport, employment, safety) in order to operate more efficiently. Therefore Rijkswaterstaat (RWS) as executive body has to focus on its primary goals of being a network manager and leaving as much labour intensive work and risk to the market, this policy is called ‘markt, tenzij’ (Rijkswaterstaat, 2004). In practice this means that RWS was a heavily involved client with a lot of in-house technical knowledge and became a somewhat more distant though knowledgeable process manager. This is connected with the trend that RWS wants to purchase a service from a contractor (available roads in DBFM contracts) rather than a product like a road, so risks and responsibilities for design and construction are left to the market.

The second trend is that construction projects all over the world are getting increasingly larger and more complex (Gidado, 1996). Projects also become more and more multidisciplinary as clients want multiple problems solved within a single project. To tackle this complexity a more multidisciplinary approach is required; therefore integrated contracts are used more often by the bigger clients. The earlier and more intensive involvement of market parties in different contracts can be seen in Table 1. This trend is becoming increasingly visible in the construction industry as a whole (Labyrinth, 2014).

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1 For all the meaning of all abbreviations see the last page of the report (Appendix F.)
### TABLE 1 RESPONSIBILITIES OF DESIGNERS (LIGHT RED) AND MAIN CONTRACTORS (DARK RED) IN PDM

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The first trend of shifting responsibilities is slowly reversing as some projects experience bad results, because risks cannot be controlled by market parties. To bring back their know-how, the client is becoming more involved in larger infrastructure projects. Rijkswaterstaat is one of the initiators for national infrastructure projects and is therefore investing more in public-private participation and alliances (Koenen, 2015b). This can be a cooperation in a programme form through strategic alliances over a long time and multiple projects or in separate project alliances (Rijkswaterstaat, 2011). As an example; ProRail, the other large public client in the Netherlands which manages the main rail infrastructure, followed suit with an expansion into integrated contracts and alliances (Koenen, 2011).

*Trends in the construction industry are moving towards more complex and integrated projects, with contracts requiring earlier and more extensive market participation.*
1.2. **Alliances**

Alliances are the most extensive form of client cooperation with the market; a separate organisation is established for a project in which positive and negative results are shared between participating public and private partners (Chao-Duivis & Wamelink, 2013). It is a reaction on the development of the D&C and DBFM contracts in the Netherlands in which all risk was transferred to the contractors. This development is reversing and the new trend is towards more cooperation and sharing risks rather than transferring risks to another party. This trend is seen by clients and the market as a positive development (Koenen, 2015a; Kuit, 2014). An ‘alliance’ is a broad term for a method of cooperation in a project, there are multiple contract forms being used in the Dutch construction industry which the category ‘alliances’ covers.

It is important to distinguish a ‘strategic alliance’, in which the cooperation applies to a longer period and can be defined as: “a (project) delivery method in which the owner enters into a long-term collaborative multi-party agreement with a main contractor, multiple specialised (trade) contractors and an A/E (architecture/engineering sic.) firm.” (J. S. J. Koolwijk, 2013). The tunnel alliance by ProRail (Koenen, 2011) is an example of a strategic alliance. The goal of which is to improve the process of cooperation and reduce costs over multiple similar projects. The incentive for the parties involved in a strategic alliance is to benefit from long-term cooperation and build a relationship.

This thesis discusses alliances for projects in which only a short-term relationship is developed for the duration of the project. Because of the shorter lifespan, the long-term commitment of the strategic alliance disappears and artificial incentives are created to sustain the relationship during the project. It is defined by Lahdenperä (2009) as: “Project alliance is a project delivery method based on a joint contract between the key actors to a project whereby the parties assume joint responsibility for the design and construction of the project to be implemented through a joint organisation, and where the actors share both positive and negative risks related to the project and observe the principles of information accessibility in pursuing close cooperation.” The original Australian project alliance is called a ‘pure’ project alliance, which is the most extensive alliance available for projects. The alliance members are involved from the start of the plan phase until the end of construction (see Table 2). All risks, opportunities, benefits and costs are shared between the alliance members. This form of alliance is used extensively in Australia (Koolwijk & Geraedts, 2006).

In Dutch construction projects another form of project alliance is used, which in literature is also called a ‘design alliance’. In the Dutch project alliance the design and execution of the project are contractually separated. A contractor and the client form an alliance to develop the plan and design of a project. In the design, the alliance members share the costs and benefits. An engineering firm can be part of the alliance, depending on the extent of the alliance (Chao-Duivis, Koning, & Ubink, 2008). After the design phase, the same contractor who participates in the alliance will execute the design made by the alliance team. The execution risks are allocated with the contractor.

Another less known form is the risk or light alliance, in this alliance several joint ventures or contractors collaborate to minimise interface risks in complex projects (Winters, 2014).

<table>
<thead>
<tr>
<th>TABLE 2 PARTICIPATION BY BOTH PARTIES IN AN ALLIANCE (ORANGE) AND ONLY THE CONTRACTOR (BLUE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project phases</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Risk alliance</td>
</tr>
<tr>
<td>Dutch project alliance</td>
</tr>
<tr>
<td>Australian project alliance</td>
</tr>
</tbody>
</table>

There are several forms of alliances in the Netherlands, which have different characteristics. In this thesis the Dutch project alliances are researched.
1.3. DESIGNING COMPLEX PROJECTS

From multiple interviews it was found that from a contractual point of view, in the alliance little has changed from the traditional relations. Engineering firms are still hired as sub-contractors on a lump-sum or reimbursable basis. In the traditional project delivery method, iterations between the designer and the contractor in the design process are not standard. The design is fully detailed and then transferred to the client and the contractor (see Figure 1); any adjustments that have to be made are additional work.

There are two aspects that did change for the designers. The first trend shift is the direct client of the engineering firm. In traditional projects, the client for the engineering firms was always a (public) organisation, which would become the owner of the structure (see Figure 1). Currently the client for the engineering firm is more often a contractor which sub-contracts the engineering firm (see Figure 2) for (specialised) engineering work. Secondly, the engineering firms are often co-designer rather than main designer as the contractors are expanding their in-house (internal) engineering departments. The position of the designing parties is changing while their role in practice stays the same. The main-contractor still subcontracts the engineering works to an engineering firm on a fixed price basis.

Another shift in the entire construction market is that the bigger scope and a more complex environment in modern projects will create extra interfaces in the technical design (Couwenberg, 2011). These interfaces are physical-technical as the project gains in size, physical scope and become technically more challenging. More parties are involved due to the increasing size and complexity which create more contractual and organisational interfaces which can cause problems in projects (Pavitt & Gibb, 2003). Extra interfaces in general make a project more uncertain and risky (Weshah, El-Ghandour, Falls, & Jergeas, 2014). This is summarised in the following trends:
- Increasing need for cooperation between involved parties due to complexity (Anvuur & Kumaraswamy, 2007)
- Project complexity in alliances is mostly dynamic, these dynamic problems require an iterative solution (Hertogh & Westerveld, 2010).

Therefore, from a project interest, the design work requires a more extensive involvement\(^2\) and more flexibility than a can be provided in a predetermined number of hours. Therefore risk management has to be performed to improve the chance of a positive outcome of a project. Risk management operates on the basis that by preventing or mitigating threats and exploiting opportunities the project outcome can be increased. To obtain

\(^2\) The fixed price contract causes rigidity between the designer and his client. This was already the case in traditional project, however in First, in integrated PDMs all parties are collaborating from a much earlier point in the project, involving a much broader scope, see. As a result relations between the parties also become much closer. This makes the modern project and process much less predictable than before and therefore less suitable for a fixed price contract.

Secondly, flexibility is the main advantage of integrated over traditional PDMs because flexibility is required to be able to make the necessary iterations to create an innovative design, reduce the threats and take advantage of opportunities. As all large engineering firms in the Netherlands work according to fixed price contracts, this contradiction is an important condition for the research.
this goal it requires an integral process between the design and execution of a project. The interface design-execution in the alliance process is not clear, but gradually develops. Therefore iterations are needed to continuously improve the design.

“Risks should be allocated to the party best able to anticipate and control that risk.” (Beard, 1982) To manage the risks properly, the key parties in the design process have to be involved to manage those risks continuously. In complex projects integrated solutions require a joint risk management strategy to control all risk. Standard project delivery methods prove insufficient for this level of integration (Rahman & Kumaraswamy, 2002). Literature on alliances and integrated PDM’s calls for the “equitable allocation and management of risk” (Rose & Manley, 2010). Explicitly the risks are managed by the RISMAN method (see Appendix D.), used by both RWS and ProRail. However this method does not cover risks of the collaboration or the incentives in the alliance, which are one of most important risks that are specific to the alliance PDM. Implicitly the allocation and management of risk is determined in the procurement phase by the selection of parties involved, the division of work between them and the incentives that apply to them.

Because of changes in the construction market and within parties, designing complex projects requires a more extensive involvement of the parties and a more integrated approach.

1.4. DESIGNER IN THE ALLIANCE

To increase the result of the project, the design of the project has to be efficient, feasible as well as realistic for the contractor to build. This creates the most optimal design with the least losses in the execution phase. Engineering firms and contractors both have a lot of knowledge regarding the construction process. Combining this knowledge could improve the design of a project by covering most uncertainties. In complex projects this requires cooperation between the client, the contractor and the designers from the engineering firms.

From the preliminary research it appears that risk in alliances are managed and allocated in a traditional way. In the traditional way of working it is very rare for the engineering firm to bear more risk is defined in the standard conditions of the DNR, which is limited to the sum of their commission. While participating in a consortium bearing risk for the execution in a construction project is even less common.

The goal of the alliance is to improve the project outcome by delivering a better and/or cheaper end result. That goal is obtained by making a design which is less costly and easier to build in a shorter time. This is done through closer cooperation and more attention to the design and risk management process. The parties that are involved in the design are the client, who provides the preconditions and local knowledge, the contractor who provides knowledge on a realistic design and the engineering firm that provides general knowledge and capacity in the design. In general, the impact of the designer is greater than its share in the project. This is recognised in some Australian projects, in which the allotment on optimisations for the designer is 1.5 times that of the contractor (J. Ross, 2006).

In Dutch project alliances, the (financial) incentives to align the interests of the parties to the interests of the project only apply to the alliance participants, which are the contractor and client. The incentives are an important tool as they provide the few boundaries that exist in the alliance. The most important tools and incentives in the alliance are close collaboration and risk sharing between the alliance organisations and the parent companies. These incentives do not apply to the designers, suppliers and sub-contractors in the alliance.

The designer is identified as a critical party in the project alliance while the interests for the designer and other critical parties are not aligned with the alliance (participants) and the project.

1.5. PROBLEM DEFINITION

3 for all definitions see Appendix A.
Much research has been done on the subject of management and risk allocation within project alliances between the client and the contractor (Ng & Loosemore, 2007; ProRail, 2011). Yet there is little theory on specific incentives, role, position, added value, risks and responsibilities in project alliances for independent designers, the External Engineering Firms (EEF), as almost all project alliances in the Netherlands have been in a different composition and with different requirements.

The alliance participants do not have the knowledge and capacity to perform all the technical work in the project, therefore the alliance is very dependent on external parties that are brought into the alliance. Theory says that risks should be shared between the key players in the project. An engineering firm is a key external party because it provides the knowledge and capacity for the design team. The optimisations which are made in the design are key to the success of the alliance. An engineering firm is often involved in a project alliance as a specialised party with a large knowledge base to aid in the design of the project and reduce the risk profile. However at this moment engineering firms in the Netherlands do not share in the pain/gain structure of the alliance and there are no clear incentives for them that reflect the alliance principles. Because such a key party is not subjected to the alliance incentives, the alliance advantages may not be effective.

At this moment it is unclear what role and added value an engineering firm has in Dutch project alliances. The incentives are not equal for all parties participating in the project. In theory the interests of the designer will conflict with what is best-for-project and with the interests of the alliance participants who share the risks, opportunities and results in the alliance. Therefore, the problem can be defined as:

| The lack of knowledge on the role, position and added value of a key designing party in a complex infrastructure project alliance translates in the unclear (financial) incentives for the designer. Interests of the engineering firm in the project alliance are not aligned with the project and the other participant’s interests. |
1.6. RESEARCH

1.6.1. RESEARCH QUESTION
From the problem definition the following main research question and sub-questions can be formulated:

What is the role, position and added value of engineering firms in Dutch infrastructure project alliances currently and what should it be in the future?

- Q1. What are the characteristics of infrastructure project alliances in the Netherlands?
  - Analysis
- Q2. What is the role, position and added value of the engineering firm in alliance projects?
  - Framework
- Q3. What should the alliance organisation and incentives be for added value from an engineering perspective?
  - Recommendations

1.6.2. RESEARCH OBJECTIVES
Project alliances are relatively new and have not been used often in large infrastructure projects in the Netherlands. There is as such not much literature on Dutch project alliances and the role and responsibilities of the designer. This study aims to fill that knowledge gap and recommend a better way to involve engineering firms in future projects.

A project alliance is successful when at the end of a project, the client obtains a well-functioning object for a reasonable price while taking into account the interests of all stakeholders and providing a reasonable profit for the private parties. This is done by making an optimised and integrated design, for which they need the support and commitment from the engineer. To determine the formal or contractual and informal or practical involvement of the engineering firm will require an exploratory approach. The research is practice-oriented in order to create insight into the different forms of alliances in the Netherlands and identify the practical issues in the collaboration with engineering firms. The research objective is:

The research objective is to clarify and improve the role, position and added value of engineering firms in project alliances by providing insight into organisation, incentives and interests in complex projects from a designer’s perspective.
2 RESEARCH METHODOLOGY

The research methodology is split into two parts: the research design and the data collection. In the research design the research questions and deliverables in the thesis report have been outlined. The data collection in the second part is a more technical part which describes how the research will be performed and provides an overview of the content. For more information on how the research design was set up, see Appendix B.

2.1 RESEARCH DESIGN

The problem definition and the research objective combined lead to the following main research question and sub-questions which will be elaborated upon.

What is the role, position and added value of engineering firms in Dutch infrastructure project alliances currently and what should it be in the future?

2.1.1 PHASING

The phasing of the research is organised according to the diagram in Figure 4. For each phase there is a Chapter and in each chapter a sub-question is answered.

1. What are the characteristics of infrastructure project alliances in the Netherlands?

Since much is unclear about the exact organisation of project alliances in the Netherlands, it is necessary to determine how the alliance is set up, what the characteristics are and how it is used to obtain the goals. To explore the alliances, the following concepts have to be clarified:

- Main principles of the alliance
- Process of procurement, design and execution
- Organisation of the alliance, the subcontractors and the executing contractor
- Risk allocation within the alliance and transferred risks
- Decision making process for important design decisions

The goal is to create an overview of the Dutch project alliance, from which the role of the designer can be examined in greater depth in the next chapter.

2. What is the role, position and added value of the engineering firm in the alliance?

In this new project delivery method the role and position as well as the added value of the engineering firm is wholly different from traditional projects. In order for engineering firms to properly respond to the new challenges by the client and the contractor in the market, it is important for them to know the exact role of the engineering firm in the alliance. A role is defined in the Oxford dictionary as “The function assumed or part played by a person or thing in a particular situation”. To determine the function, the type of activities that the engineering firm performs in the situation of a project alliance is researched. The definition of position is: “A place where someone or something is located”. To perform its role, the engineering firm has a position in the alliance organisation. This position can be formal or informal. The formal position is the contractual relation between the alliance and the engineering firm and the role in the formal decision making process. The informal position is the way the employees of the engineering firm are positioned in the day-to-day organisation of the alliance.

![Balance between Value, Price and Profit](image.png)

FIGURE 3 BALANCE BETWEEN VALUE, PRICE AND PROFIT (VRIJHOEF & DE RIDDER, 2005)
Because the added value of a designer in the alliance is unclear, the position and responsibilities of the engineering firm are also still unknown. The added value of engineering firms in a project alliance is different than in traditional projects. What the added value is, is dependent on the input of the other parties in the alliance and the project goal (see Figure 3). The complexity of the real world has to be lowered to model the relationships in the alliance. This will be done by separating the contractual and practical relationships in the alliance organisation.

The goal is to create a framework with the responsibilities and risks for engineering firms and determine their added value in current project alliances.

3. What should the alliance organisation and incentives be for added value from an engineering perspective?

A shifting market, in which all construction parties are trying to determine their new role and position, causes each project alliance to differ from another. Roles and positions of engineering firms are changing; therefore the third sub-question gives recommendations on the possibilities to improve the alliances in the Netherlands. The recommendations will be focussed on the role, position, added value and other barriers that are identified for the (external) designing party in the alliance. Well-defined and clear risk allocation and risk awareness might also stimulate the further integration of the engineering in the alliance process and more attention to risk management in both the planning and design phase.

2.1.2. DELIVERABLES

The goal of the research is to provide insight into the knowledge gap that currently exists for the role, position and added value of an engineering firm in a project alliance. To be able to fill this gap, deliverables will therefore be:

1. In order to define the context of the problem, an analysis of the history, organisation, procurement, risk management and decision making of infrastructure project alliances in the Netherlands.
2. A more specific analysis of the role, position and added value of the engineering firms in a project alliance.
3. Recommendations to involve the engineering firms in the different phases for future project alliances. The recommendations are specifically aimed at the role, position and added value of the external engineering firms.
2.2. DATA COLLECTION AND RESEARCH STRATEGY

2.2.1. RESEARCH PHASING

In the second part of the research methodology, the method of data collection is discussed on the basis of Figure 4. There are three main steps in the research process which correspond with the research questions:

1. Explore and describe the alliance and the processes
2. Further explore the role of the engineering firm/designer in the alliance
3. Setup recommendations for future alliances

For the research in general an exploratory approach is necessary because the project delivery method of alliancing has rarely been used in the Dutch construction market. While in the few times that it has been used several important characteristics were different.

Q1: Project alliances (Chapter 3)

The first step is to explore the subject of project alliances and establish the context of the problem. The first sub-question will be answered in chapter 3 on the basis of descriptive research. The outcome of this chapter will provide the basis that is necessary for the next phase.

To obtain a good overview of the project alliance in order to subsequently identify the role of the engineering firms a basic understanding of the alliance is needed and this will be obtained through literature study. The incentives for the engineering firm are influenced by the procurement process and the risk allocation. The added value is determined by the knowledge, capacity and decision making power that the engineering firm has.

The literature study will be conducted divided over five subjects: principles of the alliance, organisation of the alliance, process of procurement/design/realisation, risk allocation and the decision making process. In the literature study most general characteristics of the alliance can be determined. To find the specific aspects in the Dutch project alliances relevant for the research, multiple supporting unstructured interviews with experts on project alliancing will be held. The experts include tender managers and advisors from the client and experts on legal matters (see Table 3). To add to the general analysis, a literature case study is performed on the Waardse Alliantie. The Waardse Alliantie was the first project alliance for a major infrastructure project in the Netherlands. It is not representative of all project alliances but it provides insight into the development of Dutch infrastructure project alliances. This project is chosen because much literature is available and the project is often used as a reference in current projects.

TABLE 3 INTERVIEWED EXPERTS PHASE 1

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Organisation</th>
<th>Alliances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tender</td>
<td>Client</td>
<td>OVSAAL: WALTZ &amp; Amstelspoor</td>
</tr>
<tr>
<td>Tender</td>
<td>Contractor</td>
<td>OVSAAL: WALTZ</td>
</tr>
<tr>
<td>Legal</td>
<td>Legal firm</td>
<td>Waardse, A2H, OVSAAL, MMD, GCBD</td>
</tr>
<tr>
<td>Legal</td>
<td>External engineering firm</td>
<td>-</td>
</tr>
<tr>
<td>Tender</td>
<td>Client</td>
<td>Getijdecentrale Brouwersdam</td>
</tr>
<tr>
<td>Project</td>
<td>External engineering firm</td>
<td>-</td>
</tr>
</tbody>
</table>

Q2: Designer in the alliance (Chapter 4)

The second phase consists of further practical research into the role of the designer. The research question regarding this part implies exploratory research in order to identify multiple characteristics of the designing party within a project alliance. The first aspect of the research is to focus on the role of the engineering firm. What the role of the engineering firm is, is dependent on the capabilities of the alliance participants and the engineering firm itself to manage and control (parts) of the design. The second aspect in this phase is the position and responsibilities that the engineering consultant has. Finally, the third aspect is the added value that can be provided by (the designers from) the engineering firms to the alliance design.
Case study motivation

The literature from phase 1 will be the basis for this part of the research, the context and practices of the alliance are taken as a basis on which a more in depth analysis into the role, position and added value of the engineering firm can be done. The relations between the parties are part of the commercial considerations of the construction parties; therefore there is not much literature publicly available. To gain information on the role, position and added value of the engineering firms, inside information from project experts has to be obtained. The best method to do this is by performing a case study and having interviews with people who have experience with designing in these alliances. To complete the case studies, the interviews should be complemented by document research. The document research consists of reviewing past contracts of alliance projects with focus on relation between the contractor and the alliance-designer.

Case study selection

A selection has to be made from the projects that are (being) built to make the research feasible within the set timeframe. The scope of the research is infrastructure project alliances, all of the projects that fit that criterion are listed in Table 4, which are the possible case study projects. From those projects three are chosen to get a sample size which is representative of the most recent alliances by multiple public clients, but limit the amount of interviews that need to be performed. The last two projects have not been contracted yet, therefore no information about the practical cooperation on the role of the engineering firm is available yet. The three chosen projects are the ones that are most recent, are still on-going and executed by the large traditional clients, as highlighted in bold in Table 4).

<table>
<thead>
<tr>
<th>Project alliances</th>
<th>Duration</th>
<th>Client</th>
<th>Type of research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waardse Alliantie</td>
<td>2000-2003</td>
<td>PoBr (ProRail)</td>
<td>Literature (case) study</td>
</tr>
<tr>
<td>Bataafse Alliantie</td>
<td>2007-2010</td>
<td>ProRail</td>
<td>-</td>
</tr>
<tr>
<td>A2 Hooggelegen (A2H)</td>
<td>2008-2012</td>
<td>Rijkswaterstaat</td>
<td>Case study</td>
</tr>
<tr>
<td>Waterwolfstunnel (N201+)</td>
<td>2006-2013</td>
<td>Province of Noord Holland</td>
<td>-</td>
</tr>
<tr>
<td>OVSAAL: WALTZ</td>
<td>2010-2016</td>
<td>ProRail</td>
<td>Case study</td>
</tr>
<tr>
<td>OVSAAL: Amstelspoor</td>
<td>2010-2016</td>
<td>ProRail</td>
<td>Case study</td>
</tr>
<tr>
<td>Markermeerdijken (MMD)</td>
<td>2015-2021</td>
<td>HHNK</td>
<td>-</td>
</tr>
<tr>
<td>Getijde Centrale Brouwersdam (GCBD)</td>
<td>2016-2020</td>
<td>Rijkswaterstaat</td>
<td>Interview</td>
</tr>
</tbody>
</table>

The selected alliances are A2 Hooggelegen built by Rijkswaterstaat and two OVSAAL projects built by ProRail: WALTZ and Amstelspoor.

The latest alliance by Rijkswaterstaat, the A2 Hooggelegen was quite recent and relatively well documented in a book (Bloemendaal & Geest, 2011) and on the Internet (van der Roest, 2015). The OVSAAL alliances are active during the research which made it easier to research these. The two selected OVSAAL projects (by ProRail) are separated because of geographical and learning reasons. ProRail wants to learn twice from the two projects and because they are very similar, it is relatively easy to compare these to each other.

Case study data collection

The main approach to which the case studies are conducted are semi-structured interviews with persons that work or have worked in project alliances. The interviewees will be selected based on their position in the alliance. To obtain a comprehensive view on the engineer’s role, a cross-section of the alliance organisation should be interviewed. However there is a limited amount of time and resources available for the research and interviews therefore the persons in Table 5 are interviewed.

The first group of interviewees has been involved in the tender and establishment of the case study projects. This group is interviewed to improve the orientation and obtain a better overview of the alliance organisation and incentives in the contract and at the start of the project.
The second group consists of key players that are now or at some point were directly involved in the alliance for an extended period of time. They will clarify the role, position and added value of the external engineering firms in the alliance. For the interview questions and summaries see Appendix C.

### TABLE 5 INTERVIEWED EXPERTS PHASE 2

<table>
<thead>
<tr>
<th>Alliance cases</th>
<th>OVSAAL: WALTZ</th>
<th>OVSAAL: Amstelspoor</th>
<th>A2 Hooggelegen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tender phase (establishment of the alliance)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tender</td>
<td>ProRail tender manager (PR TM)</td>
<td>ProRail tender manager (PR TM)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tender manager contractor (TDM WALTZ)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alliance phase (design and execution of the alliance)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representative</td>
<td></td>
<td></td>
<td>Rijkswaterstaat contract representative (CR A2H)</td>
</tr>
<tr>
<td>Alliance board</td>
<td>ProRail alliance board member (AB WALTZ)</td>
<td>ProRail alliance board member (AB AAS)</td>
<td></td>
</tr>
<tr>
<td>Alliance management team</td>
<td>EEF/ProRail Alliance Manager (AM WALTZ)</td>
<td>ProRail Alliance Manager (AM AAS)</td>
<td>Rijkswaterstaat Alliance manager (AM A2H)</td>
</tr>
<tr>
<td></td>
<td>Manager Technical contractor (MT WALTZ)</td>
<td>Design Manager contractor (DM AAS)</td>
<td></td>
</tr>
<tr>
<td>Design management</td>
<td>Project Coordinator contractor (PC WALTZ)</td>
<td>Design Leader contractor (DL AAS)</td>
<td>EEF Project Coordinator (PC A2H)</td>
</tr>
<tr>
<td>Designer</td>
<td>Designer Internal EF (Designer WALTZ)</td>
<td>Designer Internal EF (Designer AAS)</td>
<td></td>
</tr>
</tbody>
</table>

Legend: PR= ProRail, RWS= Rijkswaterstaat, ABM= Alliance Board Member, AM= Alliance Manager, TDM= Tender manager

**Case study validity & reliability**

By conducting interviews with persons with comparable functions in multiple projects a reproducible result can be obtained. The persons are chosen to represent the different levels within the organisation of the alliance organisation. An effort has been made to interview as many people in key positions relating to the (management of the) design. Within that group interviews have been conducted at different levels in the organisation and from different backgrounds. An equal distribution of interviews been the various alliance participants was the goal. The personnel from the contractor and the client, that still work in the alliance were easier to approach than the personnel from the engineering firms that had already finished their work.

