The impact of boundary spanners on the network performance of DBFM and D&C infrastructure projects

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ABSTRACT

Over the years the use of public-private partnership contracts in infrastructure projects have increased. The DBFM contract type is currently the most used public-private partnership contract type in the Netherlands. Besides public private partnerships, also the non-public-private partnership D&C contract is widely used in Dutch infrastructure projects. Several studies have already been comparing the cost and time performance of these contract types. Yet only little is known about the network performance of both DBFM and D&C contracts. Also limited knowledge is present about the influence of boundary spanners on the network performance. Therefore, this study not only aims to make a contribution to the comparative network performance of DBFM and D&C contracts in Dutch infrastructure projects but also makes a contribution to the theory on boundary spanning. By studying the variables that play a role in the network performance and studying the different roles and strategies used by boundary spanning, a better insight can be given on the concepts of network performance and boundary spanning. Besides literature and documents, also primary data was used. The primary data was derived from semi-structured interviews with boundary spanners of four different cases in the Netherlands. Based on the analysis the conclusion can be made that there are no differences in network performance between DBFM and D&C contracts. Also, it is possible to conclude that making use of boundary spanners has a positive impact on the outcome of a project. Another conclusion derived from this study is that boundary spanners are not bound to a single role or strategy that they use, but often a combination of multiple roles and strategies are used.

E.N. Zomer (2021)

INTRODUCTION

In many countries, public-private partnerships have become a common governance strategy to implement large infrastructure projects (Bovaird, 2004). Since the late 90's, the most common type of public-private partnerships (PPP) for new infrastructure projects that is being used in the Netherlands, is the design-build-finance-maintain method (DBFM) (Rijksoverheid, 2018). In a DBFM contract, the contractor is responsible for the design, build, finance and maintain aspects of the project. This will give the contractor a lot of space to implement its own knowledge and creativity. In a DBFM contract, risks and responsibility are handed over to the contractor who can manage these the best. The payment of the contract to the contractor can happen in multiple ways such as usage-based or revenue-based payment. However, the DBFM contracts that are used in the Netherlands and by Rijkswaterstaat is the availability-based payment (Yescombe, 2007). The other contract type that is being used in new infrastructure projects in the Netherlands is called a Design and Construct-contract (Rijkswaterstaat, 2020). In both contract types, the client (e.g. Rijkswaterstaat) provides a functionally specified request. The contractor is given the space to optimize the design and realization itself and to apply innovations in the design and implementation. Next to that the contractor also ensures optimal coordination between these phases. The reason for this is because market parties have the most expertise in finding and applying these optimisations (PIANO, 2021). Over the years, the stakeholder engagement has become increasingly important in the infrastructure projects in the Netherlands which directly relates to the increased usage of public-private partnerships. Governments are shifting from communicating towards engaging with stakeholders (Jones, 2019). This shift from stakeholder communication to stakeholder engagement means that also the roles in organisations are shifting. This new role that started to arise is called a boundary spanner. According to Williams (2002) boundary spanners are skilled networkers who have the ability to recognize and exploit opportunities to develop inter-organisational relationships. Boundary spanners are organisational members who are able to link the organization they represent with its environment.

PROBLEM DEFINITION AND RELEVANCE

There are several research gaps that this study contributes to. Firstly, there will be a contribution made to the literature on explaining the comparative performance of PPP with non-PPP contract types. Secondly, a contribution to the boundary spanning literature will be made. Starting with the comparative performance of PPP with non-PPP contracts, Verweij et al. (2020) mention that only limited research has been done on the performance of DBFM compared to D&C contracts in transport infrastructure. In the research of Verweij et al. (2020) on cost performance they found out that the literature showed contradictory results compared to empirical studies. Besides cost performance also other types of performance play a role such as network performance (Klijn et al., 2010). Network performance refers to the interaction between public, private and societal actors that influence the outcome of a projects (Van Meerkerk, 2014) One of these limited empirical studies done by Van Meerkerk (2014) focussed on water management and urban development projects. The conclusion he makes in his research is that boundary spanners play an important role in realizing trust. Via this trust building network performance will be increased. Currently there is much information available in the literature on boundary spanning (see Feldman & Khademian (2007), Brion et al. (2012)). However, only limited empirical research has been done on the effects that boundary spanners have on network performance (Van Meerkerk, 2014). There are no further explanations which boundary spanning strategies or roles are the most effective. This makes it an interesting subject to find out if and how boundary spanners influence the network performance of the main contract types that are used for infrastructure projects (DBFM vs D&C).

Therefore, this study will be relevant to find out if differences also can be found in the network performance of DBFM and D&C infrastructure projects and if boundary spanners could possibly explain why the two contract types perform differently. Despite the many differences between the contract forms. The recent study 'Leren van 15 jaar DBFM-projecten bij RWS' (Koppenjan et al., 2020) showed that there are no differences in outcomes of the overall collaboration in a project between DBFM and D&C contracts. However, DBFM-projects did outperform D&C-projects on some points. DBFM-projects showed to have a better attitude towards maintaining relations and are more open to handing out a favour than D&C projects.

This answers partially the goal of this study if PPPs perform better than non-PPP contracts, but more qualitative research is needed to find out how boundary spanners influence the collaboration between the organisation and its environment.

The insights on the influence of boundary spanners on network performance that will be derived from this study will hopefully lead to a better understanding of the variables that play a role in the network performance of DBFM and D&C contracts. Especially clients such as Rijkswaterstaat and private contractors in the infrastructure sector can build further on the results from this research. According to the rapport 'Leren van 15 jaar DBFM-projecten bij RWS', Rijkswaterstaat has the ambition to strengthen its collaboration with the market to improve future infrastructure projects. This research focussing on the role of boundary spanners and its impact on performance, can help to improve collaboration among public and private partnerships as well as in non-public-private partnerships.

RESEARCH OBJECTIVE AND RESEARCH QUESTIONS

As mentioned in the problem definition, the objective of this study is to find out why DBFM infrastructure projects (PPP) deliver higher network performance than D&C infrastructure projects in practice and how boundary planners influence this performance. To find this out, it has to be understood how boundary spanners work and which strategies are most suitable for DBFM or D&C infrastructure projects. The results can be used by both clients as contractors to improve the performance of future projects. This has resulted in the following research question:

How do boundary spanners impact the network performance of DBFM and D&C infrastructure projects?

To answer the main research question above, the following sub questions are used:

- Does the use of boundary spanners lead to more trust between actors?
- Why does DBFM have a network performance advantage over D&C infrastructure projects?
- Are there different boundary spanning roles/strategies used in DBFM compared to D&C contracts?

SCOPE

The comparative analysis of this study is determined by a spatial boundary, theoretical scope, and timeframe (Yin, 2003). The spatial boundary of this study will be DBFM and D&C infrastructure projects in the Netherlands. The theoretical scope is defined by the concepts of public-private partnerships, boundary spanning, network performance, trust and personal networks.

As mentioned in the introduction, the reason why the focus of this study lies on DBFM, and D&C contracts is because they can be seen as the default contract types in the Netherlands (Rijksoverheid, 2018). To get an understanding of how boundary spanners function and affect the network performance of a project, the focus will lie on stakeholder and communication managers. Since the managers are able to provide answers regarding inter-organizational relations, and know exactly what goes on regarding the performance of a project where they were involved (Van Meerkerk & Edelenbos, 2014)

READING GUIDE

In Chapter 1 the subject of boundary spanning was introduced and the comparative performance of public-private partnerships was compared to non-public-private partnerships. in Chapter 2 a theoretical background will be given by elaborating on the concepts of public-private partnerships and network management. Afterwards the relevant literature that is being discussed in chapter 3 will serve as a basis for the conceptual model that is used in this study. The methodology that explains how the data was collected and analysed will then be discussed in chapter 4. In chapter 5 these results will be analysed. The conclusions will be discussed in chapter 6 together with the discussion. At the end the reference list and the appendices can be found.

THEORETICAL BACKGROUND

Before a comparison between DBFM (PPP) and D&C (non-PPP) contracts in infrastructure can be made, it is important to understand the basis of what a public-private partnership is. Therefore, a little more background will be given on the concept of public-private partnerships and network management.

WHAT IS A PUBLIC-PRIVATE-PARTNERSHIP?