The goal in this stage will be to create a framework in which the role of engineering firms is determined in different alliances in the Netherlands. The second goal is to identify what the added value of the designer is, as a setup for the third question and Chapter 5.

**Q3: Future alliances (Chapter 5)**

In chapter 5, the possibilities of the engineering firms to participate in alliance projects will be discussed in open interviews with alliance experts. The experts that will be interviewed for this phase can be from the
public or private side in the alliance, but also from consultants and are selected on their personal ability to think about the project delivery method creatively (see Table 6)

The goal of the third phase will be to answer the question on how to involve engineering firms in future alliances, which is Q3. This question is answered by expanding the framework which is created in phase 2 and determine the viable options for participation.

The third group consists of experts in different fields that operate in an engineering firm. They clarified the business operations of an engineering firm. The goal is to provide insight into how a Dutch engineering firm would operate in a complex project. This is done by determining the added value and capabilities of the designer of the engineering firm discussion panel session at Antea Group. These capabilities are twofold: the first is to gain insight into the technical knowhow that is provided in a project by an engineering firm and the second is the capability of the engineering firm to control and bear risks.

### Table 6: Interviewed Experts Phase 3

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Organisation</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliance consultant</td>
<td>Alliance consultant firm</td>
<td>ACQ</td>
</tr>
<tr>
<td>Organisational development</td>
<td>Rijkswaterstaat</td>
<td>OD RWS</td>
</tr>
<tr>
<td>Legal</td>
<td>Legal firm</td>
<td>AE A&amp;O</td>
</tr>
<tr>
<td>Director Division infra</td>
<td>External engineering firm</td>
<td>DD EEF</td>
</tr>
<tr>
<td>Tender</td>
<td>Rijkswaterstaat</td>
<td>TM RWS</td>
</tr>
</tbody>
</table>

2.2.2. Assumptions

In this thesis, project alliances are researched, these are cooperation’s which only affect one project, as an organisation is established, then used and disbanded afterwards. The public-private relations between contractors and governmental parties are common and occur often and a reputation effect will occur but is weak as transparency within companies is low (Graafland & Smid, 2004). Therefore it is assumed that the reputation effect in project alliances will be small and the behaviour of the parties and the consequences for the project are caused by the incentives and contracts in the project alliance collaboration.

It is assumed that the direct alliance participants, the contractor and client will perform their work in best-for-project manner, because the company goals are aligned with the alliance goals.

All large contractors in the Netherlands have had some sort of engineering department for a long time. These departments have in recent years developed in separate ‘internal engineering firms’ (IEF), which are sometimes separate companies or large independent departments in a company. Examples of internal engineering firms from the case studies are Volker InfraDesign within Van Hattum en Blankevoort from the VolkerWessels group or BAM Infraconsult from the BAM group. It is assumed that these internal engineering firms have the same incentive in a project alliance as the rest of the contractor. Unlike the external engineering firms (EEF), which are independent companies supplying their engineering services in the market and who do not have the same incentives.

2.2.3. Limitations

One of the most important limitations in the research is getting access to the right persons in field and obtaining the right information.

As the subject is relatively new and only a few alliance projects have been performed in the Dutch (infrastructure) construction industry, the number of firms and persons that have experience with this form of cooperation is very limited. Some alliances have been completed more than a decade ago, which presents another problem that information is not readily available or can even be untraceable.

Another limitation is that the project results, relations with other firms and the allocation of funds are a sensitive matter. Especially in the scope of this thesis research which focused on the private side of the
construction industry, obtaining information from experts might be difficult as the subject includes sensitive corporate information. Therefore many people in the industry are subject to confidentiality, this also applies to project documents which are needed for the research.

The last limitation is the lack of EEF interviewees in the research of the alliance. Their experienced point of view has not been fully researched due to a lack of interview possibilities.

Another important limitation for academic research in this field is the perception of the risk, risk management and risk allocation.

- The perception of risk in a project will often be different among different parties participating in the project (Loosemore & McCarthy, 2008).
- The market parties in the construction industry are still focussed on traditionally contracted projects and probably perceive risk allocation in this way. Within alliances forms the perceptions differ in the fact that risks are shared among the alliance.
- Private firms have a different attitude towards risk, some are more risk seeking while others are risk averse (Hillson & Simon, 2012). This bias that the employees convey can have an influence on the result of the research.
3 PROJECT ALLIANCES IN THE NETHERLANDS

The goal for this chapter is to provide an overview on the characteristics of the project alliances in the Netherlands. In this Chapter it is determined how the Dutch alliances are set up and operated, with a focus on the risk bearing alliance participants (client and contractor). The role of the designer is elaborated upon in the next chapter.

In this chapter the theory on project alliances in general is analysed and elaborated upon by studying the available literature and performing introduction interviews with experts in a broad field of the construction industry. To obtain a good overview of the characteristics, the following aspects will be researched: conditions for an alliance, principles of the alliance, organisation of the alliance, process of procurement, risk management and the decision making process. There have been very few project alliances in the Netherlands, therefore little literature is available on Dutch alliances. A lot has been published about project alliances in the Anglo-Saxon world, the area where the project alliance originated. In this chapter the literature from mainly Australian project alliances will be compared with the literature and information from the interviews on Dutch project alliances. To illustrate the theory a well-documented project alliance in the Netherlands is used: the Waardse Alliantie.

The question to be answered in this chapter is about establishing the conditions in which the research is executed.

What are the characteristics of infrastructure project alliances in the Netherlands?

The main method that will be used in the analysis is a study of the literature on alliances, risk management and allocation. Supporting the literature will be (semi) open interviews with experts. The outcome of this chapter will be the foundation on which the framework can be constructed in chapter 4. This creates the context for the way the parties collaborate and what each of their views are on risk and responsibility.

3.1. CONDITIONS AND PRINCIPLES OF PROJECT ALLIANCES

What are the general characteristics of a project alliance?

To find out what the general characteristics of project alliances are, the main principles, features and conditions for a project alliance are determined.

Alliancing originated in the 90’s in the oil & gas industry when BP as a client wanted to developed the Andrew field in the North Sea. It created a temporary cooperation with seven contractors in a project alliance in which they would work on an equal basis. From that point this project delivery method developed and expanded especially in the UK and Australia as well as to other sectors including the onshore construction industry. A project alliance works by aligning the interests of the parties participating in the alliance and collaborating on an equal basis. The end result for the client is to obtain a complex product within a (short) timeframe for a reasonable price without major overruns. The interest for the non-owner parties or contractor is that they can realise a complex and high risk product with a reasonable risk margin which increases the chance on profit. The goal of a project alliance is defined by the alliance guide made by the Victorian Government (Australia) as: “Project alliancing is about providing better value for money and improved project outcomes through a more integrated approach between the public and private sectors in the delivery of infrastructure projects.” (J. Ross, 2006).

There is not a single model for a project alliance, multiple models for cooperation can be found in the literature. Project alliances in Finland (Lahdenperä, 2009), Australia (Jim Ross, 2003) and the Netherlands (Chao-Duivis et al., 2008) have distinct features. In this research there is a focus on project alliances in the
Netherlands and in the Anglo-Saxon world. As the Dutch alliances originated from the Australian or Anglo-Saxon model, they have similar characteristics.

The two main characteristic of the alliance are that the alliance parties work on an equal basis and share in the end-result and both win or both lose. By cooperating on an equal basis, the traditional relationships and incentives are abandoned. Traditionally, in construction projects there is a hierarchical relation between the principal (client) and agent (contractor). Risks and responsibilities are allocated precisely with commercial and legal consequences for the parties involved. According to the principal-agent theorem, their interests are often not aligned and sometimes opposed. When extra work (outside the project scope) is needed, the agent profits while the principal has extra costs.

The goal is to create a basis of trust for extensive (supply chain) collaboration. The tools to achieve this goal are hard and soft incentives to ensure that the interests of the main parties align with the project goals. By sharing risks and having an equal relationship the goals in a project can be aligned for both parties. This is illustrated by the ProRail Alliance handbook: “If parties have enough common/aligned interests, the collaboration will follow, especially in complex and dynamic projects, where cooperation is key.” (ProRail, 2011).

Therefore the alliances can be defined as: “a project delivery method in which the client or future owner(s) and one or more service providers work together in an integrated project team to deliver a project under specific contractual framework in which the commercial interests are aligned” (Jim Ross, 2003).

3.1.1. AUSTRALIAN VERSUS DUTCH ALLIANCE

The largest difference is that the Anglo-Saxon project alliance covers the entire length of the project and includes more parties that bear risk and have more equal incentives for all participants. The Anglo-Saxon alliance is considered as a ‘pure project alliance’ because the entire project is made in the same organisation with the same incentives. This method of cooperation is according to the alliance spirit.

The project alliances in the Dutch infrastructure sector are focussed on the design (phase) of the project and often there is a hard division between the design and execution phase. The Dutch model has therefore been called a ‘design alliance’ (Koolwijk & Geraedts, 2006). Because of these differences, it is important to understand the incentives and drivers of the project alliance in general to understand the Dutch project alliances.

The origins of the Dutch alliance practices can be traced back to the Waardse Alliantie. The Waardse Alliantie was part of the Betuweroute megaproject to construct a freight railway from Rotterdam to the German border, close to the Ruhr industrial area. The scope of the project was the area between Sliedrecht and Gorinchem in the province of Zuid Holland. The project was tendered as a D&C contract but experienced of major set-backs in time through stakeholder and Supreme Court concerns. The choice for alliance PDM was taken after the project was already awarded and the design had started. The alliance was set up after a difficult project start with little trust between the client and contractors. The scope of the project was then redefined and the alliance organisation was set up. The scope was changed drastically and there were many cost overruns in the program, a positive financial result and excellent care for all complaints towards the environment & stakeholders were two (political) project goals for the alliance. From a technical project perspective the main principles were: making the planned delivery date, quality control through collaboration and preventing and limiting accidents. To summarise: cost, stakeholders, planning, quality and safety were the main drivers for Waardse Alliantie.

3.1.2. CONDITIONS FOR PROJECT ALLIANCES

Not every project is suitable for a project delivery method such as the project alliance. There are several drivers that influence the choice of a project delivery method, these are project, market and client drivers (Gordon, 1994). These drivers are the basis for the conditions for an alliance and it is important that the conditions are right before committing to an alliance.
**PROJECT DRIVERS**

Project drivers that influence the choice of contracting method are: time constraints, flexibility needs, preconstruction service needs, design process interaction and financial constraints (Gordon, 1994). The complexity that originates from the project drivers mainly relate to time constraints and project risks in the project.

A project is eligible for an alliance when the complexity is high, this is characteristically intangible and hard to determine. The Australian government issued in the National guide to alliance contracting in which it advises on the complexity and constraints of the project delivery method (Department of Infrastructure and Transport, 2011).

Time constraints are often an important factor in choosing for a project alliance. A project needs to start as early as possible and a short procurement process is needed. If there are no further time constraints, every risk could be managed in succession and mitigated to the full extend. However, in a project with a tight timeframe there is a dependency on parallel processes which can be the cause for more risks. In case of an alliance project, the need for flexibility is high. When the scope or project risks are not yet developed to the point that they can be controlled, they are uncertain and flexibility is needed to manage them. Then a collective approach to risk management will benefit the project.

Pre-construction service needs are high in a project alliance because of the complex nature of the projects. The focal point of a project alliance is therefore optimising the best-for-project design, prior to the construction. Optimisation of the design in parallel processes also requires extensive interaction between the alliance parties.

Alliance PDM should be chosen when project risks cannot be adequately defined at the project initiation. Project risks will be unclear at the start of the project, because the scope is still unknown. However, in this phase, the mitigating measures are still easy to implement into the design (see Figure 5. Therefore some of the biggest gains can be made in the early phases of the project. Early contractor involvement is a broader trend in the Netherlands (Van Valkenburg, Lenferink, Nijsten, & Arts, 2008).

![Cumulative cost in the project phases according to Risman (1999)](image)

A more practical constraint is a minimal project value of at least the equivalent of €35 million, which is recommended by the national guide on alliancing (Department of Infrastructure and Transport, 2011). In order for the necessary optimisations to be implemented a certain project size and complexity is required to recover the high initial start-up costs of an alliance organisation. A project alliance is very costly for the client to establish, both in terms of money and labour (Jim Ross, 2003). In Australia the costs are high because all of the tender costs are borne by the client, as the entire design is made in the alliance (Walker & Hampson, 2008). One of the procurement strategies is to produce two designs in parallel by two separate consortia and both are fully paid by the client. There are also significant investments done in the qualitative selection of a project partner. Starting an alliance is therefore a big investment and is only advisable when an analysis has shown that there are significant project benefits that outweigh the downsides (Jim Ross, 2003).

**COMPETENCIES CLIENT**

Client drivers relate to the conditions that the client has to meet, the capabilities of the client to manage a project, the risk aversion and the limits in which a public client can operate. In a project alliance, this can be an
important condition from a project perspective, because much input and information from the client is needed. The client has superior knowledge, skills and capacity than any other party to influence the project. The client in an alliance project often has secondary goals for example: learning on the project or testing innovations or unproven technology in practice. These secondary goals will increase the project risks, which will make the contractors hesitant in using these.

**CONTRACTOR COMPETENCIES**

The market drivers determine the state of the market, the availability of capable contractors, the conditions of the market and what the relation is between the project demand and the size of the contractors. The project demand and market capacity affects the number of contractors needed for a project (Gordon, 1994). The choice for an alliance can also be dependent on the market conditions, if the cost of transferring certain risks from the client to the market is (too) high. An alliance should be chosen because risks can be shifted easily, when the market cannot provide the total solution for a project.

The project alliance can only be used as project delivery method for certain projects. The most important factors that influence the decision of using an alliance are related to project uncertainty, complexity and the influence of risk. Smaller ‘straightforward’ projects are not suitable for an alliance PDM as they require a lot of effort in the start-up phase and commitment from the higher levels. Those are high risk factors which are only worthwhile if they compensate for the even bigger risks of not working together in an alliance. These are the core conditions that are required for an alliance project to be successful.

A project alliance is a very elaborate PDM, therefore it is only used in projects which are complex because of high time pressure, many (powerful) stakeholders or risks or a combination of these factors.

3.1.3. **ALLIANCE CHARACTERISTICS AND PRINCIPLES**

The project delivery model is further explained along the following key characteristics by which the project alliance is defined:

1. Cooperation and equality between the alliance parties during the entire project
2. Collective sharing of project risks
3. Pain/gain sharing between all parties in the alliance
4. Early contractor involvement
5. Procurement process is focussing on quality and skill instead of price
6. Soft factor principles

**COOPERATION**

A key distinction from traditional forms of collaboration is that instead of a hierarchical relationship between the owner and non-owner participants there is an equal relationship. The owner is part of the alliance project management organisation, rather than a client who keeps its distance from the project. All members of the project management team will work for and be controlled by the alliance organisation, however, they originate and stay employed with the individual alliance parties. The project team will work for an extended time for the alliance with as little attachment to and interference from the parent company. In combination with other arrangements these features help to create closer cooperation.

**RISK SHARING**

The second feature of alliancing is the collective responsibility for the project, the goal of which is to align all parties’ interests, by sharing the risks, opportunities, responsibilities and the results. The risks and responsibilities are shared between the alliance parties rather than allocated to individual participants. The obligations and responsibilities become mostly collective as the project is jointly made and delivered. In the Australian model, all risks and opportunities are preferably shared in the alliance, with exceptions being
possible (J. Ross, 2006). In the Dutch alliance model a more separate allocation can be seen. In Dutch alliances, there is a three-way split in risks in owner risks, alliance risks and NOP risks, as can be seen in the alliance handbook by ProRail (2011). Besides the risks and responsibilities, the net results are also shared, by creating a situation in which all parties win or all parties lose. When one party profits while the other one loses, friction arises. Several incentives and actions are implemented in the alliance to obtain these goals.

Sharing the project result is another form of collective spirit of the alliance. The result of the alliance is the budget that is left from the target cost price (for further information see chapter 3.3). By splitting the result evenly between the owner and non-owner participants (NOP) both have an incentive to reduce costs. A positive result can be obtained by reducing the construction cost of the project which is the biggest expense. The preferable way of reducing costs is the optimisation of the project design and execution methods through cooperation.

PAIN/GAIN SHARING

The third characteristic is a pain/gain sharing mechanism which applies to the alliance parties. The incentive is established to share the pain or gain depending on whether a pre-agreed target is met or not. If a target is not met, none of the parties will receive their bonus that was set for that specific target, as part of the risk sharing. The idea of this incentive is that when risks are borne by all parties and the rewards are shared between those parties, then they will have more consideration for each other’s views and collaborate more efficiently (Lahdenperä, 2009). The goal of both incentives is to reduce the total project costs and collaborate closely when threats are encountered. In the Dutch model the mechanism works by fining all parties in the alliance when a single company is making a loss on the project (Koolwijk & Geraedts, 2006).

EARLY CONTRACTOR INVOLVEMENT

The fourth characteristic is that of early contractor involvement (ECI): “the use of ECI was to gain the benefits of a design and construct (D&C) delivery method whilst minimising the intensive resources required in the tender process of a normal D&C delivery method” (Department of Infrastructure and Transport, 2010). One of the goals of an alliance is to bring forward knowledge on design and execution in the process (Koolwijk & Geraedts, 2006). Because 65% of the costs in a project are determined in the definition phase (Gallagher, 2002), it is important to involve the experts in the early stages when changes can still be implemented. By involving the executing party early on in the process, unnecessary design iterations can be avoided. This cooperation strategy closely resembles the Dutch design alliance. The type of alliance that is most used in those countries is the project alliance, therefore most available literature is about this form of cooperation.

PROCUREMENT PROCESS

The fifth characteristic is the procurement process in which the selection of alliance parties is based on quality rather than the lowest price. The procurement process for many projects will start when not all requirements are known yet and this causes friction. With an alliance project, this factor is even more difficult as much of the designing and decision making has to be done in a later stage. A procurement process based on an initial design and pricing is virtually impossible. The participants in the alliance have to align well as the project teams have to be fully integrated and collaborating on complex issues for extended periods of time.

The reasoning in Australia is that if a design cannot be made for the project, submitting a price would be useless. The project budget or ‘target cost’ is determined by the client who selects the NOP’s on their abilities to perform similar works and an assessment of the alliance managers’ competence. The design is then made in the alliance. In the Netherlands the tender differs from project to project and from client to client in the few cases that are available. The process is however much more price-based than in the original setup and a certain price for the design and execution is agreed upon before starting the project, see chapter 3.3 and 4.

The last key characteristic is a collection of soft factors, which are incorporated in the alliance to establish guidelines for trust. Establishing trust is one of the most important parts of the procurement process, because there are no set legal boundaries to fall back on. These guidelines are: best for project decision making, open
book transactions, open and straightforward communications, clear responsibilities and a no blame culture. There is always a chance that strategic behaviour could occur, therefore an elaborate management structure in which mechanism for dealing with disagreements in setup.

**Alliance principles**
The soft factors are translated into the alliance principles. There are several principles that shape the alliance, the main benefits of are good cooperation and aligning the commercial interests of all parties. There are formal principles and practical characteristics how the alliance works. The formal principles according to Jim Ross (2003) are:

- Primary emphasis should be on an outcome where all parties either win or lose*
- Collective responsibility for the project performance while sharing risk and reward*
- An relationship based on equality where everybody has an equal say
- Best for project should be the starting point for decision making*
- Decisions should be unanimous*
- Clear accountabilities and responsibilities
- No blame culture*
- Communications and transactions are always open-book*
- Encourage innovations in the project*
- Unconditional support from the top level of each participant*

These key principles for alliances are recognised in roughly the same form in more studies like the (Department of Infrastructure and Transport, 2011). The principles can be subdivided in project decision making, relations in the alliance and relations with parties outside the alliance. Trust between alliance partners is a key feature when setting up an alliance; this is recognised by multiple studies (T. K. Das & Teng, 2001; Langfield-Smith, 2008).

*Project alliances are not used to gain a significantly cheaper project, but to be able to create a highly complex project without many cost overruns. This is done by sharing risks and optimally using all parties’ knowledge.*

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*4 The principles with the asterisk (*) are also recognised in Dutch alliances see chapter 4.4.*
3.2. **Organisation of Project Alliances**

In the Netherlands there is a large difference between the contractual and practical organisation of the project alliances. Therefore this sub-chapter is split into a formal and an informal organisation.

### 3.2.1. Contractual Organisation

In all project alliances at least the client and a contractor are involved. As the client wants a new product, together with the contractor this product has to be realised. Other parties supplying materials, construction labour or engineering services can participate in the alliance according to the project requirements.

Potential parties outside the construction industry can also be involved: stakeholders who can provide essential input, or public authorities that contribute and have influence over the project. For each project a different combination of participants can be involved to best suit the project. These parties can be involved in the alliance in several ways, ranging from being hired by the alliance for small works to full collaboration during the entire project (J. Ross, 2006). The extent of their involvement is dependent on the project needs and participants’ capabilities.

In the Australian model, all parties can potentially participate in the alliance bearing risk. In a pure project alliance all risks are shared in the alliance between the owner and NOP. They share almost all risks as well as the profits and losses of the project. The involvement of other parties than the client and a contractor is risky as more parties complicate the decision making process. When a party has enough added value or the project is dependent on the cooperation or expertise of a certain party, those parties can be involved in a risk bearing manner. Subcontractors can be involved for essential and specialised parts of the project. Suppliers of important products or services can also be involved in the project organisation. Service providers like an architect or engineering firm can be involved to aid in the design of the project (Department of Infrastructure and Transport, 2011).

There are however multiple ways to involve key parties in the project without making them part of the project organisation. This can be through sub-contracting though a lump-sum or rates contract, which is a rather traditional approach to the involvement of parties. Another form is a sub-alliancing in which a non-alliance party is involved in the project and shares risks, pain and gain (J. S. J. Koolwijk, 2003).

In the Dutch project alliances, there are three legal parties that bear risk in the project: the client/owner, the non-owner participants in the alliance and the contractor in the execution phase (Dutch: uitvoerend aannemer (UA)). There is a legal separation between the contractor as part of the alliance and the contractor who executes the work. The actual number of alliance participants outside the client and contractor that bear risk in the organisation is smaller than in the Australian model.

Only a few risks are shared in the alliance, the client retains some of the risks and the contractor manages the construction risks during the execution. That is the reason why the executing contractor is a separate legal entity in the alliance.

In the alliance organisation all decisions are made and all risks and rewards are shared on an equal basis between the two contractual partners, the client and the consortium of contractors. Which legal entity the private parties use internally is left to the market, in practice it is often a consortium of multiple contractors.

In the alliance there is at least one contractual relation, the alliance agreement. The alliance agreement is the contract between the client and the NOP and consists of guidelines for the collaboration between the parties in the alliance, which apply to all layers of the organisation. The guidelines are described by the following items (ProRail, 2010):

- The goals and management structure of the alliance organisation
- Scope of the alliance in relation to (financial) responsibilities and risks of the parties
- Consequences in case of disagreement or termination of the alliance
- Allocation of certain risks and responsibilities between client/owner, alliance and contractor
- Optionally: the specifications for the construction and execution of the project.
In some projects a separate realisation contract is set up to create a formal barrier between the design and the execution (see Figure 6). If a realisation contract is used, than the contract is a relatively standard contract for the execution of the design which is made by the alliance (Legal expert). In the realisation contract the client orders the contractor (UA) to execute the design made in the alliance.

The two parties in that contract are the client and the contractor. The contractor (UA) in the execution phase has a different role than the contractor as part of the alliance. The contractor (UA) will execute the design, somewhat similar to a traditional (Dutch: RAW) contract. Therefore, as stated earlier, the Dutch alliance is sometimes called a design alliance, because only the design is made in the alliance. The risks in a Dutch project alliance are divided in a three-way model. There are client risks, alliance risks and execution risks see chapter 3.4.

Once the project enters the execution phase, the alliance organisation becomes a mandated client. The contractor who will execute the alliance design is the same party as the contractor in the alliance (model A in Figure 7).

In the Waardse Alliantie, the Project Organisation Betuweroute (PoBr), which was a sub-business unit of ProRail especially set up for the Betuweroute, was the client. A consortium of contractors was the NOP, that same contractor executed the design for the alliance organisation. It was decided that there was going to be equal representation of the client and the consortium in the alliance organisation.
3.2.2. **Practical Organisation**

The alliance organisation consists of the alliance board, alliance management team and the alliance team (see Figure 8). The Alliance board (AB) is highest authority of the project and consists of an equal number of directors from the client and the contractor. This is the highest institution for escalating disagreements and decision making within the alliance.

If the project changes because of a change in the design or an optimisation and the change falls outside the scope of the alliance, then a change to the project scope has to be made. The stakeholders in the project have to be consulted and then the scope change has to be validated and approved by the contractual representative. This person represents the client and is not involved in the alliance organisation, the representative’s responsibility is to review, approve and provide extra budget for these scope changes.

The alliance management team (AMT) is responsible for the daily affairs of the project. The alliance management team in the ProRail alliance, for example consists of an alliance manager from the ProRail organisation and technical, environmental and cost & change managers from either organisation. The AMT is responsible for the implementation, day-to-day management and evaluation of the alliance (ProRail, 2011). The alliance manager has a mandate from the alliance board in which the boundaries are presented up to which the AMT can take decisions. When a decision is outside the scope of the AMT, the decision is passed on to the AB.

![Figure 8: The Alliance Management Structure Adapted from (ProRail, 2011)](image)

In the RWS alliance, the AMT is based on the IPM model that is used by RWS for all their complex projects. The team consists of environmental, technical, project control, contract managers headed by the alliance manager. The alliance managers control the respective processes of environmental (Dutch: omgeving), technical (Dutch: technisch), project control (Dutch: risico beheersing) and contract (Dutch: contract) management. Ideally there would be an equal distribution between owner and NOP employees.
The parties that are involved in the different project phases can be seen in Figure 9. The client takes the lead in the pre-tender phase and gradually becomes less important in the process. The client is very important in the starting phase of the alliance when many requirements have to be established and input has to be provided from the mother organisation of the client. As the design and other works continue the role of the client will diminish. In the design phase of the alliance, the contractor as well as the NOP will take the lead in the technical design and interface with the execution phase. When the design comes up to the point of a detailed design, the design is transferred from the alliance to the contractor in work packages. These work packages are comparable with a standard contract (Dutch: RAW-bestek) and contain very few design risks, which are borne by the alliance. All the execution risks however stay with the contractor; the alliance will be the client of the contractor in the execution phase. The alliance will control and assess the contractor during the entire execution.