Klijn & Tijsman (2003) give a short explanation of PPP. According to them PPP is:

> *"a more or less sustainable cooperation between public and private actors in which joint products and/or services are developed and in which risks, costs and profits are shared''*

However, under this explanation many different forms can be found, this can make the concept of PPP confusing. Klijn (2010) mentions that this confusion about PPP takes place in three different areas that are also connected to each other. The first confusion is about the meaning of PPP. Next to the different definitions, there are also many different appraisals and emotions that play a role. The second confusion is about the argumentations and rationality of PPP. There are contradictories in argumentations how PPP can achieve better results (e.g., innovations, investments, value for money etc.). At last, there is also confusion about the preferable form of PPP. In the literature and policy documents several different approaches are seen as the best form of PPP. In each of the following sections one of the confusions will be taken away to create a better understanding of PPP.

PPP AS A BRAND

To clarify the first confusion about the meaning of PPP, Klijn et al. (2010) says that PPP can be seen as a brand. According to him the concept of PPP must not only be seen from a scientific perspective but is it just as important to see how PPP is used in policy documents, party programs, and political speeches. In scientific debates, concepts are differently used than in political speech and policy documents. Therefore, Klijn et al. (2010) argues that the concept of PPP must be seen as a brand. A brand is *''a name, term, sign, symbol or design, or a combination of these, intended to identify the goods or services of one seller or group of sellers and differentiate them from those of competitors''* (Kotler et al., 1999: 571). A brand is about the meaning and identity it defines and not about the product itself. This is in line with Probst (2016) conclusion on PPP. He mentions that PPP of course helps to pool resources and expertise to address the problems, but it also helps to create and strengthen their own brands on company or national levels. This means that meaning and identity matters more than the product itself. However, there still has to be a link between the two (Klijn et al., 2010).

ARGUMENTATION AND RATIONALE FOR PPP

Next to the different meanings of PPP that creates confusion, there are also different reasons why PPPs are useful. In general, it is assumed that the more intensive cooperation in PPPs compared to non-PPPs lead to better and more efficient policy products and policy outcomes (Hodge and Greve, 2005). However, the confusion lies at the fact that PPP is a hybrid idea of which assumptions can be found in two major perspectives. From the perspective of New Public Management and from the governance perspective (Klijn et al., 2010).

According to the NPM point of view there needs to be a strong emphasis on efficiency and market mechanisms and performance indicators must be used by public actors to check on the private actors. According to Osborne and Gaebler (1992) there needs to be a separation between policy formulation and policy implementation. The public actor (government) should focus on the formulation of the policy, whereas the policy implementation should be done by private actors. The added value in PPP lies in the fact that the public actor can allocate their risks and efficiency will be increased. Also, the length of PPP contracts will add extra value to attract private actors. In DBFM road infrastructure projects in the Netherlands (most common type of PPP) the contract time can lead up to 20 till 30 years (Verhees et al., 2015).

From a governance perspective, the focus lies on cooperation between public and private actors that both use their best expertise of both worlds to achieve jointly determined goals. In this perspective of partnership, there are non-hierarchical and horizontal structures and processes, shared accountability, collaborative and consensus-based decision making, trust-based relationships both informal and formal, and synergetic interactions among partners (Brinkerhoff & Brinkerhoff, 2011).

FORM OF PPP

Next to the importance of structure and form of the organization, Mandell (2001) also stresses the importance of managerial efforts in order to achieve good PPP outcomes. According to him the managerial efforts that are part of the network management, might be even more important than the structure and form of an organization. This is in line with the study of Steijn et al. (2009). The study focussed on the outcomes of the project, the managerial activities, and the organizational form between

public and private actors that was used. The analysis show that there was no relation between the organizational form of the project and the outcomes. However, the managerial strategies did show a strong relation with the outcomes of a project (Steijn et al, 2009). Contrary to these results of Steijn et al. (2009), Kort et al. (2016) showed that organizational form does matter too. Their study showed that there is not a particular good organizational form, but about combinations of organizational form and network management strategies. Still, the focus on managerial strategies are more important, but making use of combinations with organizational strategies will enhance the outcome of a project (Kort et al., 2016). Therefore, to make a PPP work the main focus must be on network management strategies, where effort and time needs to be invested for a successful partnership between public and private actors. The upcoming section will elaborate on how this network should be managed in PPPs and how their performance can be managed.