The size of the alliance team is dependent on how the design and designers are integrated in the alliance. When there is chosen for a design which is ‘high cut’, the alliance team will be very small and consist of only a few experts and some staff members. The design will be made by the executing contractor and is controlled by the AMT.

If a more integrated design method is chosen, ‘low cut’, the size of the alliance team will be very large as many designers from different parties will be employed by the alliance. The entire design is made within the alliance team and the project office will grow a few times its size in the design phase of the project (see Figure 10).
alliance is very dependent on the personnel that is inserted into the organisation by the individual parties. One of the requirements in the alliance is the guarantee that key personnel stays with the project for the project duration. This is specifically true for the AMT and the key personnel in the alliance team like head designers and work planners who have a strong interface with the designers as well as the contractor.

The contractor is also controlled and managed by the alliance management team but is more independent than in the Australian model. Some key personnel from the contractor, like work planners are incorporated in the alliance organisation to streamline the transition from design to construction.

In the first Dutch project alliance, the ‘Waardse Alliantie’, the design team had a contract with an engineering firm for all support relating to the design and engineering. This provides a more stable incentive for the designers in the alliance than the ad hoc hiring of designers in other Dutch project alliances. The engineering firm was incorporated in the alliance organisation, however it was not an alliance participant (see Figure 11).

![Figure 11 Waardse Alliantie organisation](PRORAIL, 2005)

The alliance structure of the Waardse Alliantie has more interfaces in comparison with the full or pure Anglo-Saxon alliance. Especially the interface with the execution is different from the Australian model. It was decided that in the execution phase, the alliance would become the client.

*In the Australian model all essential parties are involved in a risk bearing capacity. In the Netherlands only the client and contractor bear risk in a project alliance. Engineering firms and suppliers are in general not involved any differently than in traditional projects.*
3.3. PROCUREMENT & ALLIANCE RESULT

What is the process of procurement for project alliances in the Netherlands?

The procurement method and tender process have a large influence on the rest of the project (Love, 2002), therefore it is important to know how the procurement of an alliance works. In general the procurement process for an alliance is rather different from the traditional contracting process. In the very traditional contracts, the design and execution are tendered separately and to different companies. With a shift to more integral contracts the design and construction were combined, but still there is a focus on price and the allocation of risks between parties. The responsibilities and risks in both these traditional project delivery methods are fully negotiated; this leaves little room for design changes. Traditionally, the design is also based on a unilateral program of requirement, defined by the client. The procurement of an alliance often starts in an earlier phase, in which little is yet known about the project. Determining requirements and submitting a price for the design is therefore not a good method of selecting the right partners for the alliance.

For the client the tender process in an alliance will be more expensive because the majority of the design costs are borne by the alliance which is paid for by the client. However any additional costs will be saved later in the project. For any service provider participating in the tender costs will be significantly lower as the full design is performed in the alliance so the tendering parties do not have to submit an extended and costly design for the tender.

3.3.1. AUSTRALIAN ALLIANCE

In the Australian construction industry two methods of procurement can be found, single and multiple Target Outturn Cost (TOC) approach. First the single TOC approach will be explained. Then the differences between the single and multiple TOC approach will be discussed.

SINGLE TOC

![FIGURE 12 SELECTION STEPS IN THE SINGLE TOC PROCUREMENT (ADAPTED FROM J. ROSS (2006))](image)

Explore

In the initiation phase, the client will explore the options and feasibility of the project. When the feasibility and initial requirements are clear and the project alliance is chosen as a PDM, than the alliance partner(s) have to be selected.

Selection

From the literature, it can be determined that the most common first step in the tender process is the multi-stage open tendering, which is an open procedure in which all parties can enrol after which the clients picks a number of parties who can elaborate their application. The price rarely is a criterion during the selection procedure, as non-quantifiable factors are used for selection (Jim Ross, 2003). The evaluation of the tender is done by verifying the mandatory criteria and selection criteria. The mandatory criteria refer to the company’s ability to perform the work, which are minimum requirements as financial stability of the company and
minimum technical knowledge. The following elements are non-price selection criteria and together with a potential price criterion, these are then used by the client to distinguish the tendering parties in order to be able to make a choice.

The selection of alliance participants in the Australian model is based on the following requirements (Jim Ross, 2003)

1. Demonstrated technical, financial and management capacity
2. Understanding of and commitment to the alliance way of doing business
3. Track record and demonstrated capacity to deliver outstanding outcomes in safety, quality, environment, community relations, etc.
4. Preliminary ideas on innovation and execution for the delivery of the project.
5. Willingness to commit to the project objectives
6. Track record / demonstrated ability of proponent companies to work together
7. Quality of the personnel and their ability to work together with the owner and NOP.

If the project is relatively straightforward, an additional selection on price is possible. In the Australian project literature, some requirements defined for a ‘full price NOP selection’. There have to be few undimensionable risks, so most of the project risks should already be identified and the costs estimated. The concept of the project has to be familiar for all partners and there has to be some experience with proven technology & construction methods from earlier projects. The stakeholder environment should be manageable, with only a few key stakeholders. And finally, the construction challenges should also be manageable for the price to be included in the selection process (Department of Infrastructure and Transport, 2011).

A non-price NOP selection process should be used for project with many undimensionable risks, a unique project concept, difficult construction challenges, complex stakeholder environment in which unknown technology & methods are going to be used (Department of Infrastructure and Transport, 2011). By having a non-price selection process, there is no pressure of though negotiations over the finances, the main focus can be the core aspect of the alliance. The core aspects of the alliance are the capabilities of the project participants to collaborate and to bring the project to a satisfactory conclusion. This feature is especially important when many aspects of the project are still uncertain. At the end of the selection phase in the single TOC approach an alliance partner is chosen. At that point the project is awarded and the development phase starts.

Development

In the development phase, the project (management) plan is developed and the negotiations between the participants are started. During the negotiations, the price of the project, the so called Target Outturn Cost (TOC) is estimated. The TOC forms the basis for the risk reward model on which the alliance structure is based and is formed from three limbs, the project cost, a fee for overhead and profit and a pain/gain sharing part see Figure 13.

The target cost estimate (TCE) is a three limb model which is paid to the NOP and consists of the TOC and a bonus. The first limb are all expenditures directly related to the alliance, these are the direct project costs and the specific overhead costs for this project. The first limb is reimbursed at actual costs and is subject to audit. The second limb is the ‘normal’ fee work the work done, these are (corporate) overhead costs and a profit sum in line with market ratios. The third limb is the extra part of the payment which is part of the pain/gain sharing in the alliance. There is a possibility that the parties will be rewarded equitable with a bonus for pre-agreed targets, which is the gain part. When the project is behind budget, the pain sharing will be done by not rewarding bonuses and withholding limb 2 payments. The pain sharing is however limited to the entire limb 2, limb 1 will always be paid. This is done to ensure the NOP’s of a nominal revenue and limit their potential loss, to instil trust between the parties.
The basis for the pain/gain share are the project targets, which must be linked to clear and significant added value for the owner. The owner should be committed to targets and all participants should face the same outcome, win/win or lose/lose. For the mechanism to work all targets should be clear and undisputed.

The multiple TOC approach is very similar to the single TOC approach, the only large difference is the later award stage (see Figure 14). In the multiple TOC approach, the selection phase ends with multiple potential alliance partners. The potential partners each form a separate team, together with (personnel from) the client, to develop an initial design and TOC. At the end of the development phase, one of the teams is chosen and the alliance is then established. The advantage of having multiple teams is the extra competition element which will increase the chance of innovations and a lower price for the owner.

In the selection and project development phase the actual costs plus a minimal profit margin should be paid to reimburse the NOP’s for the work they do before the alliance is official.

The Australian procurement model is based on a qualitative selection of the participating parties. Only after the selection a design and target price for the project is developed in cooperation.
3.3.2. Dutch alliance

Procurement

The Dutch ‘tracewet’ or track decision procedure, limits the freedom of design (changes) as the preliminary design has to be assessed in multiple steps up to the court of appeal. While the ‘aanbestedingswet’ or procurement law is the most relevant for the conditions on the procurement of a construction project. The principle of this law is that the government cannot directly award a project to a private firm, there has to be an opportunity for of (semi) public competition.

In the Netherlands, there is much more experience with the more quantitative procurement process, therefore there has always been chosen to tender the project as a more traditional contract in the past project alliances. A tender with a selection based on price is much less complex, which is why ProRail makes a selection on best price for a project.

ProRail puts their projects on the market as design and construct (D&C) project with the possibility for an additional project alliance feature. The procurement of the ProRail alliance is therefore similar to the procurement of a D&C contract, which is the basis for the alliance project and the cooperation. The first step in the selection is providing a basic design and project plan which is made by the potential NOP’s. In these documents a price for the realisation of the project is offered, which is called the ‘realisation sum’.

The upgrade from a basic D&C contract to a project alliance comes when funds and risks from both parties to the alliance are transferred to the alliance (fund) see Figure 15. The alliance sum is based on the responsibilities and risks that are transferred from both the client and the NOP to the alliance. The risks and responsibilities that are transferred are defined in the ProRail alliance handbook (ProRail, 2011). The sum is completely free for the NOP to decide and is called the ‘D&C part of the alliance’. ProRail stimulates the increase of the alliance sum to a competitive and realistic sum. The rest of the ‘alliance sum extra’ consists of risks that are traditionally owned by the client like interface & cost and change management. The client still has its own project management, administrative and supervision costs.

The first selection is then made on the lowest realisation sum, to reject the bids with the highest costs. The second selection is on the lowest subtotal costs including the risks that the NOP wants to bring into the alliance. And the third selection step is based on the evaluation price, which is the total price adjusted for an alliance bonus/penalty, in which a larger alliance share relative to the realisation cost is rewarded. When the selection has been made, two contractual relations are formed. The first is the alliance agreement which determines the rules and the cooperation in the alliance. The second is the contracting agreement, stipulating the works that need to be performed under the control and management of the alliance organisation.

Inherently to this method of procurement, there is little room for changes in design or extra work as the price has already been set. The goal of the fixed price in the contract is to obtain a reasonable pricing for the project. This is however in contrast with the alliance spirit and the Australian scheme in which the building costs are reimbursed according to the actual costs.
The procurement method of Rijkswaterstaat is more similar to the Australian single TOC approach. Rijkswaterstaat projects are put on the market as alliance projects. The procurement consists of two phases, a selection phase and a dialogue phase.

The selection of the parties that can join the tender is done on the basis of exclusion grounds, minimal financial and economic strength, nominal technical and organisational capabilities and a proposed team with previous experience in complex infrastructure projects. At the end of the first phase, only a few parties (three is the principle) are qualified for the next phase.

The dialogue phase starts with a consultation between the client and potential NOP’s. On the basis of the consultation a basic management and financial plan are produced by the private parties. These plans focus on the NOP’s views on the methods and processes in the alliance rather than on the content of the plan. An optional method for selection in the dialogue phase is organising a team assessment workshop in which a practical assessment is done on the qualitative factors as experience, capabilities and potential for collaboration between the project teams of the client and NOP. The project is awarded on the basis of dialogue phase and team assessment workshop.

The Waardse Alliantie was tendered as a D&C contract, but with an option for an alliance. ProRail wanted a more extensive cooperation than normal because of the complexity of the project. The complexity was caused by many potential environment, stakeholders and technical risks. The environment was a cause for risks because there were many underground cable and pipelines, permits and land acquisition needed. Many stakeholders along the entire route appealed to and including the high court. While the project itself required difficult technical solutions as the area had poor soil conditions.

In general, the procurement methods with the biggest potential for a selection based on qualitative criteria and other soft factors are the competitive dialogue and the negotiated procedure with prior publication. These methods are the least open procedures that are offered within the law and offer the most room for selection on qualitative criteria, rather than price. The standard principles from the procurement law, transparency, objectiveness and a level-playing-field, are applicable (Klijn, 2006).

Within the Dutch legal system, many options are possible and there is not a single Dutch procurement model, the tenders for infrastructure projects were both qualitative and quantitative. ProRail has a quantitative model based on the traditional D&C procurement. While, procurement model of Rijkswaterstaat is more similar to the qualitative Australian model and based on trust and proven experience.
3.3.3. **Alliance result in the Dutch alliance**

Because of the separation between design and construction in the alliance which can be seen in Figure 16, the payment is a lot more complex than in the Australian model. When the project budget has been set, the project can start, which it does with the design.

The project budget consists of the alliance fund and the fixed realisation sum for the contractor. The alliance fund is shared between the alliance participants and consists of the costs for design and the shared project risk fund (each party also has its own risks and risk fund). The alliance fund and the realisation sum are communicating vessels. If optimisations are made in the design that realised a saving in the execution costs, that amount is transferred from the realisation sum to the alliance fund. The other way around is also possible: if a design risk occurs in the execution, that amount is transferred from the alliance fund to the realisation sum. In the end, what is left from the alliance fund is divided among the alliance participants. There is no possibility for the contractor to realise any optimisations in the realisation phase as the design is completely developed and the construction management and quality control is done by the alliance. (AM Amstelspoor)
3.4. JOINT RISK MANAGEMENT IN THE ALLIANCE

What are the risks of project alliances and how they managed?

In this section the goal and process of risk management for large infrastructure projects is determined. How risk management is used in large infrastructure projects in general and more specific in alliance projects. Often risk management is focussed on planning and mitigation of negative risks in the execution phase (Lyons & Skitmore, 2004) but it can also have a positive connotation as can be seen in definition by the Project Management Institute:

“Risk—an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective” (PMI, 2000)

Both in engineering firms and contractors have a lot more knowledge regarding the construction process than the client; this is a source of information asymmetry. The allocation and transfer risks are difficult processes with a large impact on relations and the contractual arrangements. The allocation and transfer of risks are often a problem in project between the client and the private parties according to the principal agent theorem.

3.4.1. RISK ALLOCATION IN CONSTRUCTION

In a traditional PDM the risk allocation is the result of negotiations between the client and the contracting parties. A risk would be transferred in exchange for a premium. The party that is responsible for a risk has to be able to manage the risk but also be able to bear the risk from a financial or economic perspective. This means that a party is individually accountable for a project.

A part of risk assessment and response is the allocation of tasks and risks to the right organisations. In smaller projects this is a simple task, but as the project size grows, the number of parties contributing to the project rises, as discussed in section 3.2. In a traditional PDM, a risk is allocated to the party who has the capabilities to manage and control the risk and at the same time is able to bear the (financial) consequences of the events. According to Beard (1982) the definition is: “risks should be allocated to the party best able to anticipate and control that risk”.

The responsibilities and risks in alliance projects are often so complicated that they cannot be managed by one party, therefore joint risk management (JRM) with multiple key parties becomes increasingly relevant (Rahman & Kumaraswamy, 2002). In joint risk management, instead of allocating the risks to one party, multiple parties cooperate in the management of such risks. One of the key mechanisms of the alliance is sharing of risk between the partners, which is a form of joint risk management. This is part of the project control that is needed to keep large and complex projects manageable. Cooperation is seen as the key factor which could improve the design of a project and could be used to cover many uncertainties.

All parties share in the risks and have to reach an agreement on the allocation; therefore it is important to identify risks early. When control and the PDM are in question, trust and risk go hand in hand (Langfield-Smith, 2008).

Characteristics for optimal risk allocation according to Hayford (2006) are:

- Consistent with market expectations
- That can survive setbacks relating to risks
- Sufficiently flexible to deal with external changes and unknown risks

The risks of projects change while the project progresses, because it is very complex and has a dynamic character. Different problems are encountered during the project and priorities change during the project life cycle. This causes risks to change within a project. During the project some aspects may seem very risky at first, but after a while or upon further research the event might prove less risky than expected. Therefore it is important to continuously monitor and update the risks in a project. Risk management and allocation is a continuous process during the design and has to be kept updated for new unexpected events.
Alliance projects are characterised by high levels of uncertainty and require flexibility in the management and tolerance of vagueness during the project creation. In traditional projects, risks are allocated at the start of the project, when risks are especially uncertain. Therefore good project management actually is the management of uncertainties (Atkinson, Crawford, & Ward, 2006).

In the alliance collaboration, the division of tasks is even more difficult as multiple parties share the consequences of the risks. A single risk event will often affect multiple parties in the project because many components of a structure will need attention from several disciplines. This makes it even more complicated that each party has subjective views on the following aspects.

There are several factors that negatively influence the allocation of risks, they are divided along the principles of efficient risk allocation according to Hayford (2006). Managing risks under the control of multiple parties’ risks creates complexity because each party in the organisation has its own perspective on managing the risk.

- Subjective views
  - abilities of parties to manage certain risks
  - likelihood and impact of a risk
  - costs of managing the risk
- Composition of the project team
- Risk maturity of the organisation
- Difficult risks (force majeure risks)

3.4.2. RISK MANAGEMENT IN DUTCH ALLIANCES

In the Waardse Alliantie risk management was the main reason for the switch to a project alliance PDM to keep the project in control. The project was not off to a good start and because of the many complexities it was felt that the risks management should be performed in cooperation rather than individually (for a more elaborated overview of risk management in Dutch construction see Appendix D.).

In the Dutch model not all risks are shared between the alliance participants. Risks are only shared if both parties can influence them. In general parties will assume risks in an alliance, which they would not take in a traditional cooperation. Risks are normally not assumed because parties either have no knowledge about the risk and cannot control it or do not have the financial capacity to do so. Therefore it has to be clear which of the previously identified risks can be assumed by the alliance (project participants) or have to be transferred. The hesitance of the public clients causes a reluctance to share risks which cannot be controlled by the client. Therefore only design risks are shared in the alliance and execution risks are transferred to the contractor (UA).

Therefore, the allocation of risk in the Dutch alliances is extensively negotiated by the client and the NOP. There are three possibilities to allocate risk in the Dutch alliance model: alliance risks, client risks and contractor risks.

Alliance risks

The alliance handbook by ProRail, says the following on risk management: “Generically allocating risks to parties in the alliance is not possible. Risk allocation is dependent on the financial agreements on the specific project and alliance.” (ProRail, 2011). All risks that are in the alliance agreement are for the alliance team. The individual economic strength of the party managing a risk is less important as all risks and consequences are shared by the alliance. The alliance organisation is aimed at erasing the background of the project team members as much as possible. Allocating risk within the alliance will therefore be a difficult task. Risks have to be specifically mentioned to ensure that the specific risks related to the project are borne by the party that can influence them optimally.

When a certain risk cannot be managed by the alliance parties a risk has to be transferred to another non-alliance party or if that is not possible, it has to be reduced. The latter can be done by adding an expert party to the alliance, or hiring a party on a more traditional basis. An expert can be sub-contracted by the alliance to control or reduce the risk for a fee. If a risk cannot be controlled in any way (e.g. force majeure risks), than they have to be insured.
Opportunities can also occur, the alliance PDM is intended to exploit those chances. By combining the knowledge of all alliance participants more opportunities can be exploited than when working segregated. In traditional projects the client is very hesitant about large project or scope changes to exploit opportunities, because it is not able to control the consequences. The cooperation in the alliance creates an opportunity to monitor and control those risks. Therefore it is important to share as many risks as this also creates possibilities for improvement.

Client risks
Traditional client risks are often related to the contract and the stakeholders in the project. These risks are brought into the alliance, as the contract is part of the alliance and the alliance is the client for the contractor in the execution phase. Stakeholder management in complex projects is very dynamic as many changes occur during the project; therefore the stakeholder manager is part of the alliance management team.

Contractor risk
The risks the contractor (Dutch: uitvoerend aannemer (UA)) carries, are fairly traditional because of the work packages that are used in most alliances, or the conditions in the new alliances. Both measures allocate the construction risks and final engineering risks with the contractor, because the alliance cannot influence them. The risks for the contractor (UA) are limited because all large risks are allocated with the alliance and the private party only carries half of those. “that is the reason why contractors like alliance contracts because they can make a complex project with limited risks.” (AM WALTZ)

The risks for the private parties are capped when the project costs exceed the contracted sum. In the first part of the cost overrun the risk is shared 50/50, this ratio is diminished fairly quickly (see Figure 17). When the exceedance of the total original budget and the extra introduced budget for extra work during the project is larger than 50% of the total, all costs will be borne by the client.

![Figure 17 Risk cap by the client in the OVSAAL alliances (adapted from Ingels, 2014)](image-url)
3.4.3. Risks of the Alliance PDM

The risks of the project delivery method itself are also aspects to take into account in the risk management of the alliance. In the project alliance guide the following risks are identified:

- The absence of legal recourse towards other participant to resolve conflicts and recover costs made.
- All participants are required to accept a broader range of risks than they would normally
- The absence of price competition (in Australian and some Dutch alliances) can lead to
  - Lesser value for money (that is perceived)
  - Questions on the impartiality of the choice for a participant
- Changes in key players can have significant impact on the project
- Requirement for significant involvement of senior personnel

To manage and allocate the risks efficiently, selecting and involving the right parties to participate in the alliance is critical because the alliance can only obtain the needed improvements when the right knowledge is available. This means that in the alliance organisation all critical expertise should be involved, for the alliance incentives to work properly.

One of the most important risks for the alliance is that of the loss of knowledge by sharing it between partners (T. Das & Teng, 1996).

A risk in the Dutch alliances is that in the execution phase, the alliance organisation becomes the client for the contractor. This provides other incentives for the contractor than the alliance was intended to. The contractor has its own set budget and the risks that accompany it, the contractor might act strategically as 100% of the profit in the execution phase if for the contractor, while it has to share the profit in the alliance.

3.5. Decision Making in the Alliance

What is the decision making process for important design decisions?

There are multiple principles that apply to decision making in the alliance. The first is that best for project is the starting point for all decisions. All alliance participants are equal and have an equal say in a decision, which should be taken unanimously. Finally a no blame culture between alliance parties is a softer requirement which has to be propagated by the management.

The decision making process in Australia and the Netherlands are very similar. The principle is that all decisions in the alliance are taken unanimously by the management level that is authorised. In practice there will be some discussions within the team on what is best-for-project. The most important design decisions are taken by the alliance management team, consisting of managers from the contractors’ consortium and the client. The alliance management team has a mandate to take certain decisions independently. If a decision falls outside of the mandate or if no consensus can be reached about a certain project feature, the decision is escalated to the next level, the alliance board of directors (see Figure 18). High ranking personnel from the alliance parties participate in the alliance board to get to a final decision. When extra funds are needed or certain changes fall outside the project scope, then the contractual representative, representing the client is asked to assess and approve changes in scope which are necessary.
On the other hand, when the alliance participants cannot reach a consensus because they have a different opinion on the matter, there is a legal option to appeal to a court of arbitration. This has to be avoided at all costs because if this happens, it will undermine the trust in the alliance and this could harm the project’s goals and (financial) outcome (J. S. J. Koolwijk, 2006).

The decision making in the Waardse Alliantie was based on a unanimous decision of the management team. If the management team could not reach a consensus, then the alliance board would have to make the decision. As this was the first project alliance in the Netherlands, everything was new and because a number of conflicts were expected, a council of experts was formed to provide advice in case of disputes. There is no option to dissolve the alliance, therefore a decision has to be reached and the goal is to do this in the alliance. The only other option is going to court (ProRail, 2005).

In practice, the division of responsibilities was done well, which is demonstrated by the fact that the Alliance board has been called in only a few times. The council of experts was not even been approached by the organisation (ProRail, 2005). The designer was not involved in both parties therefore that party will not be part of the decision making process. It can influence the process in the alliance team, but it does not have voting rights in the management team.

In principle, decisions in the alliance are made by the AMT. When the AMT cannot reach consensus or when it is outside the mandate, the decision is left to the Alliance board. If a decision cannot be made because it is outside the project scope, the contractual representative from the client has to make the decision.
3.6. CONCLUSION

Infrastructure projects in the Netherlands are characterised by a complex environment. With practices like price diving caused a lot of friction between the principal and agent(s). This friction could be taken away by re-aligning their interests. Because project alliances in Anglo-Saxon countries work well and realise better results with alliances this PDM is implemented in a similar way in the Netherlands. There are however some differences between the Dutch and Anglo-Saxon method as can be seen in Table 7 below:

<table>
<thead>
<tr>
<th>Theory on alliance</th>
<th>Australian project alliance model</th>
<th>Dutch project alliance model</th>
<th>ProRail Waardse Alliantie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliance participants (risk bearing)</td>
<td>All essential parties Client &amp; Contractor Engineering firm/supplier (if added value)</td>
<td>Client &amp; contractor</td>
<td>ProRail &amp; consortium HBSC (Heijmans, Boskalis, Strukton &amp; CFE)</td>
</tr>
<tr>
<td>Alliance party (non-risk bearing)</td>
<td>Non-essential parties suppliers</td>
<td>Engineering firms, suppliers, consultants</td>
<td>Engineering firms, consultants</td>
</tr>
<tr>
<td>Principles/ reasons for the alliance</td>
<td>Good price/quality Project excellence</td>
<td>Cost reduction Risk sharing Good price/quality</td>
<td>Regaining control on project</td>
</tr>
<tr>
<td>Organisation of the alliance</td>
<td>Full cooperation with engineer – no cut</td>
<td>Dutch project alliance with work packages</td>
<td>‘Half alliance’ – low cut with engineering contract</td>
</tr>
<tr>
<td>Process of procurement</td>
<td>Qualitative - As alliance</td>
<td>Both qualitative and quantitative</td>
<td>Quantitative – First as D&amp;C after tender alliance</td>
</tr>
<tr>
<td>Risk allocation design phase</td>
<td>50/50 client/NOP</td>
<td>50/50 client/NOP</td>
<td>50/50 client/NOP</td>
</tr>
<tr>
<td>RA execution phase</td>
<td>50/50 client/NOP</td>
<td>0/100 client/NOP</td>
<td>0/100 client/NOP</td>
</tr>
<tr>
<td>Decision making process</td>
<td>Unanimous among alliance participants, also designer/architect/supplier</td>
<td>Unanimous among alliance participants (only client &amp; contractor)</td>
<td>Unanimous among alliance participants (only client &amp; contractor)</td>
</tr>
</tbody>
</table>

The three main differences between the Dutch alliances and the Australian alliances are the separation of the execution from the alliance, only having a contractor as full alliance participant and the procurement method. By separating the execution from the design a barrier between those faces is created. This is done by the client to distance itself from the execution risks over which it has no control. The side effect is that more documentation is needed to transfer a design to the execution phase and some of the flexibility in the alliance is lost. Another side effect which is created by having a separate ‘executing contractor’ that instead of a reimbursable price, a fixed price is needed to prevent strategic behaviour. The incentives for these smaller key players are not aligned in the alliance. It is still unclear how key players in the alliance are involved if a party cannot bear the financial risk of fully sharing the costs of the (design) risks. These are smaller companies, who do not have the turnover of a large contractor, for example designers and suppliers.

The procurement method of RWS is more alike the Anglo-Saxon procurement method, they are both qualitative selection methods based on experience, capabilities and potential for collaboration. In the ProRail projects a more quantitative and price focussed D&C procurement method is used for determining the best party for the alliance. The price focussed procurement better fits the fixed price payment scheme of the Dutch alliances.

One of the reasons that the Australian model has not been used in the Netherlands is that attitude of the client and the construction sector is very different. A bonus structure to create added value would not be very...
probable in the Netherlands as the attitude of the public client is economical. The public clients aim for a final product with a quality of minimal demands for which they pay a minimal price. The clients are also very conservative when it comes to the prevention of project risks, which is a very important factor. For a bonus structure a number of very well defined KPI’s has to be determined and negotiated, which is very hard with complex factors as nuisance and quality. (DL AAS)
4 DESIGNERS IN ALLIANCE PROJECTS

From the semi-structured orientation interviews and literature in the first phase several findings on the role of the designer emerged, these can be found in the first three sections. In the second phase of the research the role and position of the engineering firm in current projects will be further elaborated upon. The goal of this chapter is to create a framework in which the existing options for the engineering firm to participate in the alliance are identified. This framework can be used in the next chapter to identify bottlenecks in the cooperation and find possible other options for designers.

In this phase of the research a number of semi-structured interviews were conducted with three groups of experts: general experts on alliancing, professionals with experience in project alliances and designers. This is complemented with document research into alliance management plans and contracts. From the research and interviews, a theoretical part and a practical part can be distinguished. In the first three sections, the theoretical model of the possibilities of a designer in a Dutch infrastructure alliance is discussed. In the last section three cases of projects which are now active are studied to illustrate and determine the current practical state of the project alliance in the Netherlands.

To reduce the complexity of the alliance organisation, the formal and informal relations have been separated. The contractual relations are the formal relations that two parties have with one another. The practical relations are the informal relations that exist within the alliance organisation. The contractual incentives that are passed on through the (alliance) agreement do influence the practical relations, while the opposite effect is much less. However, the practical rules and cooperation has much more influence in the day-to-day business of the alliance. Both relations in Dutch project alliances are therefore elaborated upon in general. To further develop these relations, specific case studies are done on the involvement of the engineering firms in those projects.

4.1 ADDED VALUE OF THE DESIGNERS

The designer or engineering consultant traditionally has a leading role in the design of a project as it is involved early by the client to develop their requirements into a buildable design. The involvement of an engineering firm in traditional construction projects is most extensive in the feasibility and project definition phase. The project definition phase is also the most important phase in the alliance as the largest optimisations in the design and phasing of the project are possible in the early stages of the project. The question to be answered is:

In what way and when is the designing party involved in the alliance?

In the initiation phase the client needs technical support to determine the feasibility of a project and produce initial designs for the track decision procedures. This is the same for a project alliance as the client will need specialised technical advice. The client will approach and contract an engineering firm to assist them with the design until the project is awarded to the contractor. Large clients in the Netherlands often have framework agreements with engineering firms for situations like these. Once the alliance is awarded to a party, the engineering firm that was involved on the client’s side during the tender does not have to be involved any further, see Figure 19.

In the Australian model, an architect or engineering consultant is selected in an early stage and is directly involved in the project for the entire duration. In the Dutch construction industry, the engineering firm traditionally works directly for the client as a consultant and does not take on risks greater than the previously
agreed upon sum. This does not fit into the alliance participant profile of sharing risks in a pain/gain structure. Depending on the internal NOP capabilities and the project requirements, suppliers, (specialised) subcontractors and designing consultants can be involved in the alliance in several ways. Most of the design work in the alliance is done by the contractor; therefore they will require assistance with the engineering in the design phase, see Figure 19.

![Figure 19: Involvement in the Alliance (Darker is Higher Influence), Based on: (Ridder, 2009)](image-url)
4.2. **CONTRACTUAL ORGANISATION**

In the large projects in which alliances are applied, external parties are necessary. There are several methods for involving an external party in the alliance, each of which will provide different incentives for that party. All possible methods of involving external parties can be found in Figure 20. According to the numbers the possibilities are explained.

4.2.1. **POSITIONS IN THE ORGANISATION**

**Option 1**

The first option is involving the designer through one of the individual alliance participants, in this case the client/owner. There are some restrictions to this method, as a large public client often cannot hire any party without an open procurement procedure because of procurement laws. This also brings an extra burden on the client, relating to the contract management of another party. By bringing extra designers into the alliance, the client can better influence the choice of the parties with whom it wants to cooperate.

**Option 2**

The second option is similar to option 1, however, in this case an engineering firm is sub-contracted through the NOP party or consortium. This can be an easy option to bring in extra designers in the alliance quickly, as private parties are not bound by the procurement laws and can hire personnel for the alliance easily. One of the drawbacks is that many contractors have a standard fee for risks and overheads when hiring extra subcontractors.

**Option 3**

The third option is the involvement of an engineering firm in the (contractors) consortium. This would be the choice of the private parties to establish a cooperation between contractors and offer extra designers in their tender proposal. The internal engineering firms (IFEs) can also be categorised under option 3 as they are part of the contractor’s consortium. Participating in option 3 means that risk will be borne by the designing party in this position.

**Option 4**

The fourth option to involve the designer is by involving an engineering firm as a third alliance participant. This means that the engineering firm acts as a separate legal entity in the formal alliance organisation. The engineering firm would share in the (alliance) risks of the project. This method is already used in Australia.
Option 5

The fifth and final option is hiring the designer directly by the alliance organisation. In the Netherlands, the alliance is not a formal, legal entity like an associated partnership (Dutch: V.O.F.) (Chao-Duivis et al., 2008). Therefore the alliance cannot perform legal actions like hiring people, buying materials and enter into contracts. In an alliance project every legal action has to be performed by one of the participants, option 1 is therefore legally impossible.

For example the acquisition of material for the construction of a road, the choice for the party to perform this action is easy because this is clearly the scope of the contractor. For the hiring of extra engineers outside the alliance parties to assist in the design of the road, this is more difficult as the engineer is going to work in the alliance organisation.

In the case studies multiple experts on alliances are consulted, from the interviews several models for the contractual relations are constructed. The alliances in the Netherlands are similar, but are not standard as different organisations have different demands on the alliance procurement and organisation. This results in different organisations with slightly different incentives for the parties that participate in the project.

4.2.2. Contractual incentives (Procurement & payment)

While the literature states that procurement of a project alliance is done in several stages, in practice the procurement process is only done once. The alliance agreement and the realisation contract are concluded at the same time. However, the procurement process, which leads to the alliance agreement and the price, is done differently in each project that is researched.

There are differences in the procurement process between the literature and practice. Also between public clients the tender process is different.

Jim Ross (2003) identifies the contracting options for external parties in the alliance. First is a sub-alliance, linked to the main alliance. Second is a performance contract based on the KPI’s from the alliance. And last a traditional scheme based on rates or lump sum payment. This is an important distinction, as the incentive for an engineering consultant or designer is very different when sharing risk or not.
4.3. **PRACTICAL ROLE & POSITION**

During the design the AMT manages the Alliance Team (AT), which contains most of the personnel of the alliance organisation. These are designing, specialist, planning and coordinating engineers and advisors and those who actually develop the design from a sketch to a detailed design. The alliance needs a variety of different engineers for specialised tasks. For the design of the civil structures, which is the bulk of the work, the internal engineering firms will supply most of the manpower.

4.3.1. **PRACTICAL ORGANISATION**

In the design phase, the alliance organisation is very extensive because almost the entire design is made in the alliance. A reference design is made by an engineering firm hired by the client. In general in the project alliances in the Netherlands, the contractor is responsible for most of the design and personnel in this phase. Often there is a large discrepancy in the staffing of the project organisation; there are very few project members from the client (5 to 10) and about ten times that many designers from the contractor.

![Diagram of Alliance Management Team](image-url)

**FIGURE 21 EXAMPLE PRACTICAL ORGANISATION FOR DUTCH PROJECT ALLIANCES IN GENERAL**

In Figure 21 the general organisational model for project alliances is presented. In this example the processes that are used, are taken from the IPM model by Rijkswaterstaat as many projects are arranged like this. The internal engineering firms (IEF) from within the contractor’s organisation do most of the engineering in the technical process, while the external engineering firms (EEF) are specialist within that process.
4.4. CASE STUDY 1: A2 HOOGGELEGEN

This section describes the first case study, which is the project A2 Hooggelegen. The methodology of the case study can be found in chapter 2.2.

4.4.1. GENERAL

Rijkswaterstaat executed project/program ‘A2 Holendrecht-Ouderijn’ to upgrade the road connection between Amsterdam and Utrecht to 2x5 lanes. ‘A2 Hooggelegen’ (A2H) was a sub-project to reconstruct the stretch of highway of 1700 m near the city of Utrecht between the ‘Leidsche Rijntunnel’ and the intersection ‘Oudenrijn’. This was the first project alliance for Rijkswaterstaat, which started in 2007 and lasted until 2011. It is a situated along two of the main highway axis in the Netherlands and contains one of the main access points for the city centre of Utrecht.

The two main challenges in this project were the traffic and the project planning as part of the larger program. The high traffic intensity on the highway and many interfaces with the underlying road network were an important factor and one of the key performance indicators. The project had a strict deadline as the entire program was set to be delivered in 2010. There were several reasons for choosing a project alliance for this project. The short term or project goals for this project were to: work faster than usual, minimise the traffic nuisance, maximal safety for all stakeholders, high quality execution, with a positive image, within the project budget and with a healthy profit for all alliance parties (Bloemendaal & Geest, 2011).

The main reasons for choosing this PDM was learning how the alliance and procurement model works and gaining experience for the future. On the long term the goals for using a project alliance are to: reduce bidding costs, optimise and match supply and demand in the industry, redefine the relationship client – contractor, stimulate to professionalise, achieve realistic quality / price ratio, create a win –win situation and align interests, create a new reproducible procedure for making large projects (van der Roest, 2015).

The alliance consisted of the client, Rijkswaterstaat, and the contractors’ consortium ‘Trajectum Novum’. In that consortium five contractors participated. The six main principles for alliances are stated in the book about the experiment of A2 Hooggelegen. (Bloemendaal & Geest, 2011).

1. Best for project – is the base for all decisions and actions*
2. Unanimity – is the goal for all alliance decisions*
3. Open book – openness in all respects to all alliance relations *
4. Prevent and avoid disputes – should be done as much as possible, when this is not possible problems should be resolved within the alliance.
5. Partners will share any setbacks – profit for one and loss for another is not an option*
6. Outstanding performance – is the goal for all indicators.

4.4.2. CONTRACTUAL RELATIONS: POSITION 2

In this project the main contractual parties are Rijkswaterstaat and Trajectum Novum who only have alliance agreement; there was no separate realisation contract as with other Dutch alliance projects (see Figure 22). However there were work packages that had to be turned over to the contractor (UA). Both parties shared the risks and results equally in a cooperation that was called an alliance-like-cooperation (Dutch: Samenwerking in alliantieachtig verband - SAV), because legally it was not an alliance. (CR A2H) 5

The external engineering firm was already involved from the tender and had an Engineering Services Agreement (ESA) (Dutch: regiecontract) with the consortium (Trajectum Novum). Legally, the contract was between the EEF and one of the contractors, the leading party in the contract for the consortium. In the tender

5
phase the engineering firm was hired on a basic (hourly) rate and an incentive: the consortium only paid a part of the fee if the tender was lost, there was a bonus which made the standard rate higher if the tender was won. The engineering firm had a contract with the alliance during the design, this is position 2 in Figure 20. The contract was an Engineering services agreement with an incentive of the total bonus of the alliance, between the consortium and the engineering firm (see Figure 22). “Potential bonus for the engineering firm was significant”. In the post-tender phase, there were no negative incentives for the engineering firm as the impact on the total project was limited. (PC A2H)

4.4.3. Practical relations

Tender phase
The client’s goal in the tender phase was to get a good project team for the project itself, but also for RWS to learn as much as possible from the project. To give the project the full support the goal was to have 50% of the personnel from Rijkswaterstaat and 50% from Trajectum Novum. The emphasis with the tender selections was on competencies, which were checked by the client implicitly. As part of the selections, assessments have been done on the proposed managers from both the client and the contractor. (PC A2H)

The contractors did not have any formidable internal engineering departments or firms at that time. Therefore they required an external engineering firm to be involved for the tender. During the tender the engineering firm was contracted by the consortium. This contract included a financial incentive. The contractor would pay part of its normal rate and if the tender was won, a bonus would be paid. This reimbursement scheme was appreciated by the consortium, because the engineering firm would also take on some of the tender risk. During the tender phase the engineering firm could control and monitor the input and output of the alliance and also the added value of the engineering work. A negative incentive for the engineering firm was therefore realistic. (PC A2H)

Alliance organisation setup
The 50/50 input from both participants was not possible as RWS had not enough people available for the project organisation. In the board and management the participants were equally represented, in the board two persons from both public and private parties. The alliance management team was headed by the alliance manager from RWS with an equal number of participants. The alliance management is organised according to the IPM model (see Figure 23). (PA A2H)

Outsourcing a design in an integrated contract is virtually impossible, because there are too many interfaces with the construction. That is already a problem in a D&C contract, and even more problematic in a project alliance. Therefore the design is made internally in the project organisation the designers from the engineering firm worked at the project location.

The engineering firm had a big role in the organisation and supplied some of the key personnel within the technical and project control processes. Two of the key design leaders, those of sub-structures (Dutch: GWW) and systems engineering were from the engineering firm, while the design leader civil structures was from the contractor. All designers in the alliance team were from the engineering firm.
Design phase

The goal of the alliance was to make a complete design and take on all major design risks. The result of the design phase and the alliance is to transfer the (very detailed) final designs of the work packages to the contractor (UA). The results of the alliance would be rewarded on the basis of a system of Key Performance Indicators (KPI’s). The KPI’s were time, money, quality, safety, traffic nuisance and public image. The quality would also be based on the quantities of the work packages.

At the peak of the project, 20 to 30 engineers from engineering firm were involved. Several key ‘design leaders’ (Dutch: ontwerpleiders) were also external engineers. In the design the engineering firm had a significant input in the alliance, through the number of designers and the number of key persons in the organisation. It was possible for the engineering firm to influence the design and therefore an incentive could be used. The bonus that the engineering firm could make in this project was a percentage of the total bonus that the private parties could get. This worked very well for the engineering firm to steer on quality while at the same time be conservative with the worked hours. As the bonus could be a major share of the profit in the project.

There was a separate department within the external engineering firm that had a fixed price contract for the construction of a pump station that was part of the larger project. The fixed price incentive in this sub-project gave the wrong stimulus to that department, which began to act strategically and cut corners on the quality of the pumping station. This is a good example that for the larger engineering services contract the right incentives were provided by the consortium to the external engineering firm.

Added value

The added value of the alliance was also in the permit process when the close cooperation with the municipality as a ‘proper authority’ (Dutch: bevoegd gezag) for the permits and as a client for whom the connection with the underlying road network was constructed. (PA A2H)

The added value for the contractor was the full technical support of the client organisation. The alliance manager from Rijkswaterstaat was mainly occupied with mobilising his own organisation to support the project. (PC A2H)

During the execution it became clear that the Leidsche Rijn tunnel would not be finished on time, this risk occurred and would lead to scope changes in this project. Temporary new road capacity was constructed, which drastically reduced the congestion in the area. This was only possible through the excellent cooperation...
between the contractor and RWS, because in a normal project the costs would have been too high to add this extra value. (PA A2H)

By having an engineering service agreement in which all costs for the EEF are covered, it has the benefit that there is no risk for the engineering firm. Which makes sure that the stimulus for the engineering firm is more best-for-project than in case of a fixed price contract: “quality was main issue for the engineering firm as the hours were paid anyway” (PC A2H). The risk of this incentive is whether you get value for money. In this case this is covered by the incentive for the bonus as part of the total bonus in which the engineering firm would benefit from a cheap design.

Side project of a pump station by the engineering firm with fixed price: contractor behaviour (cutting costs & minimal quality) occurred. This was reset by the alliance management by strategically coupling the bonus of the entire project to the pumping station sub-project. “Incentives were very important for engineering firm, a relatively small bonus for a contractor is huge in comparison for an engineer firm.” (PC A2H)
4.5. OVSAAL RAIL PROJECT

This section is the introduction to the next two case studies, the most important general aspects of the larger program are discussed. The tender which is almost identical for case study 2 and 3 is described as it provides a major condition for the roles of the alliance parties in the design and execution phase.

4.5.1. GENERAL

OVSAAL is part of a programme by ProRail called high frequent rail transport (Dutch: Hoogfrequent spoorvervoer) to double the number of railway tracks between Schiphol-(Airport)-Amsterdam-Almere-Lelystad (SAAL). The main goal of the project is to create extra capacity for the rail traffic in the short term and prepare the area for larger long term solutions (Zuidasdok, 2015). This undertaking is cut into several more manageable projects, in two projects, between Schiphol and Duivendrecht is chosen for alliances. This area in southern Amsterdam is a densely built with many stakeholders and technically challenging environment and an alliance project delivery method is chosen for cooperation. The choice to split up into two separate projects was made by ProRail to learn from two alliances in the same area and to split the most complex area into more manageable parts. The OVSAAL southern branches west and east are built by a consortium of companies from the respectively VolkerWessels and BAM.

4.5.2. TENDER

The tender for both OVSAAL alliances was done simultaneously and by the same tender teams from ProRail as the projects were closely connected and had to be built in the same timeframe. From the interviews with the tender manager from the contractor and from ProRail who was responsible for both these projects the most important aspects of both these projects could be obtained. The preparation for the tender by ProRail was done in a very short time span, only 10 weeks for a very large and complex project. Primarily the short preparation time was given to speed up the process and start the project as soon as possible. The reason is that these two projects are a preparation for the ‘Zuidasdok’ mega project which is scheduled to be tendered and started in 2017. The project is needed to prepare the area and create room and capacity to start the Zuidasdok project. (AB PR)

![Figure 24 Zuidasdok (Yellow) Waltz (Red) Amstelspoor (Green) (Adapted from Zuidasdok (2015))]()

As can be seen in Figure 24, the overlap with Zuidasdok project is considerable and therefore the completion date for the OVSAAL projects is a crucial factor for both projects. Planning is therefore one of the key factors in the projects.

An external engineering firm was hired for the reference or sketch design of both projects by ProRail (TM PR). The pressure and short time span the EEF had for the design only gave them room for limited elaboration of the design. The limited design that was made for the tender was mainly was made to minimally satisfy the
requirements for a track decision procedure (Dutch: tracebesluit). The high level abstraction in the sketch design left enough room for optimisations in the preliminary design of the alliance.

In the tender an external engineering firm was brought in to assist ProRail with the technical aspects of the tender, the track decision and a sketch design. This sketch design was presented by the client to the tendering parties; this was the basis for the tender offer by contractors. The intention of ProRail was for the contractors to provide their best offer on the basis of the sketch design, without further elaboration of the design. This was done to stimulate swiftness of the procurement process. (TM ProRail)

A policy change at the end of 2010 by ProRail was made to create a more robust rail network. Stretches of railroad were made more robust by unbundling the railroads and removing switches instead of the previous policy of adding connections (KiM, 2010). Besides the pressure on the planning, this was another event that influenced both projects in a major way. ProRail changed its policy (AM WALTZ). This policy change occurred right after both projects were awarded.

4.6. **Case Study 2: OVSAAL - WALTZ**

This section describes the second case study, which is the project WALTZ. The methodology of the case study can be found in chapter 2.2.

4.6.1. **General**

The western alliance project is called ‘Amsterdamse WALTZ’ or ‘WALTZ’ and is built on a relatively small, but very complex area. The track includes the crossing of a major highway, river and multiple other railway tracks, while the main fly-over that has to be built is part of the main rail connection between Amsterdam and the main airport Schiphol. Mitigating the nuisance for the traffic and stakeholders was therefore one of the main concerns of the alliance.

The alliance formed by the consortium ‘Combinatie Nieuwe Meer Sporen’ (CNMS) and ProRail, the only two parties sharing risk in the alliance. CNMS consists of Van Hattum en Blankevoort (VHB) and VolkerRail two contractors from the VolkerWessels group (VWG). The internal engineering firm ‘Volker InfraDesign’ (VID) is part of Van Hattum en Blankevoort which acts as the engineering consultant for many of the VWG infrastructure projects.

4.6.2. **Contractual relations: Positions 1 & 2**

ProRail has two contractual relations with CNMS, an alliance agreement and a separate realisation contract. Both contracts have an interface in the scope and the funds and both have a separation between the design and execution. In the alliance agreement 50% of the risks and results are shared between the two alliance participants.

VID is part of a larger alliance participant and is therefore not listed separately in the alliance agreement. Because VID is part of the alliance participants it has the same incentives as the rest of CNMS, therefore VID can be viewed as an integral part of CNMS from a contractual perspective. However VID can be seen as a separate internal engineering firm because it is a department in a company and not a part of the project organisation (Figure 25). VID is therefore positioned inside the consortium (position 3 see Figure 20)

The back-office contract with ProRail (position 1 in Figure 20) originated from before the tender started to provide engineering support. This contract was continued during the project for external quality control of the project. It was an engineering services contract (Dutch: regiecontract).
As not all disciplines we represented in both engineering firms, two independent engineering firms formed a partnership to complement each other. From the tender phase CNMS has one contract with the partnership of both parties (see Figure 25). This is an engineering services agreement without any further incentives and therefore an unlimited amount of hours could be worked by the partnership. The contract with the contractor and the limited responsibility means that the partnership is in formal position 2 (see Figure 20) When the tender was won by the CNMS, the contract with the partnership was continued. The contract with the designer is contractually established between the private consortium and the engineering partnership. In the agreement it was detailed that the engineering firms would supply the people and the knowledge. The activities that the EEF would perform were formally without responsibilities or decision making power and therefore they only had a limited role.

4.6.3. PRACTICAL RELATIONS ROLE / ADDED VALUE

Tender phase
From the perspective of the client the role and added value of a specific designer in the alliance was not a priority in the procurement process. The only requirement from the client was that a certified designer for the rail structure has to make the designs, according to the ProRail qualification system (Dutch: Erkenningsregeling). (TM ProRail)

The contractors’ consortium possesses design capabilities and knowhow with VID as an IEF. VID is specialised in the (detailed) design of mostly road infrastructure and civil constructions. VID is capable of designing the civil and sub-structures (Dutch: onderbouw), but is not specialised in the design of the track and rail components, so they do not have the necessary qualification. At the start of the project, the consortium needed a suitable external party to deliver the designing capabilities. Therefore the contractor chose a potential designer mainly as a specialised party to assist in designing all aspects relating to the rail and track structure (Dutch: bovenbouw). Secondary reason for hiring was the capability to design the civil structures. The combination of Rail engineering firms was selected as a designing partner by the Consortium in the tender phase. The reason for the combination of two engineering firms is the same as the reason for their partnership, Verebus is only qualified for the railway signalling, while one party had every qualification except the signalling. The two engineering firms therefore have formed a long-time partnership. The EEF have helped the CNMS to establish the final offer for the project, on the rail (engineering) budget. (TM VHB)

In the tender an EEF was hired to support ProRail as the contracting authority. The EEF had made the technical design for the track decision procedure and a reference design for the tender. At the end of the tender the EEF project team knew the project really well. Therefore the contract between ProRail and the back-office EEF was
extended from the tender to the project, where the external engineering firm would become a technical back-office for ProRail.

**Alliance organisation setup**

At the start of the design the EEF’s supplied most of the personnel for the design for the civil and rail disciplines, with a minimal input from the IEF. The external input in the organisation included the design leaders, who are the second layer and had a role in managing the design. The contract between the alliance and the EEF’s was a very simple agreement to supply the alliance with enough capable designers to keep the design teams functioning. In general, the other alliance parties were supportive and not part of the decision making process in the alliance. The Alliance Management Team (AMT) and the management layer below it consisted totally of personnel from the alliance participants. (MT WALTZ)

The external engineering firm is qualified on every aspect under the ProRail qualification system, it could therefore also verify and validate any design made by the alliance. ProRail wanted more personnel from the EEF to expand its role and to counteract the dominant role of the contractor in the design. “By hiring an external (rail) engineering firm, it was attempted to create a role for ProRail in the design.” (AM WALTZ) This was done by bringing in designers from the EEF to contribute on behalf of the client to balance the contributions of the alliance participants. This role for the external engineering firm was not described in the contract and caused some resistance with the market parties and was therefore not put into practice. “The role of the external engineering firm was therefore a lot smaller than anticipated by the client.” The indirect role of ProRail also became smaller because of this change. The final role for the back-office EEF was mainly focussed on quality control and support of ProRail’s contribution to the organisation within the alliance. (AM WALTZ)

Most of the design engineering work was done by the engineering firms, both internal as external. For the smaller specialised tasks and extra independent capacity, two more EEF’s were hired to support the main engineering firms. Two-B a specialised engineering firm was hired to manage and design the (underground) cables and pipes, while IV-Infra and Arcadis were involved for independent quality control. (MT WALTZ) The contribution of these firms was so small that has not been included in the scope of this research.

This created the following organisational diagram in which the main role of the EEF is displayed (see Figure 26).
Design phase

The design, execution and the risks are fully integrated in this project and they are the shared responsibility of the alliance (participants). This provides new demands for the relation between design and execution. The design is required to be fully detailed before it is handed over from the alliance to the contractor (UA) in the work packages. All important decisions already have to be taken by the alliance and processed in the design. This means that the design and engineering have been integrated and focussed on the execution of the project. A close connection and much knowledge about the preferred execution methods of the contractor are necessary.