THEORIES ON NETWORK MANAGEMENT

In the PPP chapter is mentioned that to make a PPP work, a good network management is needed. (Steijn et al., 2009). Next to PPP also in non-PPP contracts cooperation is involved since both public and private actors are involved here as well.

According to Koppenjan & Klijn (2004), within these networks there is a strong focus on information transfer. Also, due to a growing number of actors within the networks emerging issues affect more actors and networks. This means that actors or organizations cannot fix their problems on their own but need to collaborate with other actors and networks (Koppenjan & Klijn, 2004). Because of this, the need for information transfer between networks and actors increases. The need for collaboration also becomes clear in the study of Koppenjan et al. (2020). The results of the survey showed that there is a correlation between the collaboration and the performance of DBFM (PPP) and D&C (non-PPP) projects.

Tushman & Scanlan (1981) mention that this organization within the networks evolve through specialization and the creation of specialized subunits, that concern themselves with executing homogenous tasks (Tushman & Scanlan, 1981). This specialization is accompanied by the emergence of local norms, culture, language, and values, resulting in increased differences between specialized units. These units that Tushman & Scanlan (1981) mention can in this study be seen as the private actors getting involved in a relationship with public actors. Due to the differences, boundaries emerge between both subunits within organizations and organizations as a whole. This leads to more efficient processes within the organizations, but it also leads to difficulties in communication, collaboration and trust between organizations (Tushman & Scanlan, 1981). This is in line with the theory of Whelan (2016) that these networks take place within but also between organizations. To bridge the difficulties in communication and collaboration, a network must include a boundary spanner (Agranoff and McGuire, 2003). According to Agranoff and McGuire (2003) a boundary spanner must be included in order to facilitate, mediate and lead the network. This statement makes it interesting to find out how the boundary spanner impacts the network performance.

THEORETICAL FRAMEWORK

In this chapter multiple variables will be discussed that are playing an important role in creating a high network performance. Besides the independent variable network performance also the relation with the variables trust, boundary spanning roles and strategies, contract type and the personal network will be explained.

NETWORK PERFORMANCE

As previously mentioned, adding more actors increases difficulties in networks (Tusman & Scanlan, 1981). Since this study focusses on comparing DBFM (PPP) with D&C (non-PPP) contracts and thus their networks, another important issue that needs to be addressed in order to compare public-private partnerships with non-public-private partnerships is the performance of networks. How do we actually know when these networks within a public-private partnership perform well? To find out how the networks within PPPs perform, it is important to understand which type of performance is focussed. In the literature limited sources can be found on the performance of PPP and non-PPP contracts. In comparative studies (Atmo et al., 2017; Verweij & Van Meerkerk, 2020; Chasey et al., 2012), the time and cost performance of DBFM (PPP) was compared with non-PPP contracts. The results of these studies showed that the DBFM projects perform better in terms of time and cost performance. However, Verweij & Van Meerkerk (2020) mention that there are more factors playing a role in the overall performance of DBFM compared to D&C contracts. Therefore, this theoretical framework focusses on the network performance in DBFM contracts compared to D&C contracts. Network performance refers to the interaction between public, private and societal actors that influence the outcome of a projects (Van Meerkerk, 2014).

According to Torfing et al. (2012) the network performance depends on the participants' willingness to exchange or pool resources, the inclusion of relevant and affected actors, and the common conceptions of problems, solutions and decision-making promises.

The literature shows that measuring the collaborative aspect in network performance is not as simple as comparing time and costs of the different contract types since there is much discussion on measuring network performance. Van Meerkerk (2014) says that there is no particular best approach to measure network performance. He also mentions, that because of the involvement of multiple actors which all have different goals, it is not possible to pick a single goal for measurement. Another issue is the lengthy decision-making processes and the possibilities that the role of actors can change over time (Koppenjan & Klijn, 2004). A solution to deal with this measurement problem of networks, is to measure the ex-post satisfaction of key individuals about solutions and formal decisions in the project (Torfing et al. 2012). Klijn et al. (2010) are using a multi-criteria scale to perceived network performance as a proxy for measuring network performance. In their scale a distinction is made between content outcomes (hard performance) and process outcomes (evaluations).