The decision making on big issues is ultimately the responsibility of the Environmental or Technical Manager and the AMT as they are the only ones mandated to make decisions. However, at the start of the project, the design leaders from the EEF’s had influence in the decision making process because they occupied key positions. (AM WALTZ) During the project it was noticed that “The external engineering firm had much difficulties translating the design into a buildable plan”. Therefore more effort was put into a design which was feasible and cheap to build, in the course of the project. The cost of construction is significantly higher than the cost of design. In general, the management and control of the design shifted towards the contractor in the course of the project. By managing the design, the contractors’ organisation could provide a more buildable design, which was focussed on an efficient realisation. (MT WALTZ)

In practice it turned out that the external rail design leaders had little added value besides having the ProRail qualification. Mainly because the design leaders had little experience with the execution of a project, the managing role of the EEF was therefore limited. The design leaders from the EEF’s were later replaced with people from the contractors’ organisation or self-employed consultants who had experience with both design and execution. The same shift occurred at the level of the engineers, at first there were a lot of engineers from the external engineering firms, later most of the tasks were taken over by the engineers from the internal engineering firm. All tasks that did not involve rail engineering were done by the contractors. (PC WALTZ)

“The quality of the design in the whole duration of the project was not above average, this was true for all designing parties, internally as externally. This does not reflect the effort of the individual designers and the optimisations that have been made.” However this is not very different from any other large infrastructure project, the alliance does not seem to influence the quality of design. The design was not well manageable; there were cost overruns in the design. Most optimisations have been made in large and complex parts of the project, which cannot be attributed to one party, because they were a combination of cooperation, integral design and work planning (Dutch: werkvoorbereiding). “I have a feeling that the contractor (UA) has much more trust in the internal designers than in external designers, especially in the connection between design and execution.” (AM WALTZ)

The deadlines in the alliance were so strict that there was no room for large innovations in the project and the solutions were often conservative. (Designer WALTZ)

The engineering service agreement with the external engineering firms was effective for the optimisation of the project phasing, the technical solutions and the feasibility of the construction. For the specialist disciplines, it is uncertain if the lack of incentives provides the right attitude for the engineering firm as all responsibility is taken away. The biggest risk for this type of agreement is whether the client, in this case the alliance, will get value for money as there is no incentive be efficient funds that are provided. It also removes any responsibility for the design result for the EEF. Because of the incentive, the influence of the alliance management on the external engineering firms was limited.

To be better able to control the design a ‘design board’ (Dutch: ontwerpbestuur) was established, in which the alliance managers discuss the progress and problems of the design. The design board meets once every six to eight weeks and its main goal is to monitor the design and the external parties. That the contractual relation was established between the contractor’s consortium and the EEF (formal position 2) was not a problem as this was only an administrative action. (MT WALTZ) The goal of the design board was better access to the HR and staffing departments of the EEF’s for designers with capabilities that better corresponded with the needs of the alliance.

In the end, the entire design in the alliance has become more expensive, this has several causes, one of which is an optimistic budget planning from the market parties in the tender. The complexity of the project required
experienced personnel which was more expensive than the inexperienced personnel that was previously calculated. (AM WALTZ)

**Back-office engineering**

As a back-office for ProRail, the external engineering firm was predominantly deployed for External Quality Control (EQC) (Dutch: Externe KwaliteitsBeheersing, EKB) under the quality control and construction management process. The secondary tasks that the back-office EEF did were at the request of the alliance. An example of the alternative tasks was at a moment when the other external engineering firm could not complete the design of the (3kV) track and traction power supply, the external engineering firm stepped in and completed the design. (AM WALTZ)

**Added value**

Often invisible in a complex project, the added value that alliance provides is combination of shared risk and the shortening of the supply chain through cooperation between the alliance parties. In the alliance it is possible to connect the product expertise from a subcontractor with the project interests of the client. An example is the fly-over that was built over the highway A4. The fly-over was stylishly designed by the clients engineering firm in the tender, the method for this design would be very costly to construct and cause much nuisance. Very soon in the project it was identified as an opportunity to build it with prefab components and to optimise the project. The client preferred a practical, cheap and nuisance free construction over an aesthetically pleasing design. The solution was a fly-over that was technically very complex as the beams are, bent in two axes, very heavy and installed in a new way. However, it was pre-fabricated and could therefore be installed quick and with less costs and nuisance.

There are two reasons why this is possible in an alliance and not in a normal project. The first reason is that in a normal project it would not have been possible to change the design because the risks are too widely spread and cannot be influenced by the responsible parties. On this project it could be influenced by the right parties because the alliance had taken on the risks and opportunities on aesthetics and permits. The second reason is the short communication lines and supply chain. The maximal cooperation between the alliance organisation, architect, designers, sub-contractor and supplier provided an opportunity to connect the pre-fabricated elements, the aesthetics, interfaces and the traffic. In which the alliance (organisation) was the unifying factor. “The combination of risks and the connection in the supply chain is what leads to extraordinary solutions in order to realise optimisations.” Internally it was realised by the collaboration between the technical and environmental processes, with steering from the contractor in the alliance on costs, phasing and feasibility. This is necessary because the contractor knows best what parts drive up the costs during the vital windows of interruption for the train service. In the initiative to steer the project in a certain direction, the incentives for a party play a crucial role. Only the parties that have an interest in optimisations will push for them. (MT WALTZ)

The added value that the EEF’s have in this project is two sided, first their specialist knowledge of rail & track engineering, secondly their ability to integrate the design of several disciplines. Especially within the several rail disciplines, the EEF’s could connect the individual parts well. (AM WALTZ)
4.7. CASE STUDY 3: OVSAAL - AMSTELSPoor

This section describes the second case study, which is the project Amstelspoor. The methodology of the case study can be found in chapter 2.2.

4.7.1. GENERAL

‘Alliantie Amstelspoor’ (AAS) is the name of the eastern alliance which is built on a longer stretch than WALTZ and has more intersections with other infrastructure. The railway project starts at the station Amsterdam Zuid, cuts through the main Amsterdam business district, train station Amsterdam RAI, an intersection with a large highway junction and ends at train station Amsterdam Duivendrecht. From ProRail the same conditions on nuisance mitigation are used as with the WALTZ project.

ProRail together with the BAM Consortium Amstelspoor (BCA) forms the alliance. BCA consists of several contractors belonging to the BAM Group including their internal engineering and advisory firm that is a stand-alone subsidiary of the contractor. The IEF participated in this project under one of the contractors contracting parties.

Formally, the project consists of two parts, the first started at the beginning of the project in 2010 when it was unknown what exactly had to be designed. The second part started in the summer of 2013 as the project scope was redefined after most of the important decisions had been taken. This scope definition had a large impact on the position and added value of the EEF’s.

4.7.2. CONTRACTUAL RELATIONS

BCA and ProRail are the alliance participants in this project, an alliance agreement and a separate realisation contract. Within the alliance all risks and alliance results are shared 50/50 between the alliance participants BCA and ProRail. The realisation contract only starts after the design has been transferred from the alliance to the contractor (UA).

The IEF is not an official alliance participant because it is not part of the alliance agreement; however it is one of the five companies from the contractor participating in BCA. The IEF is an integral part of the contractors’ consortium (position 3, for reference see Figure 20), therefore it has the same incentives as the rest of BCA and it can be viewed as a part of BCA from a contractual perspective.

The client had decided that all external engineering and subcontractors would in principle be formally contracted by ProRail (position 1 in Figure 27). This was done to create an even revenue stream from both private and public alliance participants. The second reason to position the external parties was to prevent the contractor from imposing an extra risk and management percentage on the work and costs alliance subcontractors.

The external engineering firm had an engineering services agreement with the client of the project (ProRail projects) to provide technical assistance before the tender. This EEF was contracted according to the rules in (position 1 in Figure 27). This agreement was continued in the design phase of the project as the contribution of ProRail to the alliance organisation was smaller than expected.

Phase 1 2010-2013: Position 1 & 2

In the tender, the external engineering firm had a contract with BCA for all rail engineering in the alliance. Despite the preference of ProRail to contract all EEF’s on the client’s side, the contract from the tender was respected and the contract with the external engineering firm remained with BCA (position 2 in Figure 27).
the alliance, the external engineering firm would work under an unlimited engineering services agreement (ESA) (Dutch: regiecontract). This was a conscious decision as there were many scope changes at the start of the project and the engineering costs were very uncertain, therefore the most flexible contract was chosen. (AM AAS)

![Diagram of contractual relations in the first part of the design 2010-2013](image)

**FIGURE 27 CONTRACTUAL RELATIONS IN THE FIRST PART OF THE DESIGN 2010-2013**

**Phase 2 2013-2015: Position 2**

In 2013 when the design progressed, much of the uncertainty and complexity diminished and scope for the remaining rail engineering activities could be established and fixed. The old engineering services agreement between BCA and ProRail was annulled and a new one was made between the external engineering firm and ProRail. This act moved the external engineering firm from contractual position 1 to position 2 (see Figure 28). This was an administrative act which changed the position and incentives; it did not change the tasks and activities of the EEF. As content wise nothing changed, there was no need for a new tender by the client.

The new contract with the external engineering firm would include a maximum target number of hours and price based on the scope, which was connected to an incentive. The incentive was introduced by the alliance parties to provide an incentive to conserve the number of engineering hours put into the entire project. If the number of hours was below the ceiling, all hours would be fully paid and from the remaining hours a percentage would be paid as a bonus. If the number of hours was over the ceiling, all hours up to the ceiling would be paid fully and the remaining hours that the external engineering firm would need to finish the project only a percentage would be paid for.
4.7.3. Practical relations role / added value

**Tender phase**

The external engineering firm assisted ProRail in the initiation and feasibility phase with a sketch and preliminary designs. By tendering a preliminary design for a project on such a scale there was a possibility for optimisations in the alliance. (AM AAS)

The IEF as an internal engineering firm within the contractor has taken on a proportional percentage of the total alliance share in risks and in profit. The IEF is however not an alliance partner as it is part of the contribution of the contractor to limit the amount of alliance participants. This is the first alliance in which an engineering firm has taken on a considerable part of the risk. The IEF has a ProRail qualification for the (civil) sub-structures and together with an external engineering firm it made the price estimates and design for the tender. (AM AAS)

The external engineering firms were hired for two reasons: their knowledge on rail design, which was not available with the contractors’ consortium and to design the civil structures in the project to support the internal designers of the IEF. The EEF that was chosen by the contractor is an engineering firm, which is fully qualified according to the ProRail qualification system. The external engineering firm had a contract with the consortium from the tender phase, with a clause that they would be offered the work in the alliance if the project was awarded to the consortium. (DM AAS) the external engineering firm was involved in the cost estimation of the project engineering budget for the rail design, based on the reference design of another external engineering firm.

The tender proposal by the contractor and the external engineering firm was based on a rough estimation of the entire project, this was dictated by the short time, but was also a tender strategy. The design by the NOP was based on probabilistic estimation and therefore had a wide range, which affected the budget in the project. (DL AAS)

**Alliance organisation setup**

In the alliance agreement, the contribution of personnel by the alliance participants is set at 50% ProRail and 50% private parties. The involvement of the client in the project organisation in practice was much less than the initial percentage that was aimed for. In the setup of the alliance, the approach of the client was too much like traditional D&C project with a corresponding project team. (AM AAS) The contractor had a much larger role in the alliance as they provide the bulk of the personnel.
During the setup of the alliance organisation it was decided that for the design the IEF would be the main supply of knowledge and people from the contractors' side. However, this was not an obligation as the main focus for the alliance was to find the right person for the task rather than the right person from the right organisation. A focus on the right people was according to the alliance principles.

Other engineering firms than those in Figure 29 have also been involved to supply engineers for design, mostly in specialised functions or as design leaders with experience in execution and design. From the engineering and consultancy firm, rail design leaders were hired. The EEF made the preliminary design in the tender but made a more elaborate design for the rail station that is also in the scope of the project. Designing a rail station is not complex technically, as a good structural engineer can calculate the design, but it is environmentally complex with many stakeholders in a limited area. The external engineering firm historically has a lot of connections in the rail world and was therefore requested to design the changes to the rail station. (DM AAS)

The IEF designed and engineered all the sub-structures, which included the foundation and the civil structures. The main external engineering firm provided all rail related engineering works as they were certified to design the track, catenary, rail safety and traction control systems. The EEF was hired for the overall rail design and would assist the IEF with specialised rail and track designers.

The technical process within the alliance organisation is further developed because the main input from the EEF’s is here. The organisation chart was developed in the interviews with the managers and engineers from Amstelspoor (see Figure 30). In the AMT the alliance manager was a person from ProRail, the technical and design manager were from the contractor as the technical expertise was needed in the design. Most of the design leaders (Dutch: ontwerpleiders) are from the contractors organisation because a good connection with the contractor (UA) is needed. The engineers and designers the disciplines except the rail discipline were mostly from the contractor.
Designers in the alliance (PUBLIC VERSION)

Within the rail discipline this was the other way around, as “The EEF was responsible for an integral rail design and provided a full rail design team. As the EEF had a responsibility, they could also participate in the decision making process.” However, the contractor managed the input of the EEF very closely as it had many interfaces with other design disciplines in the project. (AM AAS) Therefore the design leader the rail discipline was from the IEF. The assistant design leader and discipline leaders who coordinated the design of the signalling, power supply, track, platforms, catenary and cables were from the EEF. The specialists were all from external parties, mostly from the EEF’s. As they are the other traditional rail design firms who are fully qualified, they provided a pool of experts. (DM AAS)

External engineers were also hired for other tasks than rail design, but this was done outside the engineering service agreement. If other activities would be included, the scope in the agreement required major changes. (DM AAS)

Design phase

During the tender, the designs of the sub-structures and track-structure were detailed until the preliminary design, while the rail plan (Dutch: alignement) was further elaborated, until the final design. The designs were quite detailed for a project of this scale; however the designs were not optimised in any way because of the lack in time in the tender. (ENG AAS) This provided the alliance organisation with a lot of potential for optimisations but also risks.

The general responsibility for the design of the project lay with the alliance; the final design was therefore almost completely made at the project location. This was necessary for the coordination and interfaces. Only the very specialist production work for the rail design was made externally because it had fewer interfaces and depended on specialist tooling which was only available at the external engineering firms’ office. (AM AAS)

The engineering services agreement (Dutch: regiecontract) with the EEF did not contain any incentives; this meant that an unlimited number of hours could be worked under this agreement. The choice to have an engineering services agreement was made by the client because of the uncertainty in the project scope in the first part of the project (2010-2013) and the optimisation principle. The uncertainty and complexity in the project scope was caused by scope changes. To cope with the uncertainty flexibility was needed for the engineering from the EEF’s.

As a consequence of (ideas for) optimisations, the scope of the project changes continuously. The development of those ideas by the EEF cost time and money, which the EEF’s do not control. Therefore, at the start of the...
project, the responsibility for the integration of the separate designs lay completely with the alliance. The EEF’s left much of the design integration to the alliance organisation, as this was not in the interest of the EEF. With closer and constant monitoring and management from the alliance organisation, the EEF’s design became more integrated. (AM AAS)

The lack of financial incentive in the contract provided a wrong stimulus to (the management of) the external engineering firm. The rail part of the design turned out much more expensive than the alliance and the EEF had anticipated when determining the budget for the engineering works in the tender. When the scope for the engineering could be determined in 2013, the total engineering costs had grown significantly from the tender budget. Therefore a new contract was drafted, between ProRail and the EEF, this time with a clear scope for the remaining works. In the new engineering service agreement, the alliance management team (in consultation with the external engineering firm) set a ceiling for the remaining engineering budget. The ceiling was set low because negligible mistakes had been made first part of the project by the EEF. (AM AAS)

The bonus was attractive for the EEF, however soon after the start it became clear that the target was not a realistic option and the budget ceiling was exceeded in 2015. For the external engineering firm it became a calculation of the costs: even with only a percentage of the rate paid, the large amount of hours would cover the costs. The engineering in the project continue without major problem. After the scope was redefined and the new contract came into effect, the EEF was better manageable by the alliance; therefore it was a useful incentive for austerity. (DL AAS)

The connection with the work planning (Dutch: werkvoorbereiding) is more difficult in the alliance than in a normal D&C project. In a D&C the connection was very close and with a risk allocation in two parts: client and contractor. In the alliance this is more complex as the design is made by the alliance and the work planning by the contractor. However the main problem for the design is that the contractor will require a higher level of detail in the design. The higher level of detail is better for the contractor because it wants minimal risks in his (execution) domain as he is not paid for it, also the contractor wants a higher level of detail, which he then does not have to pay for. (AM AAS) (DL AAS)

**Back-office**

The back-office EEF remained involved in the project out of historic necessity, as they had most knowledge on some design aspects, especially for the design of the rail station. The main role for this engineering firm was however as independent External Quality Controllers (EQC). (DM AAS) The back office engineering firm was hired by the alliance through the client. (AM AAS)

**Added value**

The optimisations are a significant part of the alliance and add a lot of value to the project. In the alliance there is more freedom to develop a design, but this also brings in more risk. For the design it is very important to communicate early with important external and internal stakeholders, through ProRail this was possible and easier than in a normal project. One of the major benefits of the project was to align the expectations and requirements with the operator early in the process. Some optimisations could only be realised by involving the operator in an early stage. The alliance PDM requires more openness, higher productivity and responsibilities for the private parties. (DL AAS)

The key parts of the alliance are optimisation and risk sharing and these two factors can be applied to any size project. The added value of the PDM is largely in developing ideas into optimisations. The commercial attitude by the contractor towards anything in the project was one of the key aspects that made the alliance into a success. This is done by trying to make everything better, cheaper and more functional. (AM AAS)
4.8. CONCLUSIONS

In this section a summary of the case studies will be provided and a comparison between the cases will be made. This will be done according to the same structure of the previous sections, first outline the contractual relations, then focussing on the practical relations and outcomes.

4.8.1. COMPARISON OF THE CASES

In Table 8 all formal relations in the alliance are described, in general: which parties are involved in the project and which incentives for the external engineering firm (EEF) are used in the contract.

<table>
<thead>
<tr>
<th>TABLE 8 GENERAL INFORMATION ON THE CONTRACTUAL RELATIONS IN THE CASE STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public party/ client</td>
</tr>
<tr>
<td>Private party/ contractor</td>
</tr>
<tr>
<td>External EEF (position)</td>
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<tr>
<td>Back office EEF (position)</td>
</tr>
<tr>
<td>Internal EEF (position)</td>
</tr>
<tr>
<td>Pre-tender EEF</td>
</tr>
<tr>
<td>Contract EEF</td>
</tr>
<tr>
<td>Incentives for External EEF</td>
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</tbody>
</table>

There are many differences between the contractual relations with the external engineering firm in the different case studies. Besides, there are also practical different relations between the parties, these can be found in Table 14 in Appendix E. The practical relations are not a direct result of the contractual relations, there is a trade-off between the practical and contractual relations. The contractual relations are chosen, because the external engineering firm has a certain role and added value in the alliance project. In Table 9, the most critical (independent) variables for the relations of the external EEF are compared between the different case studies. The categories are: the procurement process, the influence of the EEF in the decision making process, its contractual position, its role and financial incentives.

From the processes that are described in chapter 3, the processes that have the most influence on the cooperation between the alliance and the EEF are determined. These processes create the conditions for the alliance. The procurement process determines the influence and cooperation early on in the process, while the role in decision making influences the rest of the project. The (contractual) position of the EEF in the alliance determines the interests of the EEF, through the sharing of opportunities and risks, but also its position in the alliance organisation. In the practical relations the role and involvement of the external engineering firms is presented. Finally the financial incentives in the contract are compared in the last category. These financial incentives are extra to the incentives that are embedded in the (contractual) position, sharing risks for example.

Within the categories, the independent variables differ and have an outcome in the project. First the differences are described and in Table 10 the outcomes of the practical relations are presented.
The independent variables influence each other and combined they have an impact on the outcome of the project. In Table 10, the project outcomes for the most important goals of the external engineering firm in the project are presented in a way that they can be compared between different projects. The first goal is to maintain a good control over the costs of the design and engineering done by the EEF, whether an efficient design is made (design versus costs). The second goal is an outstanding design, which is also easy to build. This goal is mainly focussed on creating a design, which is integrated and easy to build for the contractor. The cooperation between the designer and contractor therefore plays a major role in this. The third goal of the EEF is to create a design which can be realised by the contractor within the project budget and still have enough budget left for a positive result for the alliance participants. The fourth goal is to provide (enough) added value to the project, to make it worth the extra interface and effort. Added value can be provided through engineering or project management services. The final aspect is a summary of the previous in which the interest of the EEF in a positive result is determined and compared.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cases</th>
<th>Literature (Australian)</th>
<th>Case study 1 (A2H)</th>
<th>Case study 2 (WALTZ)</th>
<th>Case study 3 (AAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Procurement process</strong></td>
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<tr>
<td>Based on quality</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Based on price</td>
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<tr>
<td><strong>Decision making</strong></td>
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<tr>
<td>Involved</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X*</td>
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<tr>
<td>Not involved</td>
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<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Positions</strong></td>
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<tr>
<td>1 (traditional)</td>
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<td>2 (traditional)</td>
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<td>X</td>
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<td>3 (risk sharing)</td>
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<td></td>
<td>X*</td>
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<tr>
<td>4 (risk sharing)</td>
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<tr>
<td><strong>Role</strong></td>
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<tr>
<td>Engineering capacity</td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>Specialist support</td>
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<tr>
<td>Quality control/BO</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Management/DL</td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td><strong>Financial incentives</strong></td>
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<tr>
<td>Cost reimbursable (CRI)</td>
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<tr>
<td>CRI + bonus</td>
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<td></td>
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<tr>
<td>CRI + bonus/penalty</td>
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</tr>
</tbody>
</table>

* = only in the first part of the project, = change between variables, BO = Back-office, DL = design leader

The independent variables influence each other and combined they have an impact on the outcome of the project. In Table 10, the project outcomes for the most important goals of the external engineering firm in the project are presented in a way that they can be compared between different projects. The first goal is to maintain a good control over the costs of the design and engineering done by the EEF, whether an efficient design is made (design versus costs). The second goal is an outstanding design, which is also easy to build. This goal is mainly focussed on creating a design, which is integrated and easy to build for the contractor. The cooperation between the designer and contractor therefore plays a major role in this. The third goal of the EEF is to create a design which can be realised by the contractor within the project budget and still have enough budget left for a positive result for the alliance participants. The fourth goal is to provide (enough) added value to the project, to make it worth the extra interface and effort. Added value can be provided through engineering or project management services. The final aspect is a summary of the previous in which the interest of the EEF in a positive result is determined and compared.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Case study 1 (A2H)</th>
<th>Case study 2 (WALTZ)</th>
<th>Case study 3 (AAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control of design &amp; engineering costs</strong></td>
<td>Good as the responsibility of the EEF (depended on bonus)</td>
<td>The costs of the design were higher but in line with other projects</td>
<td>Cost control was not a priority; demonstrable mistakes in estimation in tender</td>
</tr>
<tr>
<td><strong>Buildable and excellent design</strong></td>
<td>Was realised by close cooperation (in decision making)</td>
<td>The design that was made was of average quality and further integration was needed</td>
<td>Theoretical design was made in which the alliance had integrate the design</td>
</tr>
<tr>
<td><strong>Design so construction is within project budget</strong></td>
<td>Close cooperation guaranteed a design which was within project budget</td>
<td>A design was realised that is (still) within budget</td>
<td>Scope changes enlarged the budget; design was made so the construction is within that budget</td>
</tr>
<tr>
<td><strong>Provide added value</strong></td>
<td>In all disciplines an integrated design was made</td>
<td>The added value of the EEF in the design management was less than expected</td>
<td>The added value was only in the certifications that the EEF provided</td>
</tr>
<tr>
<td><strong>Interest in positive alliance result</strong></td>
<td>Through the bonus which depended on it, the EEF had an interest in a positive project result</td>
<td>The CRI contract provided no incentive to work for a positive project result</td>
<td>The CRI and the ambitious ceiling in the second part did not provide an interest in a positive result</td>
</tr>
</tbody>
</table>
4.8.2. Differences between the project aspects

In this section not all aspects and goals will be discussed, only the most striking differences that can be found in the comparison will. In general there is a large difference in the setup between the A2 Hooggelegen (A2H) and OVSAAL projects. The OVSAAL projects are very similar, because the procurement process, timeline and the client are identical while the scope is quite similar. The differences between A2 Hooggelegen and the OVSAAL projects are caused by the differences in circumstances in the projects, the client & procurement process, role and position, incentives & responsibility.

Changing circumstances

Several things have changed in the market in the years between the start of A2 Hooggelegen and the start of the OVSAAL projects. The internal engineering firms within the large contractors have obtained a much bigger role in the alliance design. At the start of A2H, there were no major IEF’s, therefore the contractors were dependent on the EEF for the design, but also for the input of several key-personnel for the management of the design. D&C contracts were used more often during this period and most large contractors expanded their engineering departments to integrate the design and construction of those projects better. At the start of the OVSAAL alliances, the IEF’s of the contractors were mature enough to take on a large part of the design and the management of the design. “The extensive input by the EEF’s that occurred in A2H could not have occurred in the OVSAAL projects.” (PC WALTZ) The role of the external engineering firm in the OVSAAL project was therefore much more specialised and focussed on a project aspect than in A2H. The added value of the EEF’s has shifted from being a crucial alliance party, which could link the design to the construction, to a specialised party, which has to complement the contractor and the IEF’s. The shifting of responsibility towards the contractors has even continued after the start of the OVSAAL projects. As at the start of both projects the EEF’s provided key personnel, like design leaders. And in both projects the key personnel from the EEF’s were replaced by design leaders from the contractor or independent self-employed persons6.

Clients & procurement

The different public clients had an effect on the differences in the projects, because they chose the method of procurement and the contracts. The client decides the procurement method and goal, which influences the organisation and thus the entire project. The procurement of A2H was done with a lot of attention, as it was a pioneering project for RWS and the qualitative procurement process meant that there was a lot of effort put into selection of the right (management) personnel. In the OVSAAL projects, the client tendered the project very early and the focus was on fast procurement and selection to start as soon as possible with the project. Because the exact requirements were not known at the start of the project and a major policy change occurred during the start of the project, a lot of scope changes were needed. The scope changes caused cost overruns in the total project, combined with mistakes from the EEF caused an overrun of the design budget for both OVSAAL projects.

It can be seen that in practice, the contractors (consortiums) select the EEF during the tender and bring them into the alliance as support. An important requirement for the selection of an EEF is whether the contractor has a good experience with the EEF. While the client has no specific requirements for the involvement of an engineering firm, except that the private consortium as a whole is qualified according to the ProRail qualification system. (TM PR)

The tender phase is crucial for the relations and incentives in the rest of the project. Arrangements that are made with the external engineering firm in the first phase are often taken along in the rest of the project. These arrangements are set up by the party who hires the engineering firm and not by the alliance itself. The influence of the market on the engineering firms is much larger than the influence of the alliance.

Roles

The EEF is used in a specialised and capacity providing role within all projects; the main difference is the absence of further involvement in the more recent projects. This is already covered under the changing circumstances. The role of project manager in the alliance will be discussed in the next sub-section.

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6 see asterisk (*) in the categories decision making and role of Table 9
The role of both the public clients in the case study projects is too small for the project requirements in such a large and complex project. (Multiple interviewees) ProRail has a corporate goal to reduce a significant share of their personnel and is struggling as rail infrastructure is much more complex and labour intensive than road infrastructure. However, ProRail chooses to outsource the management functions in the IPM model. This is an area of opportunity for external engineering firms to supply key personnel. The role of the EEF in the supply chain of both OVSAAL projects, is quite large as they are hired for multiple parts of the OVSAAL projects while there is not a clear role defined for them in the contract or through the procurement process. The demand for qualified personnel in the alliance organisation for such large and complex projects is very high. The reliance of ProRail on an additional external party is not a desired situation from a procurement and organisational perspective. Practically, on the other hand, the entire market for specialised rail engineering and design in the Netherlands is too small to have real alternative options. The external engineering firm is involved in so many parts of the OVSAAL projects, because they have a lot of knowledge on rail construction. Historically it is hard to change Dutch rail industry, because it was privatised only 15 years ago into several companies, which still have close connections. (PC WALTZ) In case of the OVSAAL projects the client has tried to expand its role through positioning the input of an external engineering firm in a back-office role.

**POSITION, INCENTIVES & RESPONSIBILITY**

The real added value of the alliance according to multiple interviewees is the close cooperation and communication between the alliance and other key stakeholders, which can be summarised as supply chain management. For the supply chain to work properly there is a need for well-composed agreements in which the incentives are adjusted to the role, position and added value of each participant.

The contractual position of the EEF in the Netherlands is not as an alliance participant, but is less involved in the general project. The main reason to refrain from involving the EEF in the alliance organisation is to keep the organisation simple. (Multiple interviewees) The positions (1 & 2) that are chosen in the alliance are not risk bearing. The financial incentives and payment mechanism (cost reimbursement) that are chosen and combined with the position in theory fit well with the alliance as a form of collaboration. The project and the design are very uncertain and risky. An engineering services agreement fits well with these projects, as the need for engineering is very flexible and this contract provides that flexibility. The main downside of reimbursing the costs is that there is a negative stimulus for the engineering firm to put more work in the project than is strictly necessary as they are paid for it anyway.

This was countered with an extra incentive on top of the engineering service agreement in case study 1 and 3 (second part)\(^7\). However, there should also be a reasonable responsibility and involvement in the decision making process, if an incentive is presented to an EEF. This is an important condition for the EEF to have control over the project the incentive.

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\(^7\) see asterisk (*) in the categories position and incentives of Table 9
5 DESIGNER IN FUTURE ALLIANCES

In the previous chapter, the possible positions and roles for an engineering firm in a Dutch project alliance have been determined. The practical cooperation and the added value of the engineering firms have been researched in the case studies. The views on future alliances by the people that worked in the case study projects have also been part of the interviews in the second phase. This information is combined with the open ‘brainstorm’ interviews that have been performed for the third and last phase of the research.

What should the alliance organisation and incentives be for added value from an engineering perspective?

In this chapter the options for involving an external designing party in future project alliances are discussed. This is done according to the possible contractual positions the role and added value of the (external) designer in the project. Key features are the process of procurement and the way in which the risks and responsibilities are shared.

The interviewees are not unequivocal about the added value, role and position that the designer should have in the alliance. Therefore the options for the three factors that are researched are presented together and at the end of the chapter a comparison and number of recommendations are made for different scenarios.

“Huge steps have been taken from the traditional model and the D&C contract towards the alliance in its current form; however the transformation is not yet completed.” (AM WALTZ)

DEVELOPMENTS IN THE INDUSTRY

Besides the trends that can be seen in the entire construction industry in chapter 4, the interviews have revealed more specific trends among the designers and engineering firms. The first trend is that traditionally, engineering firms have been used to work as a service provider and being reimbursed for all costs by the public client, for whom additional work was often not a problem. Roles and positions are shifting; the profit driven contractor is more often the client rather than a public party. For a contractor, the engineering firm has to put more focus in a realistic estimation and have to substantiate their claims to additional work more thoroughly. (AM AAS)

The second trend can be seen with the large Dutch infrastructure construction firms, which have established and expanded their internal engineering firms. The designer in Figure 31 can also be an internal engineering firm. These firms are specialised in civil and geo-engineering and structures to no longer be dependent on EEF’s. “Contractors are in principle self-sustaining, with a large flexible and temporary pool of employees. The design of the sub-structures has become part of the core business of the contractor.” (DL AAS) This was triggered by the emergence of the D&C contracts in which a more integrated approach is required between the design and construction of a project. (AM AAS)

FIGURE 31 MODERN RELATIONS IN CONSTRUCTION
However, some internal engineering firms are now turning away from the integral designing and focusing more on detailed designs for the execution of a project. (DD AG) The internal engineering firms support the contractor (UA). In the recent projects, the IEF has good connections with the contractor (UA) and therefore has to be the principal designing party. The rest of the organisation has to be filled with capable people to get a well-balanced project team, without looking at their background. (MD AAS)

Currently, most positions in the alliance organisation that are not filled by alliance participants are filled in by external engineering firms or independent self-employed experts. The role of an engineering firm in the alliance is not very different from their role in a D&C contract as they either work for the client or the contractor. (DL AAS) The EEF’s have the same incentives and position as in a more traditional project while the alliance participants share risks, opportunities and the results.

5.1. ROLE OF EXTERNAL ENGINEERING FIRMS

“The alliance is mainly an organisational model which makes the decision making process between the public and private party easier. There is a risk that the client in the alliance has an impression of the alliance that is too technical and makes the specialist role the designer too large. The external engineering firms should maximally be involved in the management of the design, not in the entire project management.” (ACQ)

The internal engineering firm of the contractor has the largest role in the design and will probably keep that role as they keep growing and the focus in those firms is on the relation with the execution, which is one of the most important parts of the alliance.

In the previous chapter four different roles are identified, the possibilities of those roles in future alliances are elaborated. The roles for external engineering firms are providing: engineering capacity, specialist engineering support, quality control and project management.

5.1.1. ENGINEERING CAPACITY

The first two roles are focussed on the support of the internal engineering firm of the contractor. The first supporting role is to provide engineering capacity in areas where there is a lack in the internal engineering firms. The designers from the EEF’s perform the same tasks and will work besides the designers from the contractor. In large and complex projects, the demand for engineering capacity can change rapidly and independent (external) engineering firms often have more capacity to deal with these changes. The internal engineering firms are still growing but they are relatively small for all the projects the contractors are involved in. The demand for support in this role will continue to exist in (every) type of project.

5.1.2. SPECIALIST ROLE

The second role for external engineering firms is the specialist role that they now have in alliance projects. “An engineering firm in the position of the EEF in case study 3 is the same as in a normal D&C contract.” The disadvantage of this contract is: the interest of the external engineering firm to work as many hours as possible instead of realising a positive alliance result. (DL AAS) The specialised support that is required is different in every project, but in complex alliance projects there are often specialised part for which the contractor needs support. The involvement of an external EF is needed in the projects in which a large technical component is present or where the technical complexity is even the reason for an alliance. If the technical complexity (of a component) is vital to such extend that the entire project is dependent on the positive outcomes of the technical solution, than there is always an option to expanded the specialist role. It can be expanded towards the EEF as an integral designer or even towards the project management.

In these supporting roles, it is important that the designers from the external and internal engineering firms work well together and know what is expected from them. This added value requires a more extensive cooperation than is common in current projects.
5.1.3. **QUALITY CONTROL**

The third role is that of (external) quality controller. Engineering firms can and already have a role as external quality controllers. Most EEF’s are experienced in this role which is often performed for clients or financial institutions that fund projects. Often the tasks consists of quality control for progress and performance (KPI) checks or the final project acceptance & transfer. (DD AG). This role is also necessary in future alliance projects, but fits better with an EEF which is not directly involved in the design of the project as impartiality is needed for quality control.

5.1.4. **PROJECT MANAGEMENT**

The final role is that of the external EF in the management of the project. There are three options, one as an EPC consultant, an alliance participant and one as a supplier of key personnel to perform ‘client tasks’ in project management. For the first option, the EEF has to take over the risks and integral design from the contractor. The EPC model and its characteristics are contrary to the core alliance principles of equal cooperation and risk sharing.

For the second option the EEF has to know the client organisation very well to be posted in the project organisation for the client for a limited time. The client (ProRail) has to realise and determine on which key-positions it is important to have client personnel. “An alliance manager has to be someone who works and is acquainted with the client (ProRail) organisation.” (PC WALTZ)

For the third option “A possible role for the EEF is to participate as a shareholder in the project and bearing risks. That has to be a percentage that is worth the risk, about 10% or so, and that is a lot. Risk sharing in the alliance is not a natural activity for the engineering firms in the Netherlands. The engineering firms themselves have to work on their business model before participating in a more risk bearing capacity and sharing the pain and gain in a project.” (DL AAS)

When a more managing role is taken in the project and risks are borne by the EEF, there are two main requirements. The first requirement is that there are enough project managers, also as a potential back-up, who have experience with these kinds of projects. The second requirement is an equitable participation and influence in the decision making process in the design phase. If those requirements are satisfied, than the engineering firm will gladly participate in a project alliance. (DD AG)

The engineering firms can take over almost any role but it can and will only do so if enough value is added. Added value for the project is the main concern when adding another party because adding a party also means adding an interface which complicates the organisation and decision making process. Within the project three main roles for designers can be distinguished, supporting the client, supporting the contractor and a project supporting role by the designers. The added value is determined as best-for-project as that is one of the key alliance principles. In the next section, the added value for the design and engineering of the project is presented according to each of the parties.
5.2. **ADDED VALUE OF THE DESIGNER DURING DESIGN**

The power of the alliance is in the connections and the cooperation between the alliance parties. The communication between the public and private parties becomes much simpler in the alliance. “The (technical) design is only a component; the alliance is so much more.” (AM WALTZ) The added value of the alliance is in the large network that it can rely on through the management of the alliance organisation. Those alliance managers are currently employed by the main alliance participants, public party and contractor.

5.2.1. **FOR THE CLIENT**

The exact requirements for the involvement of the client in alliance projects are not clear. However, it is clear that the client was (and still is) numerically underrepresented in the alliance organisation. In theory the client should provide half of the alliance personnel and resources, this is too much for practical purposes, the organisation could do with much less. The current involvement should be extended. During the OVSAAL projects (case 2 &3), gradually more balance was introduced by a more extended the involvement of the client in several key positions in the projects management. In an alliance project there are totally different requirements than in a traditional project, especially on the level of the project management. The choice for a project alliance PDM requires a proper preparation and ability to give configure the alliance by providing capable personnel. (AM AAS) The slimmed down public organisations require external support and will do so in the future as there are no major policy changes that will expand their organisation in the near future.

Added value can be provided by supporting the client with the technical and project management personnel during the entire project. External engineering firms will continue to be essential for the plan study during the feasibility phase, technical advice during the design and quality control in the final stages. An example of an engineering firm that is supporting the client is the EEF in the OVSAAL projects, see chapter 4.

5.2.2. **IN RELATION WITH THE CONTRACTOR**

The contractor’s internal engineering firm has moved towards the role of the traditional engineering firms and now provides the main added value in the design. The internal EF’s are now responsible for the integration in the design and the connection with the execution. The close connection to the contractor (UA) produces a realisable design. (MD AAS) The key to good integration in the design and the high quality in the deliverables from the Internal EF is the easy communication between the Internal EF and the contractor (UA). (DD AG) To match the integration of the internal EF with the rest of the contractor’s organisation is very hard for an external engineering firm.

Therefore the main added value that is provided within the alliance for the contractor is mainly in a specialised role for a specific component or discipline in the project. What often happens in an infrastructure project, which also happened in case 2; during the design the external designing party focuses too much on the specific parts for which they were hired as experts. Within the alliance there is a much higher demand for an integrated design of the infrastructure in the environment. That is why the expertise on integrated design has shifted towards the internal engineering firms. (MT WALTZ)

A design which is practical and easy to build is a key aspect of the alliance. (MT WALTZ) As the internal engineering firms grow further, the internal engineering and execution planning will become more integrated. More design knowledge and further integration the internal engineering firms and the contractor means that the IEF will provide a larger added value and role for the in future alliance projects. However, the IEF can never make the design alone. In case 3 a relatively large internal engineering firm was involved and could not make the design independently as not all design disciplines were available. Therefore a specialised external engineering firm will be a necessity for example in the specialised disciplines (rail for example). The same goes for design leaders, if multiple projects are performed at the same time then the internal capacity will run out and external personnel is needed (see section 5.1.1). (MD AAS)
5.2.3. As external expert

For the design of a complex project, external parties will always have to be involved. If external parties are needed in a project than it is important to minimise the interfaces that are created. (OD RWS)

The added value in relation to risk is the ability of a participant to control a significant part of the uncertainty in a project. Examples of this added value are the possibilities to control design risks or to realise or create an opportunity. An external engineering firm could participate in a risk bearing capacity in an alliance, it is important however to bring added value. The added value of an EEF is dependent on the (added) value and resources that the alliance participants have as the contractor and client are by definition needed to build the project. (MT WALTZ)

Value can be added by an external engineering firm when it can control a project risk which has a large chance of occurring and/or has major consequences for the project result. If the input and added value of the EEF is sufficiently large then the firm will have to get more influence and risk. An example can be the integrated design of the technical installations in a tunnel, which requires integrated specialised technical managing. This part is so critical that it could best be managed by another firm than the contractor, which even can be involved as an alliance participant. (MT WALTZ)

Real added value in the technical design can be created by a good integration of the execution in the design. A well-integrated and realistic design can be made by the engineering by knowing the contractor. Knowing the contractor consists of two parts, knowing the contractors preferred method of execution and project strategy of the contractor. By knowing the preferred methods of the contractor, more realistic designs can be made that are easy to construct. By adapting to the contractors business model and strategy for a project the design and engineering can be done much more efficiently. Examples of a strategy for a project are a focus on less material, shorter execution period and risk control of integrated design. (DD AG) “Strategic cooperation between EEF’s and contractors can help to design and build more efficiently, but only for similar projects.” (DD AG)

On the other hand: problems in project are rarely technical; the alliance creates added value through widely supported decision making not by technical engineering. The EEF’s could create new added value for themselves, by thinking about and developing their business model towards supporting the key aspects of the alliance: the coordination between the project and the environment, the client and the operator of the infrastructure. (ACQ)

If external engineering firms want to expand their role in the alliance to a risk bearing role, they have to create another form of added value. The engineering firms have to redefine their business case and look for new opportunities to support the alliance or become an indispensable alliance specialist. There are limits to the risks and responsibilities that the engineering firm can handle. The ability of the engineering firms to bear the consequences of risks is much smaller than that of the contractor and public client. The risks for the engineering firms are the largest in the design phase. An engineering firm cannot and does not want to bear risk for the consequences of the design (in the execution). (AM WALTZ) (DD AG)
5.3. **CONTRACTUAL POSITION OF THE DESIGNER**

Combining the theory on the role and position of the designer in chapter 3 and 4.2 and the construction industry practices in the case studies in chapter 4 results in the following possibilities (see Figure 32). In this section the possible positions for the designer are discussed and weighed. This will be done by combining the positions and incentives into models which are then compared to each other.

### 5.3.1. POSITION IN THE ALLIANCE

Currently there are four contractual positions for a designer in project alliances to be involved. The theory on all positions already has been discussed in chapter 4.2, position 3 has been split into two sub-positions. The choice for a split has been made to distinguish between the internal engineering firm of a contractor in a consortium in position 3a and the external engineering firm in position 3b as part of the consortium. The internal engineering firm is also active as a designer in the alliance.

**FIGURE 32 CONTRACTUAL POSITIONS FOR THE DESIGNER IN FUTURE PROJECT ALLIANCES**

Practically the options can be categorised into two main roles for an engineering firms, risk bearing or not. The positions are grouped into two models, in which an external engineering firm can be involved in the alliance. The alliance models are a traditional model (positions 1 & 2) in which the external EF bears no or limited risk in the project and a risk bearing model (positions 3 & 4) in which the EEF participates in the alliance. The models are based on the positions of the external EF, but they are also influenced by the role and added value that an engineering firm has in the project.

**TRADITIONAL MODEL**

The difference between position 1 and 2 is limited as it is ‘mostly administrative’ (MT WALTZ) and both are used positions in the Netherlands. The role in the traditional model is usually a supporting or specialist role for the main alliance participants. In general, the contractual positions 1 and 2 are more distant options from the alliance, which means a supporting role, smaller added value and less involvement in the decision making. This is in line with the traditional method of involving engineering firms in complex projects.

The choice for the positions in the traditional model was made because the engineering service agreement has been used many times and creates a simple alliance organisation. In future projects ‘the legal organisation for hiring an external engineering firm have to be as simple as possible for which position 2 is the best option. There are already enough interfaces in the alliance organisation. (MD AAS) By using the traditional model there...
is one less alliance participant to negotiate with. Simplicity in the alliance organisation is an important condition for future projects.

There are three distinct disadvantages to the traditional model. The first is that the external EF is placed outside the alliance organisation without any (financial) interest in a positive alliance outcome. The interests of the EEF are crucially different between positions the traditional and the risk-bearing model. If a company is not involved as an alliance participant it is also not involved in the project opportunities. This provides the wrong incentive as it benefits the external EF when the design takes more time and costs more money. Less involvement also provides none of the alliance spirit. (OD RWS) The spirit and cooperation are the key features of the alliance; therefore it is the second disadvantage. The design would become much simpler if the EEF’s would be further involved and invested in the project as the interests would be better aligned with the project interests. (DL AAS) The last disadvantage is the administrative complexity which is created by hiring an external party in the alliance organisation through one of the participants. Internal settlements and risk margins are often used in standard procedures; therefore it would be much clearer to have a direct relation with the designer.

There are possibilities to combine a non-risk bearing position with incentives to provide extra responsibility (see section 5.3.2).

**Risk & Opportunity Bearing Models**

It is inherent to positions 3 and 4 that risks are borne by the designer in that position. The positions do not differ much in the interests and incentives and they are therefore together in the risk bearing model. In the risk bearing model, the engineering firm takes on a certain share of the risks in the (alliance) design or even in the execution of the construction.

In position 3 the external EF joins the consortium, which means that it will share in the private component of the alliance. Advantage is that the EEF will share in the risks and opportunities which will create an interest for the company in a positive alliance result. An added advantage for the client is that nothing changes in the shares between the public and private components of the alliance, which can stay at 50/50. From the contractual perception of the alliance or the client, there is no difference between positions 2 and 3. For the involvement of an external EF in position 3, a larger contribution and more added value is needed.

There are several disadvantages for involving the designer in the consortium, for the client as well as for the consortium. For the client little will change from a purely formal viewpoint, in practice two aspects change. Firstly, an extra party (with influence in the decision making process) is added to the alliance organisation which complicates the decision making and relations. Secondly the influence of the private consortium grows even further, while they already perform most of the design and have the most personnel in the organisation. Within the consortium the contractors will lose some power as a part of the responsibility and decision making power, which must be handed over the external EF in exchange for a share in the risks and opportunities. The second challenge for the consortium is the internal accounting and division of risk and rewards. The contractor(s) and external engineering firms have a different size and tasks in the alliance which complicates the sharing of the potential risks and results. The allocation of engineering and design tasks will also require good coordination as the internal and external engineering firms will compete for the same tasks in the alliance.

The external engineering firm in position 4 provides a clear role and position for the external designer. The advantage of this ‘golden’ triangle of engineering, construction and commissioning is that all essential parties are represented equally in the alliance organisation. In the project office each party has a clear role and responsibility while the organisation is simple. “From the contractual options for bearing risk position 4 is better in theory because it is more ‘pure’. Otherwise the weight of the alliance (decision making) will shift too much towards the private (contractors) consortium.” (DL AAS) The disadvantage is that the role of designer and engineer also has been shared with the internal designer from the contractor in position 3a. Practically, it is a difficult point for the EEF to share in the project results. (DL AAS) With the standard volume of engineering work of 5 to 10%, a medium-large engineering firm could bear the risks independently for projects up to €100 or €150 million. The largest (international) engineering firms could cope with even larger projects. (DD AG) The procurement for an external engineering firm in the current process is the largest problem, because there has
to be a fair and equal tender process (for elaboration see chapter 5.4). “Position 4 is most progressive and equal when looking at the distribution of responsibilities in the alliance. However this is difficult in the procurement of a project.” (AM AAS)

In the risk bearing model, the engineering firm will become an alliance participant with a significant role in the decision making and management of the organisation. Therefore, significant added value (in the project) by the external engineering firm is the main condition for involvement through this model. The percentage of the risk and the share in the alliance results can be determined in the alliance or consortium agreement (see section 5.3.2).

A shift towards more risk and responsibilities for the engineering firms has already started with more incentives responsibility. “There are a number of engineering firms that would like to take more risk and responsibilities in complex (alliance) projects through Engineering, procurement & contracting (EPC) contracts.” (AM AAS)

5.3.2. CONTRACTS & INCENTIVES

One of the main conclusions of phase 2 of this research was the importance for future alliance in the Netherlands to align interests for the external engineering firm with the alliance (participants). As a portion of the added value of the alliance PDM could be lost when one or multiple key parties in the alliance have another interest than the alliance (participants). (PC WALTZ) Aligning the interests can be done by involving the EEF in a risk bearing position (3 or 4) or by adjusting the contract and incentives within that position. In this chapter contract and incentive possibilities for the two major models are discussed.

TRADITIONAL MODELS

First all possible incentives for the traditional models (non-risk positions 1 & 2) are discussed. The opinions of the experts on the incentives for external engineering firms range from very traditional with no incentives at all: “The EEF’s should be contracted and paid per hour that they worked and nothing more as their role is only very limited. The added value of the alliance is in connecting environment and project, the technological side is not an issue.” (ACQ) In the case studies, traditional model with an engineering services agreement in which the costs are reimbursed did not provide the right incentives for the external engineering firms. Therefore an incentive should be provided that aligns the interest of the external EF properly with a best-for-project interest.

To the other side of the spectrum in which a bonus structure is proposed in which the “bonus of the external engineering firm is coupled to the alliance result” (PC A2H), similar to the structure for the external EF in the project of case study 1.

“Another method for aligning interests and austerity in an ESA (Dutch: regiecontract) can be a limited amount of hours or scope in the project.” (MT WALTZ) This incentive will stimulate the saving of costs in the design phase. However this can be opposed by: “The alliance contract offers room for creativity in the design. For the project it is best to stimulate the creativity of an EEF and make sure that it is not impeded by a (too) strong incentive.” (DL AAS) The incentives therefore have to be weighed carefully to achieve a cost-saving behaviour without restricting the creativity.

Target price

“I am not a proponent to let non-alliance participants bear risk in (a part of) an alliance projects. Because risks and optimisations can best be controlled and managed by the alliance itself.” (AM WALTZ) In the Bataafse Alliantie the engineering has borne risks in the alliance and realising optimisations was very difficult in that project. “From the client perspective I would rather take on the financial setbacks in the design if a part has to be redesigned, because the loss can be recovered by saving on construction costs.” (AM WALTZ) The savings that can be made from a fixed price in the design are negligible when compared to the optimisations in the construction as can be seen from case 3: “The designers are in principle creative people whom you should give enough space within those agreements to be creative.” (AM AAS) A fixed price or ceiling contract within an alliance project is therefore not an optimal option as the creativity is limited and it does not provide the flexibility that is needed for the complexity in the project.
Cost reimbursable

Best-for-project in the alliance would be to involve a designing party and provide the same incentives and therefore the same interests as the client and contractor. In cases 2 and 3 this is done through a contract and agreements (outside those contracts) that should have the same effect as sharing risks as a participant. In practice this seems to work reasonably well, however (administratively) it is a far from ideal situation. (AM AAS) An alternative to risk sharing and a fixed price to align the interests is a reimbursement model in which only a positive incentive is provided. This can be done by providing a bonus or share of the optimisation that was made as part of an opportunity in the design. The bonus should then be provided in case of a positive result for the alliance or design. In this case the (high) risks of the alliance are not shared, but a positive incentive is provided to be creative and have a drive to explore the opportunities in the alliance.

Risk & Opportunity Bearing Models

Equally sharing in the alliance profits provides an incentive that aligns the interests of the EEF with the alliance. However this also implies that the engineering firm has to be seriously affected when the alliance fails and loses money. External EF’s cannot sustain an unlimited responsibility because of their smaller revenues and profit margin, risks for the EEF should therefore be limited. (MT WALTZ) The payment in the contract of the risk bearing model is cost reimbursement at a basic rate and a share in the alliance end result, positive or negative. Because a fixed sum or ceiling price for the in the alliance has two disadvantages. First, a target price has to be determined; this is difficult in a very uncertain project. Secondly, if there are optimisations or changes, which is likely, the target has to be adjusted. “Focussing on reducing the construction costs in the design is more efficient.” (AM WALTZ)

The share that an external engineering firm has in the alliance is a difficulty in both positions (3 and 4) as their reward is then dependent on the alliance result and activities that they performed. Their basic costs will be paid; their share of the result will have to be negotiated before or after the project. This is also dependent on the process and progress of the project. To share the risks equally from the start of the project, the share of the external engineering firm can be made proportionally to the size of the entire project. In normal construction project the share is 10% of the total budget, in an alliance this share can be larger through the extra effort that is put into the design which is made in collaboration. The exact share is than the result of the negotiation of tasks and risks between the internal and external engineering firms.
5.4. PROCUREMENT OF FUTURE PROJECTS

TRADITIONAL MODELS
The procurement for engineering firms in position 1 and 2 can be done through traditional tenders for engineering services. The main requirement for the involvement of an external engineering firm will be a minimal added value for the alliance; the PDM or contract does not have any effect on the procurement process of a firm.

However, when a firm is selected, the selection of the (key) personnel that is required for the alliance has to be performed more carefully than it was in past alliance projects. (AM WALTZ) The requirements for the key personnel are much higher in the alliance because there is more (design) freedom and therefore the responsibility is much larger. Not all people that are technically capable are able to work effectively in the alliance; this applies to all people from all parties in the alliance.