The content outcomes are characterized by six different elements derived from literature on governance networks and network management. The first element that Klijn et al. (2010) describe is the innovative character of the outcome. This is about how projects show innovative results. The second element they mention is the integrative aspect of the solution. The focus is on how the plan represents different environmental functions such as housing and recreation. The third element is the recognizable contribution that is made. This refers to the impact of the involvement of stakeholders in decision-

making processes. This means that not only communication towards the other stakeholders take place but also try to listen and implement other visions. Fourth, is the problem-solving capacity of results. This means to what extent solution within the project address the problems. The fifth element that they mentioned is the robustness of the results, for example the how future resistant the booked results are. The last element that is identified is the relationship between the costs and benefits of results. This element focusses the fact that costs should not overrun benefits in a project.

The process outcomes characterized by Klijn et al. (2010) also consist of six different elements. The first element is the management of the network. This refers to the level of satisfaction of the ways in which actors are involved in the project. The second element that influences perceived performance is conflict resolution. Conflict resolution is about the way in which conflicts are solved or averted. The third element is about to which extent the project has encountered deadlocks or stagnations in it process. The fourth element is the productive use of differences in perspectives. According to Klijn et al (2010) this is the way in which differences in frame and perspective have been reconciled. Fifth, contact frequency among actors is an element. The last element they mention is the support for results coming from governance networks. According to Klijn et al. (2010) this refers to the extent to which the actors involved in the project are satisfied with the results that are achieved.

TRUST AND COLLABORATION

To improve the network performance in infrastructure projects, collaboration and trust is needed. If there is trust between organizations, the collaborative performance of inter-organizational relationships could be enhanced (Edelenbos & Klijn, 2007). Trust can be seen as one of the most important factors to influence inter-organizational relations (Williams, 2002). According to Sorensen & Torfing (2009) trust can be built by showing goodwill, agreement among actors, and when there is absence of opportunistic behaviour. Building and sustaining trust is also a cyclic process due to expectation forming and risks that are taken in projects (Vangen & Huxham, 1998). Every time when actors are collaborating, they take a risk and form expectations about the intended outcome and how other actors will contribute. When the expectations of an outcome are met, trust is reinforced. The outcomes will be part of the relationship and each time an outcome will be met, the trust in relationships will be reinforced.

ROLE OF THE BOUNDARY SPANNER

To understand the role that boundary spanners play on the network performance of infrastructure projects and what activities they perform, first a definition of a boundary spanner is needed. According to Williams (2002) boundary spanners are organizational members who are able to link the organization they represent with its environment. He also mentions that competent boundary spanners are skilled networkers who have the ability to recognize and exploit opportunities to develop inter-organizational relationships.

To elaborate further on the conclusion made by Steijn et al (2009) (see PPP chapter), that the organizational form doesn't matter in order for a project to be successful, the principal-agent character of DBFM can partly be ignored. Instead, he mentions that the focus should be on managerial efforts and thus connecting actors to make a project successful. This is in line with the statement of Agranoff and McGuire (2003) that a network manager must be included to bridge difficulties in communication and collaboration.

Also, the study 'Leren van 15 jaar DBFM-projecten bij RWS' mentions that boundary spanners have a positive effect on the collaboration that leads to a better network performance in both DBFM and D&C projects (Koppenjan et al., 2020). Next to that, the study shows that making use of boundary spanners also lead to more trust, and trust leads to better performance. According to Brion et al (2012), in a project multiple members of a project team can perform boundary spanning tasks. However, especially the manager plays an important role in the boundary spanning process due to their position within a project. The reason for this, is because the manager frequently reports to top management and is also part of the project team (Brion et al., 2012)

BOUNDARY SPANNING ACTIVITIES, ROLES, AND STRATEGIES

In networks, boundary spanning activities are important in building and activating relationships among different actors (Van Meerkerk, 2014). To overcome difficulties in communication and collaboration boundary spanners are engaged in multiple activities that are also interrelated. According to Van Meerkerk (2014) the main boundary spanning activities leading to a better fit between the organization and its environment are connecting or linking different people and processes across organizational boundaries, selecting relevant information on both sides of the boundary, and translating this information to the other side of the boundary. These main activities that boundary spanners perform, can be achieved through three different roles to connect relevant information between organisations. Feldman and Khademian (2007, p. 312) distinguished three roles based on their research:

1. Boundary spanners can perform the role of a *broker*. The role of a broker means that information from several perceptions is gathered and spread outside of the organizational boundary. By making use of boundary spanning as a broker offers the possibility to gain insights into potential obstacles and problems within the network (Feldman & Khademian, 2007).