RISK & OPPORTUNITY BEARING MODELS
Positions 3 and 4 have not been used in practice in the Netherlands before and also have not been tendered.

The external EF in position 3 has to be tendered integrally with the consortium; the client aims to procure the integral services of the consortium. The main difficulty is again within the consortium in which an equitable allocation of the tasks has to be made between the internal and external engineering firm, preferably before the tender.

The procurement of the external EF for contractual position 4 is more difficult in the Dutch alliances as the selection is based on a price for the design or on the capabilities of the contractor. In the current quantitative procurement process, the external engineering firm will always either be procured by the public party during an open tender procedure or selected by the private party before the tender. There are EEF’s involved during the tender, the client requires engineering support for the plan studies, while the private parties have to hire an engineering firm to make an estimation of the costs for the design.

If the external designer is procured by the public party, the tender and selection is difficult because the engineering firm has to be procured separately. This provides a problem, because the collaboration between the alliance participants is the most important aspect of the alliance. The private party has to work with an unknown engineering firm, who might have other estimations during the tender than the contractor. (DL AAS) When a new EEF is selected, the knowledge-base of the EEF’s which are already involved in the tender phase will decrease.

While the selection by the private party before the tender is also difficult, because the criteria to award a contract should be clear and equal for all participants so an equitable decision can be made. (DL AAS) If the external EF from the contractor (consortium) would be involved, than the engineering firm would be contracted as a separate third party without a fair tender among other firms. (AM AAS) Which would be politically difficult and the operation of the market would be disturbed.

In the Australian model, the engineering firm and contractor are involved early in the design process and they are selected on their ability to collaborate, based on qualitative criteria. The Australian model therefore offers a solution as the client takes a larger role in the design while the design and selection a process are made parallel. The selection on qualitative aspects counters the policy and procedures of ProRail. In the procurement for Rijkswaterstaat it also has to account for the equitable procurement and the legal procedures, which is politically sensitive for very large projects. Therefore the selection process cannot be brought forward and a traditional procurement is more logical.
5.5. **THEORETICAL DUTCH ALLIANCE MODELS**

The practices and legislation in the Dutch construction industry have a significant impact on the way alliances are used in infrastructure projects. Without the impediment of these conditions there are more possibilities for collaboration within the framework of the alliance. Taking this into consideration, two theoretical models are presented in which assumptions are made about the certain conditions for processes. These models are made by combining multiple positive aspects of the alliance models from the Netherlands and from abroad, without the main practical obstacles that hinder the cooperation between the alliance and the (external) engineering firms at this moment. The goal of this section is to explore the theoretical possibilities for the form of collaboration within the project alliance framework that best suit the needs of the Dutch construction industry.

Conditions for the involvement in the alliance in the Dutch construction industry are:

- Clear role and cooperation with the contractor;
- More simple organisation;
- Option to share and profit from the opportunities;
- Limit (the consequences of) the risks

Within the Dutch model two main options for involving the external engineering firm are identified, the traditional and the risk (and opportunity) bearing model. These models both have advantages and disadvantages. Theoretical model 1 is based on the traditional model (presented in 5.3.1) and is used for projects with a smaller role and added value for the EEF, therefore a position outside the alliance organisation is in order. Theoretical model 2 is based on the risk and opportunity bearing model and is used when the project (outcome) is dependent on the involvement of the EEF. In the second model, the EEF has to be part of the alliance to be fully incorporated in the alliance organisation and fully share the results.

The designers and engineers are creative people whom you should give enough space within those agreements to be creative. (AM AAS) Therefore the contracts have to provide incentives, but not to forcefully.

The procurement process that is used in the latest Dutch alliances is based on a traditional process for D&C projects. The traditional procurement process starts at a point at which the scope of the project is fairly clear and no major scope changes are necessary. This provides less complexity in an alliance project comparing present projects, as the preliminary and detailed designs often already have been made before the tender. Therefore a procurement process with a focus on the price is possible and logical. However, a project alliance starts earlier and often has more complexity than a traditional project. Determining a price based on a design, which has a very high likelihood of changing (multiple times) is not a reliable estimation. Also, the compatibility of the personnel in the alliance is more important for the alliance PDM than the lowest price. Therefore a procurement and selection process based on the quality of the participant is more suitable to the alliance PDM rather than a selection based on the price or budget. An initial selection has to be made on the capabilities of the tendering parties. In the procurement process, the compatibility between the different organisations and people is most important, which has to be the focus of the selection in the second phase. This process should be used for both theoretical models.

**5.5.1. THEORETICAL MODEL 1: TRADITIONAL**

The role and added value is very important for the involvement of the external engineering firm. In projects where a smaller specialised role is necessary, the position of the engineering firm does not have to be risk sharing, as the added value is too small to outweigh the extra interface that is created. The theoretical model 1 is therefore based on the traditional model in which the EEF is hired by the alliance organisation (see Figure 33). To obtain this position, the alliance has to become a legal entity, which requires a change in the current contractual legislation. This is the main assumption for this model.
The contract with the external designer will be an engineering service agreement with a cost reimbursement payment to cope with the complexity of the alliance project. The incentives for the EEF are important as the position inherently causes a negative interest in the alliance result. The incentive is provided by a bonus, which is determined by the key-performance indicators of the entire project and the total alliance result as was used for the EEF in case study 1 by Rijkswaterstaat. This provides an incentive for improved quality and in a positive overall result; it also creates a pain/gain-sharing mechanism in which the EEF has an interest aligned with the alliance participants.

5.5.2. THEORETICAL MODEL 2: RISK & OPPORTUNITY BEARING

From the risk bearing model, the choice for position 3b (Figure 32) as a position for the external engineering firm is most logical. An EEF in position 3 inside the consortium makes the organisation simpler, because there are less interfaces in the consortium which could complicate the process even further (see Figure 34). Also, the current procurement method and relations in the tender with the contractors can be maintained. The main advantage of position 3 over 4 is that while sharing risks, a good integration can be obtained when the EEF and the contractors work well together. The EEF has in interest in the positive outcome of the project and will share in the possible opportunities.

The obstacles that hinder the cooperation can be split into external obstacles, which are identified earlier in this chapter as the traditional roles between contractor, IEF and EEF’s. Internally the integration of an EEF in the consortium will be difficult, as the contractors will most likely resist any changes in the cooperation as the alliance is already very progressive and their influence is diluted. (AM AAS) Besides a share in the opportunities,
Designers in the alliance (PUBLIC VERSION)

the risks will also have to be shared in the alliance by the EEF, which has to be limited for the smaller financial capability of the engineering firms.

Because there are multiple obstacles, there are conditions for the involvement of the engineering firm in position 3. One of the major problems that was identified, was the cooperation and added value between the internal and external engineering firm. These parties have a difficulty in finding each other’s strengths and using these accordingly as their expertise is very different and may not have cooperated on projects before. A strategic cooperation between contractor and EEF over a longer term would be a method to get to know each other’s strengths and weaknesses. The strategic cooperation can range from multiple projects in the same discipline to a joint venture or integration of departments through a merger. By doing this, the consortium can provide an integral solution for all key roles and more added value in the alliance.

To provide an incentive for creativity, while at the same time saving costs, the costs of the EEF should be reimbursed. The risks, opportunities and results should be shared proportionally to limit the risks to which the EEF is exposed to. The share should be determined as a percentage of the risks, which will be proportional to the tasks and revenue that the EEF will contribute to the alliance.

5.6. COMPARISON OF ALLIANCE MODELS

For the clarification of the main options for the involvement of an external engineering firm, which are identified, the different options have been compared. The options that are reviewed are the Australian model from chapter 3, an aggregation of the most recent Dutch model from chapter 4 and the theoretical model as presented in section 5.5. The main alliance principles and the (contractual) incentives are presented in Table 11 and compared for each model. In Table 12 the theoretical outcomes of the models form Table 11 are presented. The outcomes are considered from a best-for-project perspective, which is in line with the alliance principles.

The options in the columns of Table 11 and Table 12 are the models that were encountered in the Netherlands, the Australian model and the two models in which the positive aspects of the other models have been combined into a theoretical model. The first model is the Australian model, which is the most pure risk bearing option (positions 4). In this model the engineering firm has a large role and significant added value for the project, a condition is also substantial (financial) risk bearing capacity.

The second model is the Dutch alliance model for EEF’s according to ‘traditional’ engineering service agreement without any incentives or risk sharing. The role and added value was smaller than in previous projects and therefore the involvement was lower. This model was used in the most recent projects by ProRail, as in case studies 1 & 2 and the Waardse Alliantie. The general characteristics are combined in the current Dutch model.

In the third theoretical model the EEF is not a risk sharing alliance participant (position 5) and has no significant added value. The incentives provide the alignment of the interests through a positive-only-bonus, a bonus structure that depends on the alliance result with only a positive incentive.

The second theoretical model requires substantial added value, which is combined with a larger role (in decision making) and a position as an alliance participant (position 3b). This option is mainly theoretical because of the extensive cooperation between the IEF & EEF that is required.

Table 11 is based on the comparison in Table 9, the aspects to which the different options are compared can also be found there. The first two aspects are main alliance principles (from chapter 3.1), which can be passed on to the alliance participants. The second aspects (role and position) are practical characteristics for the model. The last category of aspects relates to the incentives within the alliance agreement.

Further explanation on the rows in Table 11 can be found in chapter 4.8.1
### TABLE 11 COMPARISON OF THE MODELS FROM CHAPTER 3 (AUS) AND 4 (DUTCH) WITH THE THEORETICAL MODELS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cases</th>
<th>Australian model</th>
<th>Current Dutch model</th>
<th>Theoretical Model 1 (trad.)</th>
<th>Theoretical Model 2 (risk)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td><strong>Cases</strong></td>
<td></td>
<td></td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Procurement</td>
<td>Based on quality</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>process</td>
<td>Based on price</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decision making</td>
<td>Involved</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Not involved</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Positions</td>
<td>1 (traditional)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 (traditional)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 (risk sharing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 (risk sharing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 (traditional)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role</td>
<td>Engineering capacity</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Specialist support</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quality control/BO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Management/DL</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial</td>
<td>Cost reimbursable (CRI)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>incentives</td>
<td>CRI + bonus opportunity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CRI + bonus/penalty</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The rows in Table 12 are used to compare whether the general alliance principles and incentives are transferred to the external engineering firms. There are six aspects; the first aspect is an interest in a positive alliance result, which is of critical influence on the relation with the engineering firm. The second aspect is the control of the design and engineering costs by the EEF internally, while the third is on the control of the total project costs in the alliance organisation. The fourth aspect covers the interest of the EEF in the design, which is easy to build for the contractor and provides adequate quality for the owner. The fifth is about the level of added value the EEF provides, and whether it is significant. The last aspect is added in this table to compare the relation IEF-EEF. The relation IEF-EEF was not an issue in the previous comparison. If both the internal and external engineering firms are involved, do both parties have the same interest in the project and will they compete for the same tasks? If so, this could negatively affect the collaboration between the EEF and the IEF/contractor.

The involvement of the external engineering firms, as presented in Table 11, theoretically leads to the outcomes in Table 12. A plus (+) in the comparison means that the incentives have a positive relation with the outcome, a minus (-) indicates that the incentive has a negative relation with the outcome. A null (0) means the incentive does not impact the outcome.

### TABLE 12 COMPARISON OF THEORETICAL OUTCOMES FOR THE EEF’S

<table>
<thead>
<tr>
<th></th>
<th>Australian model</th>
<th>Current Dutch model</th>
<th>Theoretical Model 1 (trad.)</th>
<th>Theoretical Model 2 (risk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest in positive alliance result</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Cost control of engineering costs</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Cost control of total project costs</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Buildable &amp; qualitative design</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Provide significant added value</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Aligned interest with Internal EF</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

---

9 Further elaboration on the first five aspects can be found in chapter 4.8.1

---

Designers in the alliance (PUBLIC VERSION)
The first aspect is the most important, whether it is in the interest of the EEF to have a positive alliance result. Only in the Dutch model there is a clear (theoretical) interest of the EEF to have a longer project with more (design) costs as more revenue can be made. In the other options it is in the EEFs interest to have a positive result as their bonus or the share in the profit is related to it. From the interest in the total alliance result a split can be made into two sub-aspects: an interest in the cost control of the engineering and design and the total project costs.

The incentive for cost control in the design and engineering is related to the first as fewer costs mean a higher alliance result. Both risk and opportunity sharing is done in the Australian and 2nd theoretical model, but not in the traditional model. The bonus in the first theoretical option is only rewarded with a positive result, while no penalty is set in case of negative risks; therefore the space for creativity and optimisations is preserved.

The control of costs for the total construction is important for the risk bearing models, as the alliance result is dependent on it. In the traditional models however this is of secondary interest. The traditional models have a clear cut scope and are managed on the total outcome or their performances in the alliance design. The EEF’s therefore having no direct incentive to realise a cheap design.

A design, which is easy to build as well as qualitative, does not benefit the EEF in current model. In the other models, there are incentives to ensure an integrated and qualitative design.

A requirement of the risk and opportunity bearing models is a significant added value that the EEF contributes to the alliance, therefore the relation is positive. If the EEF is involved as a non-participant, than the added value does not have to be significant as no extra interfaces are created in the alliance organisation.

The internal and external engineering firms have to complement each other; this is possible in the traditional model as the EEF is contracted for a specific part of which the scope is determined. In the Australian model the contractors internal engineering firms do not have such a large role and influence in the alliance. The design is mainly made by an independent engineering firm in collaboration with a contractor, the interface is therefore not present in that model. In the second theoretical model, the IEF and EEF will be each other’s competitor for engineering services, this is a potential for a conflict in the alliance. The relation is therefore negative.

The traditional Dutch procurement process can be kept with all models except for the Australian model. The selection of the EEF is very important for the client (equal opportunities for EEF and operation of the market) and the contractor (influence on the choice of EEF). In the Australian risk bearing model a new process has to be established.
5.7. CONCLUSIONS

The added value of the external engineering firms (EEF) in current projects is the supply of specialist knowledge for the design and engineering. The contribution of specialists will also be needed in the future, because the internal engineering firms are more generalist. The current contractual positions are mostly derived from historical positions of the firms in projects. Whether the position of the engineering firm in current alliance projects fits with the role of designer is debatable. Some experts think that the contractual position and incentives of the EEF’s should be aligned with the rest of the alliance and move the EEF’s towards positions 3 and 4. The EEF’s should therefore get more responsibility, bear risk and share in the alliance result. There are however large practical drawbacks to these positions in relation to the procurement and cooperation with the Internal Engineering Firms (IEF). Another point of view is that their (technical) role should not be overestimated and that their role and responsibility should be kept limited. A limited role of the EEF’s is more similar to the traditional methods and creates fewer interfaces in the already difficult contractual and practical relations in the alliance.

On top of the contractual positions that influence the role of the engineering firms, the incentives that follow from the contracts can also have a major impact on the interests. Independent of the position, an incentive can be added to the contract with an engineering firm.

The experts that recommend a limited role for the EEF’s (in position 1 and 2) are divided on the incentives. Some experts think that any incentive on top of an hourly rate could limit the creativity of the designers, while this can create large added value in the construction of the project. And paying them in a traditional manner gives them enough incentives to provide the right support for the project.

Other experts think that the interest of both the engineering firms should be aligned, as the budget for the design in the alliances is relatively large because of the size of the projects and uncertainty of the scope. A large fund and much uncertainty do not provide the right incentives to an external party who has no interest in a cheap design. By sharing the risks and opportunities or connecting a bonus to the alliance result, the interest can be aligned.

In the Australian model, the incentives and interests of the designer are fully aligned, as there are no obstacles in the procurement, cooperation or added value of the design. In the Dutch construction industry for the involvement of the EEF, there are a number of difficulties, for which several conditions are identified:

- Clear role and cooperation with the contractor
- More simple organisation
- Option to share and profit from the opportunities
- Limit the (consequences) of the risks

With these conditions and the input from the experts, two theoretical models are created. The models are made by combining multiple positive aspects of the alliance models that exist in the Netherlands and abroad, without the main practical obstacles, but taking into account the market conditions. The theoretical models 1 and 2 are a step towards the Australian model in which the interests are completely aligned.

Model 1 is based on the traditional Dutch model for involving the EEF in the alliance, for a project with a limited scope, role and added value for the EEF. The position\textsuperscript{10} is therefore outside the alliance, but incentives for aligning the interest are created by providing a bonus based on the positive result of the alliance and the performance of the EEF.

Model 2 is based on a risk bearing involvement in the (contractor’s) consortium, for a project in which the EEF has an important role and significant added value. Both positions create a simpler organisation than the current organisation, however the position\textsuperscript{11} and the integration in the consortium creates a better

\textsuperscript{10} Position 5 is chosen for model 1
\textsuperscript{11} Position 3b is chosen for model 2
cooperation between the IEF and the EEF. The influence is increased, because there has to be an exchange between the bearing of risk and the influence in the design. For the current market, the consequences of the risks for the EEF have to be limited to remain in the capabilities of the alliance. The risks can be limited by providing the EEF with a proportional share in the alliance.

By making the organisation simpler, providing the EEF with a more clear role and cooperation, giving them an incentive so their interest are aligned and limiting their risks, the interests of the EEF are more aligned with the project than they were before.
6 CONCLUSIONS & RECOMMENDATIONS

Infrastructure project alliances in the Netherlands have been studied in this thesis. The main focus of the research was the role, position and added value of the External Engineering Firm (EEF) in the alliance. The first part of the research is done by performing a comparative literature study of project alliances in Australia and in the Netherlands. The second part of the research is done by conducting various interviews with (experienced) experts of current alliances and exploring the possibilities for future projects. The following chapter outlines the conclusions that are drawn from the research that has been performed.

6.1. DESIGNERS IN DUTCH ALLIANCE PROJECTS

Q1. What are the characteristics of infrastructure project alliances in the Netherlands?

The concept of the project alliance as a project delivery method (PDM) has been imported from Australia, where the PDM has been used and improved on a significant number of projects. When the alliance was brought to the Netherlands, not all aspects were directly copied. Dutch project alliances have similar characteristics and principles, but there are many differences. Differences can be found mainly in a more conservative organisation, procurement and reimbursement in the Netherlands. In the organisation, fewer parties are involved in project alliances in the Netherlands than in Australia; this has a historical origin as the first project alliance was set up as an experiment with as few parties as possible in order to reduce complexity. There is also a big difference in reimbursement between the Australian and Dutch models. The focus in Australia is more ‘excellence oriented’, which means that all direct costs are reimbursed and bonuses are available if value is added to the project or nuisance is limited. In the ‘risk mitigating’ Dutch model there is a more conservative approach, which focuses on the avoidance of risk (for the client) by procuring through a fixed price for the entire project. The incentives in the alliance are aimed at limiting extra costs by providing a functional design with minimal quality. In the procurement the Dutch alliances have also been conservative as traditional procurement processes have been retained.

The two main goals of the alliance are to align the interests of the participants and to create conditions for equal cooperation. The project alliance as a project delivery method has not been used very often in the Netherlands, therefore it is still considered an exceptional tool for creating a project and it is also still treated as an experiment. The public client has to put a great deal of effort into a project to ‘upgrade’ it to a project alliance and find a suitable project manager.

Project alliances in the Netherlands cannot be viewed separately from the shifting market conditions that have occurred in the construction industry in the past 15 years. Project alliances have been adapting to the changing sector in the relations between contractors, clients and designers. These changes were instigated by the development and increased use of design & construct contracts around the year 2000 which caused a distance between the client and the private sector. Around 2010, with less effort by the clients in construction projects, the large infrastructure contractors established and expanded their internal engineering firms. The internal engineering firms are fierce competitors of the external engineering firms in some disciplines. And as the contractors start to design and work more integrally, they are becoming more influential in the design phase of large infrastructure projects by taking on more tasks and responsibilities.

6.2. ROLE, POSITION AND ADDED VALUE OF THE DESIGNER

Q2. What is the role, position and added value of the engineering firm in alliance projects?

The design phase has a major role in an alliance project as most decisions and optimisations are made in this phase. The only parties that have real influence in the decision making are the alliance participants, which in
Dutch alliance projects are the public client and the contractor. Both are supported by engineering firms, the clients often hire an external engineering firm to assist with the design in the plan study and tender phase, while currently the contractor often has its own internal engineering firm. In the recent project alliances the internal engineering firm is the main designer. Most design work is performed by the alliance participants, in order to reduce costs and complexity in the communication between designer and contractor. External parties are still needed for specialist design disciplines and to supplement the capacity where the internal firms lack. Currently the external engineering firms in current projects are hired in the alliance by either the client or the contractor. Their contractual relation starts in the tender phase to assist either party with the initial designs and the estimation of the project costs.

In earlier project alliances, which started before 2010, the EEF’s had a major role in the design. The EEF provided key-personnel and all designers in the alliance. As the only party that provided knowledge they had significant added value in the project and responsibility accordingly. The contractual position was traditional (see designer (1) & (2) in Figure 35), hired through an Engineering Services Agreement (ESA) (Dutch: ‘regiecontract’). The EEF shared in the alliance result through a bonus which was dependent on a positive result. This facilitated the alignment of the interests of an external party with the alliance participants.

FIGURE 35 POSITIONS OF THE EEF (TRADITIONAL: 1/2/5, RISK BEARING: 3/4)

From 2010 on a shift can be seen, in which the role of the main knowledge provider shifted from the external to the internal engineering firms. The incentives that were created for the external engineering firms were more traditional with standard engineering service agreement in which the costs were reimbursed. Therefore the external designers had no interest in a positive alliance result. The expectations for the external designers were high; however these expectations had to be adjusted as the deliverables were less integral and of lower quality, therefore the management of the design had to be tightened. This was done by installing a design board and design leaders from the EEF’s were replaced with design leaders from the IEF, or by (self-employed) independent experts. By doing so, the alliance management gained more control over the input of the EEF’s to correspond to the alliance requirements. The role of the EEF’s during the design was getting smaller and their new position in the alliance gave them less influence in the design. In general, the interest of the EEF did not align with the interests of the project and the alliance participants.

The role and position that the alliance firms had in the past were based mostly on other project delivery methods, from which the same incentives have been used. The choice for this form of collaboration was mostly because it was familiar and often used. The alliance parties are satisfied with the results of the alliance projects; however the role of the external engineering firms can be improved.
6.3. FUTURE ALLIANCES & RECOMMENDATIONS

Q3. What should the alliance organisation and incentives be for added value from an engineering perspective?

There are several options for how the EEF can be involved in future project alliances. First of all, at least four positions have been indicated above in Figure 35. In addition to this, several (positive) contractual incentives in the form of profit sharing or bonuses could be taken into account. However, by creating another form of cooperation an extra interface can be created in the already complex cooperation. To prevent adding complexity, several conditions (improvement over the current models) for the involvement of an external engineering firm in the alliance in the Dutch construction industry are identified:

- Clear role and cooperation with the contractor
- More simple organisation
- Option to share and profit from the opportunities
- Limit the (consequences) of the risks

Australian model

The Australian model can be taken as an ideal benchmark, in that option the external engineering firm is added as a third party to the alliance participants (position 4 in Figure 35). In this so-called ‘golden triangle’ a public organisation or owner (client), contractor (builder) and engineering firm (knowledge) are equally involved. This is the most ‘pure’ form of cooperation in which the alliance participants have a clear role and position in the alliance. Besides clear added value to the project, the ability of the engineering firm to manage, control and carry the consequences of the risks is a key requirement for cooperation in this model.

The Australian model cannot be used at this moment because there are too many obstacles in the Dutch construction industry. First of all, the external engineering firms cannot provide enough added value to outweigh the disadvantages of an extra interface in the alliance. Secondly, the interests of the internal and external engineering firm (contractor) will clash since they will compete for the (some) of the same tasks and responsibilities. Thirdly, the cooperation between the parties could be a challenge because of the general cooperation and the method of procurement.

Theoretical models

To align the interests of the EEF with the project and comply with the conditions for improvement, two (theoretical) models have been developed. The first model is aimed at projects in which the designer has a smaller role, the second on projects in which the designer is a key party with significant added value.

In the first model the ESA is traditionally involved without bearing risk. The contract is an engineering service agreement, in which incentives are included to align the interests. By combining the ESA with a bonus, the flexibility and focus on quality from the ESA is not changed, while at the same time providing an incentive for spending hours efficiently. It is based on a model which worked well previously, because the position is well known, the design is strictly managed and only a specialised supporting role is needed. The engineering firm is hired by the alliance (position 5 in Figure 35) this position is chosen to simplify the organisation. The position is theoretical because it requires a change in legislation to make the alliance a legal entity.

In the second model, the EEF is involved as a risk and opportunity bearing participant. In this form of collaboration the external designer is part of the (contractor’s) consortium (position 3 in Figure 35). The EEF shares in the risks, opportunities and results of the consortium, and therefore also shares in the risks of the alliance. By sharing in the results, the EEF has the ability to profit from any optimisations, so the interests are aligned. To obtain optimisations, the internal and external engineering firm will work beside each other and cooperate.

In the second model an extra interface is added in the alliance which complicates the organisation. With an equal public private share, the influence of the contractor in the alliance and the consortium is diluted. Therefore, significant added value has to be provided by the EEF to make the extra effort of involvement worth
the trouble. This organisation form is theoretical in the Netherlands, because the difference in size between
the parties and the cooperation and allocation of tasks between them is a potential hazard for the internal
organisation of the consortium.

Both models could be used for future projects successfully, there are however conditions to make them
realistic. The first model is dependent on the change of legislation, but could also work with a slightly more
complicated organisational model (position 1 or 2). The second model requires more changes by multiple
parties. Firstly, the EEF has to search for and provide (more) added value to the project. Secondly, the EEF has
to be able and willing to bear a significant portion of the alliance risks and opportunities. Thirdly, the contractor
has to be willing to share influence in the alliance organisation and decision making process. And finally, the IEF
and EEF have to know each other and be able to collaborate well.

6.4. ANSWER TO THE MAIN RESEARCH QUESTION

The main research question of this thesis is formulated as follows:

What is the role, position and added value of engineering firms in Dutch infrastructure project alliances currently and what should it be in the future?

The role, position and added value of the external engineering firms are researched through a literature study
and an analysis of case studies of several projects.