2. Boundary spanners can operate as *translators* between organizations. This boundary spanning role focuses on making information understandable and thereby usable across organizational boundaries. The translation of information between organizations helps to create a mutual understanding (Feldman & Khademian, 2007).

3. Boundary spanning can be executed by *synthesizers*. Synthesizers can help in finding common ground between organizations and foster collaboration. This will be achieved by moving beyond translating information and try to combine several perceptions in search of new ideas and concepts (Feldman & Khademian, 2007).

The roles mentioned by Feldman & Khademian show similarities with the strategies mentioned by Nederhand et al. (2018). According to Nederhand et al. (2018), boundary spanners are dealing with barriers and tensions. To overcome these barriers and tensions Nederhand et al. (2018) identified three different boundary spanning strategies.

However, these boundary spanning strategies are focussed on barriers and tensions within public organizations. According to Williams (2002) a boundary spanner can be seen as a connector between an organization and its environment. Therefore, these strategies might also be applicable in the study on road infrastructure projects in the Netherlands and therefore not only applicable within the public

organization but also between organizations. The strategies mentioned by Nederhand et al. (2018) listed below are entrepreneurial, mediating and hierarchical strategies.

1. The *entrepreneurial* strategy focuses on finding creative approaches in contacting and connecting people and organizations within the network. With this strategy people are carefully selected to contact. The carefully picking and avoiding conflicts and classifying relevant initiatives is part of this strategy (Nederhand et al., 2018). The entrepreneurial strategy also shares some of its characteristics with the role of a synthesizer, since a synthesizer is combining and adding perceptions in the search for new, creative ones to align diverging positions(Feldman & Khademian, 2007).

2. The *mediating* strategy searches for a common ground between actors. Searching for common ground can be done through argumentatively persuading officials in showing the importance of bending rules to move beyond existing tensions. However, it can also be done through trust-building and paying respect to everyone's position and opinions. In both ways the goal is to create a common understanding on which a collaboration can be based (Nederhand et al., 2018). Same as with the entrepreneurial strategy, also synthesizing characteristics of boundary spanning activities are shown in the mediating strategy, since it focuses on aligning each other's positions and building a collaboration out of it (Feldman & Khademian, 2007). The second approach to mediation also shows signs of translating boundary spanning activities, as it aims to make opponent's positions understandable for each other (Feldman & Khademian, 2007). As it combines different roles, mediating is often also applied in combination with the entrepreneurial strategy as it takes both the argumentative side of mediating and the creative side of entrepreneurial to gain movement (Nederhand et al., 2018).

3. The *hierarchical* strategy focusses on breaking through processes with the help of leading managers. This hierarchical strategy is seen as a last resort when conversations and processes are stuck. The strategy is considered to be effective, but not suitable for building sustainable relationships (Nederhand et al., 2018). When comparing this strategy with the roles of boundary spanners as mentioned by Feldman & Khademian (2007) it is difficult to fit this strategy in a role. This strategy should more be seen as a strategy that can be applied when initial boundary spanning activities have failed or didn't work as planned.

CONTRACT TYPE

Since this study focusses on the comparative performance of PPP and non-PPP contracts and boundary spanners, the contract type will also be used as a variable to find out if the contract type affects the boundary spanner.

To answer the knowledge gap about the performance of PPP and non-PPP contracts that is mentioned by Verweij & Van Meerkerk (2020), first, a clarification on PPP and non-PPP contracts that are used in the road infrastructure sector in the Netherlands will be made. The main type of PPP contract that is used since the late 1990s in the Netherlands, is called a Design-Build-Finance-Maintain contract (DBFM) (Rijksoverheid, 2018). The default non-PPP type of contract for new infrastructure projects that is used, is called the Design and Construct contract (D&C) (Verweij et al., 2020).

To get a clear understanding of the DBFM and D&C characteristics the similarities and differences table 1 already gives a short ovrview. These similarities and differences will be further explained in the following section.

	D&C	DBFM
Scope	Design and construct	Design and construct plus maintenance
Financing	Public	Private
Timespan	Short	Long

Table 1. Characteristics of DBFM and D&C contract types.

SIMILARITIES

In both DBFM and D&C contract types, the client (e.g., Rijkswaterstaat) provides a functionally specified request. The contractor is given the space to optimize the design and realization itself and to apply innovations in the design and implementation. Next to that the contractor also ensures optimal coordination between these phases. The reason for this is because market parties have the most expertise in finding and applying these optimisations (PIANO, 2021). Other similarities between both contract types are that a competitive selection process is used to select the best private actor for the job (Culp, 2011).

According to Culp (2011), both contract types use the same selection process, in which the owner (government) sets up a contract with a private actor to design and build the project.

DIFFERENCES

One of the conditions for a PPP is private financing. The reason why a DBFM can be seen as a form of PPP and D&C not, is because, there is no private financing in D&C contracts, in contrary to DBFM contracts (Yescombe, 2007). The owner hands out a single, fixed fee contract for the design and construction to the private actor that executes the project. This competitive process does come at a cost for D&C contracts. Culp (2011) mentions that due to the competition, respondents to the contract propose lower costs for the contract, which is beneficial for the owner. He states that these lower costs are also translated into the construction, since the private actors wants to make profit. Of course, the private actor still needs to meet certain goals to be accepted by the owner. Next to differences in financing, there is also a difference in contract duration. A DBFM contract for road infrastructure projects in the Netherlands has an average length of 27 years, while a D&C contract has an average length of 5 years (Metselaar & Klijn, 2020). The reason for this difference is that a DBFM contract is also responsible for maintenance of the project (Rijksoverheid, 2018).

In a D&C contract the owner will not be responsible for maintaining the project after completion. Meaning that there is no long-term vested interest by the private actors in combination with trying to complete the project as cheap as possible, can lead to a less sustainable project that might require more maintenance (Culp, 2011). In D&C contracts (short-term), less collaboration among actors takes place due to their short contract period. While the long-term contracts (DBFM) require strong sustainable relationships for a good project outcome due to their long contract length (Kumaraswamy & Motiar Rahman, 2005). According to this difference in interest mentioned by Culp (2011) and collaborative

differences by Kumaraswamy & Motiar Rahman (2005), DBFM contracts are expected to show show a more positive effect on network performance than D&C.

IMPORTANCE OF PERSONAL NETWORKS

According to the literature, another variable that plays an important role for a good project outcome are personal networks. According to Brion et al. (2012) personal networks have a positive impact on the boundary spanning activities, which in their turn improved the performance of a project. Especially strong ties where there is trust, helps to acquire sensitive and unofficial information (Hochwarter et al., 2007). Strong ties within the personal network might also lead to better support for the project, to additional resources, to spread positive information about the project, and to secure priority over other projects when there are strong ties with decision-makers (Brion et al., 2012).

Also, the strong ties between individuals create a motivation for a contact to provide resources and support to the other actor. Due to the boundary spanner's ability to sympathize with other actors, and their feeling for the social aspects, sustainable relationships are developed and maintained (Levina & Vaast, 2005).