The market conditions and historic relations between parties in the construction industry proof to have a
significant impact on the organisation of the alliance. The role and position of external engineering firms has
changed little from the now ‘traditional’ D&C contract. The contractors take the lead in the design and project
management of the alliance, while the external designers provide support through specialist knowledge and
engineering capacity. The involvement of the EEF remains limited to a position outside the alliance and has
therefore no interest in a positive (alliance) project result and no incentive for cost control. This in turn causes
higher engineering and project costs (see column 2 in Table 13).

A bonus structure that depends on the alliance result with only a positive incentive could be an improved
incentive to align the interests. In this model (model 1), the leading role and main added value for the design
remain with the IEF and the contractor. While the EEF can share in the opportunities of the alliance and an
incentive for cost control is introduced (see column 3 in Table 13).

Depending on the ambitions of the external engineering firm, it could gain a larger role and more
responsibilities through gradual changes added value and cooperation with a contractor. Through which
project alliances in the Netherlands may evolve to a point that external engineering firms can become alliance
participants. However in the light of the research that was done, this is not considered realistic for the near
future as the alliance participants are still looking for the right way to work in alliances. The public clients are
searching for the right method and framework to apply the alliance PDM. While the contractors are not really
open for cooperation with the EEF and competition with the IEF is foreseen to occur (see column 4 of Table 13).

Until the project alliance is settled as a project delivery method as any other, DBFM, D&C or RAW contract, the
role, position and added value will remain fairly traditional.

| TABLE 13 COMPARISON FOR THE INVOLVEMENT OF THE EEF |
|--------------------------------------|-------------|----------------|-----------------|----------------|
| Interest in positive alliance result | +           | -              | +               | +              |
| Cost control of engineering costs   | +           | -              | -               | +              |
| Cost control of total project costs | +           | 0              | 0               | +              |
| Buildable & qualitative design      | +           | -              | +               | -              |
| Provide significant added value     | +           | -              | -               | +              |
| Aligned interest with Internal EF   | 0           | +              | +               | -              |
6.5. DISCUSSION OF THE THESIS

In this section the conclusions and research (methods) are discussed. First the conclusions of the research are discussed: ‘What is the value of the conclusions?’. Secondly the research and the methods that were used are discussed: ‘How did the research (method) influence the conclusions?’. The possibilities for future research are also indicated in the next section: ‘What needs to be done in order to strengthen our understanding of these forms of collaboration?’.

6.5.1. DISCUSSION OF THE CONCLUSIONS

Project alliances are only used by the large public clients in the Netherlands, there is not a large support within those clients for forming project alliances for various reasons (Rahat, 2014). The public clients have used many new project delivery methods with varying degrees of success in the last 15 years and project alliancing is not a priority. In general the possibilities for research into project alliances are limited as only eight infrastructure project alliances have been initiated thus far. The number of potential projects is also low as only a few large projects are initiated every year, of which not more than one is selected as project alliance. Therefore the number of potential cases and current expertise in this field is limited.

The research adds to current scientific literature by providing new insights into the mechanisms (of the organisation) of the alliance. On large scale the interests of the parties in project alliances are determined. On a smaller scale, the relations and roles of the designers in the alliance organisation and project office have been explored. New case studies have been performed into the most recent project alliances in the Netherlands. This research can also add to the internal reviews that have been performed by the alliance participants and provide an impartial view on a specific part of the alliances.

The societal relevance of this thesis is found in the provision of information to organisations in the construction industry. The conclusions of this research can support future clients and alliance participants in choosing the right contractual and practical relations for the involvement of an engineering firm in the alliance. By involving the designing party with the right incentives, their interests can be aligned with the (project) goals, thereby limiting possible misalignments and cost overruns. It can also help engineering firms to obtain a position and role in the alliance that fits with their ambitions and goals.

Some of the interviewees did indicate their own reasons for participating in the research, which are mainly concerned with promoting the project alliance. Many or all of the interviewees are, for their employment, dependent on the continued use of project alliances in the Dutch construction industry. Therefore they could have their own strategic reasons to promote project alliances and omit the disadvantages of the project delivery method. These aspects can influence the information input and therefore also the conclusions of this thesis.

6.5.2. DISCUSSION OF THE RESEARCH (METHODS)

The conclusions for the first sub-question, on the characteristics of the alliance, are based mostly on the initial literature study. Most of the literature on the characteristics of project alliances in Australia is fairly consistent as the model is applied more often and according to the same principles and often even the same client(s). The literature on project alliances in the Netherlands is less consistent, because the research that is done into Dutch alliances lacks a proper number of cases to provide a consistent result. The inconsistencies in the alliance projects are caused by a small group of cases which are also performed by different clients and have had different incentives, compositions and structures. This has made modelling in the literature and in this thesis more difficult.

Some alliance projects have ended already 12 years ago, so the people that worked in past alliances have moved on. The time that has passed makes obtaining information and approaching experts extra difficult.

The choice for the research method of open interviews in the first phase of the research into the characteristics was made to gain insight into the barriers in the alliance. Through the open interviews important information was gained, however it also provided biased information as the initial research approach was founded on a limited opinion.

The interviews for the second phase focused on determining the role, position and added value of the engineering firm in the alliance were done through semi-structured interviews with experts. The questions that
were used may have been coloured by the researcher’s opinions, preferences and limited knowledge at the time of the interviews. The sample size of the experts in this phase is limited due to time constraints in the research.

The results of the interviews cannot be generalised to all alliance projects. The opinion of the experts does not reflect the opinion of all persons that work in the same role and function. Nor do the interview results reflect the opinion and views of the company or group of companies.

The research on the future options for designers in alliances are based on the interviews done in phase 2 and the purposefully conducted open interviews in phase 3. By combining the information of those two phases a framework is constructed for the possibilities on how to involve an external engineering firm in a project alliance.

The goal of the open interviews was to come up with new possibilities through a brainstorm. This provided some new insights but not many new options or possibilities for the involvement of the designers in a way that was new.
6.6. RECOMMENDATIONS FOR FURTHER RESEARCH

In this section the possibilities for further research into the subject are discussed. This list is established based on the questions in the research that remain unanswered and the limitations in the discussion. Therefore, further research can be done on the following:

- The optimal method for the procurement for alliance projects in the Netherlands?
  - Further research into the difference between fixed price and qualitative procurement

- What is an equal share in the alliance for an external engineering firm when proportionally sharing risks, opportunities and alliance results

- A framework for public clients in which the alliance PDM can be applied.

- A new business case for engineering firms in complex projects, by determining the added value that is required from the external engineering firm for the risk bearing involvement in the alliance.

- Whether the current alliance incentive (a 50-50 risk share) is effective for the alliance participants, the contractor and client

- Is the approach and scope of Dutch project alliances integral enough? Are all aspects of a construction project fully applied in the alliance and are the right parties involved?

- Can strategic alliances between private parties bring added value to project alliances?

- Research into the views and aspirations from a wide range of designers and suppliers on the involvement in project alliances.
REFERENCES


ProRail. (2010). Alliantieovereenkomst "OV SAAL Zuiderak West".


Ridder, H. d. (2009). *Design and Construct in Civil Engineering*

*Lecture Notes CT5981*: TU Delft.


Appendix A. Demarcation & definitions

**Integrally contracted projects** (integral projects) – In this category are all project projects that have a project delivery method that do not fall under the traditional design-bid-build (DBB) contracts that are common in the Dutch construction industry. Examples of these relative new and ‘innovative’ contracts are Design & Construct (D&C), Engineering, Procurement & Construction (EPC), DBFM and Alliances.

**Alliances** – Project alliances will be the focus of this thesis, but as ‘pure alliances’ have not been practiced in the Dutch construction industry, the Dutch version of project alliances are researched instead.

**Projects sector** – The projects that will be researched are larger and more complex civil works (infrastructure, hydraulic structures). And as a comparison projects in the energy sector (oil & gas and renewables industry) can be used to investigate private alliances in complex projects.

**Risk management** – Not all risks can be managed from a technical and engineering perspective technical, financial and juridical risks will be examined, the other common types, such as management, market, policy and political will be left out of the scope as these risks are less relevant for this research project.

**Project phases** – The time scope will be on the plan and design phases of project out of the following phases: Initiation, Definition/Plan, Design, Execution, Completion/handover, maintenance, and end-of-life. In the research, the interface with the execution is an important condition as the design phase in an alliance often overlaps with the execution.

**Alliance participants** – parties that are involved in the alliance risks bearing and can be divided in clients/owner and market parties/non-owner participant (NOP)

**Alliance parties** – These are all parties that are directly involved in the project without bearing significant project risks. This can be market parties in the entire supply chain in the building industry but also (semi-) governmental that have a significant participation in the project. Market parties can be: contractors, subcontractors, suppliers, engineering firms and advisory firms.

**Clients** – The clients in the civil construction industry are usually governmental parties as they manage almost all large infrastructure and civil objects in the Netherlands. Clients are the larger governmental clients in the Netherlands (RWS, ProRail, provinces, water boards).

**NOP** – These are private companies in the civil construction industry that execute the practical work for the client and bear risk for the design as well as for the execution. This is usually one or multiple contractors that cooperate in a consortium form.

**Other market parties** – The parties and organisations that work in the alliance but are not alliance participants and do not share directly in the project risks and opportunities.

**Joint risk management** – Risk management performed jointly in integral projects by the client, contractor and or the engineering consultant.
Appendix B. Research methodology

Research framework
First the conditions for the research have to be investigated found in the existing literature on the organisation and contractual relations of the different project alliances in the Netherlands. The main research is done on the role and added value of engineering firms in the alliance. To do so the responsibilities and cooperation in the project team and with the separate parties in the project alliance will be determined. Within the engineering firm, the added value and conditions for working in an alliance will be analysed. This will result in overview on how the alliance works and what role the designer has in current alliances. Finally the results will be input for recommendations for future alliances. See the framework in Figure 36.

FIGURE 36 RESEARCH FRAMEWORK

The formulation of the research framework:
A study of the risk allocation is based on:

- a literature review of relevant scientific literature (collected on the basis of benchmarking);
- analysis (of contracts) of former alliances;
- expert interviews
- analysis of current collaboration and incentives for designers.

A comparison between the results of these four analyses provides an insight into the conditions for the added value and collaboration of engineering firms in project alliances.
Data collection

1. What are the characteristics of infrastructure project alliances in the Netherlands?

<table>
<thead>
<tr>
<th>Sources</th>
<th>Accessing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons</td>
<td>Alliance experts TUD</td>
</tr>
<tr>
<td>Documents</td>
<td>Literature on alliances</td>
</tr>
<tr>
<td></td>
<td>Literature</td>
</tr>
</tbody>
</table>

2. What is the position and added value of the engineering firm in the alliance?

<table>
<thead>
<tr>
<th>Sources</th>
<th>Accessing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons</td>
<td>Engineering firm PM</td>
</tr>
<tr>
<td></td>
<td>Alliance project managers</td>
</tr>
<tr>
<td></td>
<td>Client &amp; contractor</td>
</tr>
<tr>
<td>Documents</td>
<td>Alliance contracts</td>
</tr>
<tr>
<td></td>
<td>Risk allocation documents</td>
</tr>
</tbody>
</table>

3. What should the alliance organisation and incentives be for added value from an engineering perspective?

<table>
<thead>
<tr>
<th>Sources</th>
<th>Accessing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons</td>
<td>Construction industry consultants</td>
</tr>
<tr>
<td></td>
<td>Open interviews</td>
</tr>
</tbody>
</table>
Appendix C. Interviews

Interview setup phase 2

Het doel van het onderzoek is:
Het verbeteren van de samenwerking in de Nederlandse projectalliantie door vast te stellen hoe de organisatie nu is en hoe ontwerpers/ingenieursbureaus betrokken zijn. Dat daarnaast onderzoeken wat de toegevoegde waarde is van de IB's in de alliantie.
Het interview zal in principe een uur tot anderhalf uur duren. Audio van het gesprek graag willen opnemen om het makkelijker uit te kunnen werken, gaat u daarmee akkoord?

Interview vragen
1. Wat zijn uw dagelijkse bezigheden en wat is uw rol bij project allianties geweest?
2. Bij welke allianties bent u betrokken (of betrokken geweest)?
3. Wanneer is een project alliantie in uw ogen van toegevoegde waarde? Waarom heeft is in dit geval een projectalliantie toegepast?
4. Worden er ingenieursbureaus ingehuurd binnen dit project, en zo ja waarom?
5. Wie huurt de ontwerper/IB in?
6. Hoe ziet de organisatiestructuur van een Nederlandse projectalliantie er uit?
   a. Kun u aangeven wat de positie/relatie tussen de volgende partijen is:
      i. Alliantie – ontwerper
      ii. Private partij – ontwerper
      iii. Publieke partij – ontwerper
      iv. Alliantie - uitvoerend aannemer
7. Wie is bevoegd om welke beslissingen te nemen?
   a. Welke rol heeft de ontwerper in het besluitvormingsproces?
   b. Heeft hij een inbreng?
8. Welke juridische relatie heeft de alliantie met de ontwerper (/onderaannemers/leveranciers)?
9. Wat zijn de afspraken met de IB’s?
   a. Worden de incentives, die in de alliantie worden gecreëerd, doorgegeven
   b. Zo ja, hoe worden deze doorgegeven?
   a. Welke risico’s draagt de ontwerpende partij?
10. Wat zijn de gevolgen van deze afspraken en incentives?
11. Hoe is het ontwerp aan de uitvoerfase gelinkt (zodat de optimalisaties ook echt gerealiseerd kunnen worden)?
12. Zou een ontwerper mee kunnen of moeten doen in een alliantie?
   a. Hoe zou, gezien de relatief kleine omvang van een ontwerpende partij, dit vormgeven kunnen worden?
   b. Risicodragend?
   c. Wat zouden de voor- en nadelen hiervan zijn?

Organisatie

13. Is er scheiding tussen het D&C contract en de alliantie overeenkomst?
   a. En zo ja, waar zit die?
14. Wat zijn de eisen van de OG over welke partijen minimaal betrokken moeten worden in het project en hoe wordt een projectalliantie opgezet?
15. Wordt er ook gekeken naar de technische en financiële draagkracht van de partijen zelf?

Designers in the alliance (PUBLIC VERSION)
Afsluiting
- Is er nog iets wat u wilt toevoegen/vermelden?
- Ik zal het verslag uitwerken en opsturen ter akkoord. Daarna graag binnen 2 weken goedkeuring
- Mag ik uw naam opnemen in het verslag of wilt u liever als anonieme bron?
- En mag ik u citeren in het verslag?
- En als u geïnteresseerd bent kan ik u het eindresultaat ook toesturen, wilt u dat?

Interviewed persons & summaries
In this public version, the summaries of the interviews are intentionally left out as they are confidential.
Appendix D.  Risk management in construction projects

Risk management methods
To control a risk, the likelihood or the impact has to be managed, that can be done with the following methods according to Hillson and Simon (2012). Identification and assessment are the analytical phases in the process. With the results these actions, combined with a quantitative risk analysis, the response planning can be set up.

Identification
For the identification it is important to define a risk. A risk consists of two separate parts, the likelihood of a certain event occurring and the impact of the event if it does occur (Nicholas & Steyn, 2012). Risk is measured as following:

\[ \text{Risk} = \text{likelihood} \times \text{impact} \]

An event is determined as a risk to the project when it has an impact on a project aspect. Using the definition from the (PMI, 2000), risks are uncertain events that can have positive and negative consequences. These are threats and opportunities and there are several methods to control these risks. If a risk to the project is identified it has to be determined if it is worthwhile to act upon it.

Risk assessment
The goal of the assessment is to assess if a risk or group of risks is deemed critical for the project. If a risk is indeed critical, the allocation of the risk to a risk owner is determined.

The assessment is performed by determining several aspects of a risk. The Manageability determines whether a risk can be influenced by the alliance. Impact severity, can the risk be borne by the project partners. The availability of resources to implement the response in the project. And finally for a commercial project the most important factor: the cost effectiveness of a response. These are the assessment criteria to which the following responses have to be considered.
**Risk responses**

From the responses to threats, the response of reducing a risk is the most common action and aims at reducing probability or impact to a level that is acceptable in the project. This can be done in many ways, usually by taking measures that reduce the impact of risk or the probability that the risk will occur.

The response to a threat to avoid a risk is done by eliminating the probability or the impact of the risk completely. This is done by altering the plan or method and removing the cause for a risk.

If it is not possible to manage these risks at all, besides accepting the risk, an alternative is to transfer the risk to another party, to an insurance company, to a subcontractor or to the client. Transfer to an insurance company entails, paying them a premium to cover the consequences of that risk in case the event occurs. By transferring a risk to a specialised subcontractor or supplier the impact or probability can be managed. The consequences of some risks are too large to be handled by a private party, which will have to be transferred to the (public) client. If these risks do occur, the private parties are unable to handle the consequences. The consequences are not in proportion to the profit or turnover of a project or the company itself and only a government can accept the effects. Designing or engineering firms are therefore very risk averse and do not want to bear (design) risk in a construction project.

When a response to a certain threat is planned, changes in the project are made. These changes may cause risks themselves, which are secondary risks. In planning a response to a risk these secondary risks have to be accounted for in the cost effectiveness of a response. When a measure is taken to reduce the risk of a project, some of the risk will remain, in the form of a smaller chance or impact on the result, this is the residual risk. Before a response is incorporated in the project, it must be ensured that risk level of the planned response, the secondary risks and the residual risk combined are of an acceptable level for the project and are an improvement to the original risk.

Some risks are not manageable by default and the only option will be to accept them, whether they are threats or opportunities. This is the case if the responses to these risks are too expensive, inefficient or unacceptable at the time.

There are often also uncertain opportunities in a project; the goal of risk management is to take full advantage of these risks. If a response is feasible, there are several possible responses to maximise the output for the event.
The first method is to exploit an opportunity. This response is focussed to guarantee the event definitely occurs. The second method is to enhance the opportunity; this constitutes the increase of the probability or impact on the project.

The response that will be most common in the alliance is to share the risk with a party who is better able to manage it. The opportunity that is shared is then either exploited or enhanced. Sharing the opportunity can be done within the alliance organisation. The advantage of this course of action is that the complete profit can be retained in the alliance budget. The other option is that the opportunity is shared with a third party that is specialised and can exploit or enhance an opportunity better than one of the alliance parties.

Risk management in alliances focuses on reducing threats mostly within the alliance organisation, while transferring the least amount of threats to the client. On the other hand, opportunities are exploited, enhanced and shared within the alliance by having a broad spectrum of knowledge within the organisation.

**Causes of project risks**

*Which risks are common in large and complex projects?*

Risk breakdown structure for project risks which are typical for infrastructure project that are relevant for allocation joint risk management practiced in alliances (Hillson & Simon, 2012).

Adapted from the ATOM method (Hillson & Simon, 2012)

<table>
<thead>
<tr>
<th>Technical risks</th>
<th>Commercial risks</th>
<th>Legal</th>
<th>Organisational risks</th>
<th>External risks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inside research scope</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimates, assumptions &amp; constraints</td>
<td>Contractual terms &amp; conditions</td>
<td>Legislation</td>
<td>Project management</td>
<td>Site/facilities</td>
</tr>
<tr>
<td>Requirements definition</td>
<td>Internal procurement</td>
<td>Permits</td>
<td>Program/portfolio management</td>
<td>Pressure groups</td>
</tr>
<tr>
<td>Scope changes</td>
<td>Suppliers &amp; vendors</td>
<td>Regulatory</td>
<td>Organisation</td>
<td>Competition</td>
</tr>
<tr>
<td>Technical process</td>
<td>Subcontractors</td>
<td>Resourcing</td>
<td>Political</td>
<td></td>
</tr>
<tr>
<td>New technology</td>
<td>Client/customer stability</td>
<td>Communication</td>
<td>Social/ demographic</td>
<td></td>
</tr>
<tr>
<td>Technical interfaces</td>
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<tr>
<td>Design</td>
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</tr>
<tr>
<td>Performance</td>
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<tr>
<td>Reliability &amp; maintainability</td>
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<tr>
<td>Safety</td>
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<tr>
<td>Security</td>
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<tr>
<td>Test &amp; acceptance</td>
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<tr>
<td><strong>Outside research scope</strong></td>
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</table>

*Designers in the alliance (PUBLIC VERSION)*
These are general risk factors which can be allocated with all parties in the alliance.

Uncertainties in estimates (Atkinson et al., 2006)

- lack of a clear specification of what is required;
- Novelty, or lack of experience of this particular activity;
- complexity in terms of the number of influencing factors and associated inter-dependencies;
- limited analysis of the processes involved in the activity;
- possible occurrence of particular events or conditions which might affect the activity;
- emerging factors unknowable at the start of the project;
- bias exhibited by estimators, typically optimism bias.

![Defined Conditions for Impact Scales of a Risk on Major Project Objectives](image)

**FIGURE 37 PMBOK**

(This table presents examples of risk impact definitions for four different project objectives. They should be tailored in the Risk Management Planning process to the individual project and to the organization's risk thresholds. Impact definitions can be developed for opportunities in a similar way.)
<table>
<thead>
<tr>
<th>Literature research into risk categories</th>
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</thead>
<tbody>
<tr>
<td>Meso</td>
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<tr>
<td></td>
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<tr>
<td>Technical risks</td>
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<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>Scope changes</td>
</tr>
<tr>
<td>Requirements definition</td>
</tr>
<tr>
<td>Estimates, assumptions &amp; constraints</td>
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<td>Technical process</td>
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<tr>
<td>Technology</td>
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<tr>
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<td>Design</td>
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<td>Performance</td>
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<td>Reliability &amp; maintainability</td>
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<td>Safety</td>
</tr>
<tr>
<td>Security</td>
</tr>
<tr>
<td>Test &amp; acceptance</td>
</tr>
</tbody>
</table>
## Appendix E. Case study comparisons

### TABLE 14 EXTERNAL ENGINEERING FIRM (EEF) AND THEIR PRACTICAL RELATIONS IN THE CASE STUDIES

<table>
<thead>
<tr>
<th>Informal/practical relations</th>
<th>A2 Hooggelegen</th>
<th>OVSAAL WALTZ</th>
<th>OVSAAL Amstelspoor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role External EF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design leaders</td>
<td>Yes</td>
<td>Only in the first part of the project</td>
<td>No</td>
</tr>
<tr>
<td>Specialists</td>
<td>All disciplines</td>
<td>Rail only</td>
<td>Rail only</td>
</tr>
<tr>
<td>Engineering capacity</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Process involvement EEF</td>
<td>Technical and project control</td>
<td>Technical</td>
<td>Technical</td>
</tr>
<tr>
<td>Influence in decision making</td>
<td>During entire project</td>
<td>Only in the first part of the project</td>
<td>No</td>
</tr>
<tr>
<td>Cost overrun design &amp; engineering</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Incentives successful</td>
<td>Yes</td>
<td>Not applicable</td>
<td>No</td>
</tr>
<tr>
<td>Efficient design</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
## Appendix F. List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAS</td>
<td>Alliantie Amstelspoor (eastern project of OVSAAL Amsterdam cluster c)</td>
</tr>
<tr>
<td>AB</td>
<td>Alliance Board</td>
</tr>
<tr>
<td>AG</td>
<td>Antea Group (engineering firm)</td>
</tr>
<tr>
<td>AMT</td>
<td>Alliance Management Team</td>
</tr>
<tr>
<td>AOC</td>
<td>Actual outturn cost</td>
</tr>
<tr>
<td>AT</td>
<td>Alliance Team</td>
</tr>
<tr>
<td>AV</td>
<td>Added Value</td>
</tr>
<tr>
<td>BCA</td>
<td>BAM Combinatie Amstelspoor (contractors consortium Amstelspoor)</td>
</tr>
<tr>
<td>BOT</td>
<td>Build-Operate-Transfer - contract form</td>
</tr>
<tr>
<td>CNMS</td>
<td>Combinatie Nieuwe Meer Sporen (contractor’s consortium WALTZ, VolkerWessels)</td>
</tr>
<tr>
<td>CRI</td>
<td>Cost Reimbursement (payment model the ESA)</td>
</tr>
<tr>
<td>DA</td>
<td>Design alliance</td>
</tr>
<tr>
<td>DB{F</td>
<td>M(O)}</td>
</tr>
<tr>
<td>D&amp;C</td>
<td>Design &amp; construct – contract form</td>
</tr>
<tr>
<td>DNR</td>
<td>De Nieuwe Regels (standard conditions for engineering consultants in NL)</td>
</tr>
<tr>
<td>ECI</td>
<td>Early Contractor Involvement</td>
</tr>
<tr>
<td>EEF</td>
<td>External Engineering Firm (independent)</td>
</tr>
<tr>
<td>EF</td>
<td>Engineering firm</td>
</tr>
<tr>
<td>EPC</td>
<td>Engineering Procurement &amp; Construction</td>
</tr>
<tr>
<td>ESA</td>
<td>Engineering Services Agreement (Dutch: regiecontract)</td>
</tr>
<tr>
<td>GC</td>
<td>General contractor – contract form</td>
</tr>
<tr>
<td>IEF</td>
<td>Internal Engineering Firm (part of larger contractor)</td>
</tr>
<tr>
<td>IPM</td>
<td>Integrated Project Management (model)</td>
</tr>
<tr>
<td>NOP</td>
<td>Non-owner participants</td>
</tr>
<tr>
<td>PA</td>
<td>Project alliance</td>
</tr>
<tr>
<td>PDM</td>
<td>Project delivery method</td>
</tr>
<tr>
<td>PPP</td>
<td>Public private participation - contract form</td>
</tr>
<tr>
<td>RIS</td>
<td>Railinfra Solutions (external engineering firm)</td>
</tr>
<tr>
<td>RWS</td>
<td>Rijkswaterstaat</td>
</tr>
<tr>
<td>VHB</td>
<td>Van Hattum en Blankevoort (contractor part of VW)</td>
</tr>
<tr>
<td>VID</td>
<td>Volker InfraDesign (IEF of VHB)</td>
</tr>
<tr>
<td>VW</td>
<td>VolkerWessels Group (contractor)</td>
</tr>
<tr>
<td>TCE</td>
<td>Target Cost Estimate</td>
</tr>
<tr>
<td>TOC</td>
<td>Target outturn cost</td>
</tr>
<tr>
<td>TN</td>
<td>Trajectum Novum (consortium of contractors in A2 Hooggelegen)</td>
</tr>
<tr>
<td>WALTZ</td>
<td>‘Westelijke Alliantie Team Zuidtak’ (western project of OVSAAL Amsterdam cluster c)</td>
</tr>
</tbody>
</table>