CONCEPTUAL MODEL

In figure 1 the conceptual model of this study is illustrated. The model is based on the previously discussed variables that play a role in explaining the comparative performance of DBFM contracts compared to D&C contracts, and the impact of boundary spanners on the network performance. In this study the network performance is the independent variable. For a project to reach a high network performance trust is needed. In order to create a high level of trust, a boundary spanner is needed. However, the boundary spanner's effect on trust might be influenced by several variables such as their personal network, contract type, boundary spanning strategies, and boundary spanning roles. By using this conceptual model, it is possible to find out how the different variables influence the network performance of infrastructure projects in the Netherlands.
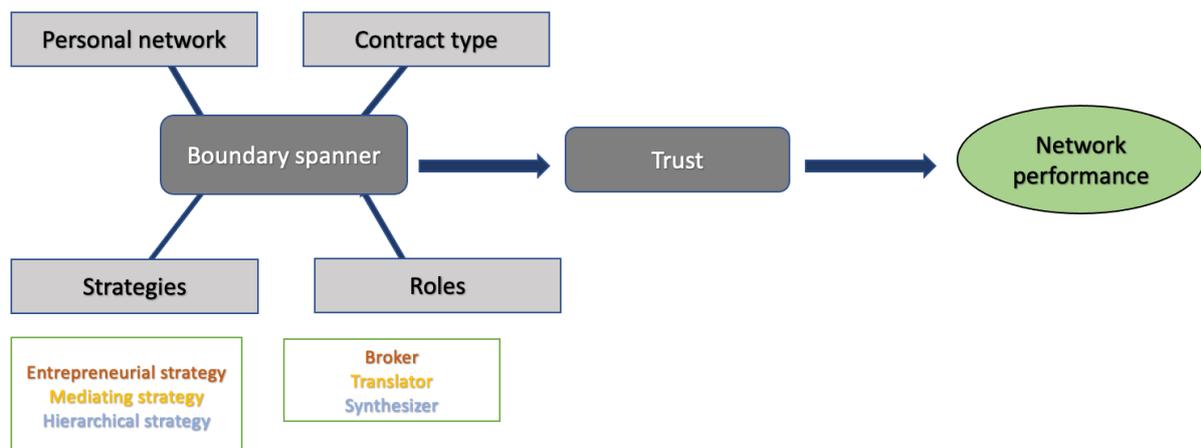

Figure 1. Conceptual model.

METHODOLOGY

This chapter will focus on the design of the research and the steps that have been taken to come to conclusions. This includes the relevant literature that has been used. Followed by the research strategy and the case selection. Afterwards the interview type used in this research will be discussed. Furthermore, the operationalisation of the variables, data analysis and ethical considerations are presented.

LITERATURE REVIEW

In order to create a better understanding of the main concepts used in this study a literature review has been conducted. These concepts are public-private partnerships, network management, network performance, DBFM, D&C and boundary spanning. These concepts were also used as keywords for searching literature in databases such as SmartCat and Google Scholar. By scanning the articles that came forward by using the mentioned keywords, additional literature was gathered through snowballing. This additional literature was used to create a better understanding of several aspects related to the main concepts. Examples are the importance of trust and personal relationships in the concept of boundary spanning. The articles used in this study made it possible to create an overview of the most relevant literature regarding the mentioned concepts. This theoretical framework of relevant literature on the main concepts is used as a basis for doing empirical research.

Also, the conceptual model is based on this literature. By comparing the literature study with the empirical results of this study, a comparison can be made to test if there are similarities and/or differences between the two worlds.

RESEARCH STRATEGY

While doing this thesis it is important to make deliberate choices in defining the type of study, the logic of research design, data collection techniques, approaches to data analysis, interpretation and reporting (Yin, 2003). The theoretical framework that consists of literature about network management, network performance and the role of boundary spanners, is compared with data from DBFM and D&C transport infrastructure projects in the Netherlands. This thesis used a comparative qualitative case study to find out how boundary spanners impact the network performance of DBFM and D&C contracts. The reason for a qualitative study is because there has already been done quantitative studies comparing DBFM and D&C contracts. However, no qualitative study has been done on the impact of boundary spanners on the contract type in infrastructure projects in the Netherlands. This means that the answer on why and how boundary spanners influence performance is lacking.

CASE SELECTION

A total of four cases are studied. For both DBFM and D&C projects two cases are selected. The reason for selecting two cases (successful and unsuccessful) per contract type is to be able to gauge the effect of contract type on boundary spanning. The two cases (successful and unsuccessful) per contract type might use different network management strategies, different boundary spanning activities or have a different personal network with other actors. By selecting two cases it is possible to make minor conclusions about the effect that the contract type has on the variables related to boundary spanners for the outcome of a certain contract type. By comparing the results with the other contract type it is possible

to find similarities and/or differences among the variables that contribute to network performance and thus the outcome of infrastructure projects in the Netherlands.

As described in the literature on network performance, it is very difficult to measure network performance. To find suitable projects, a quantitative study would be needed for selecting the right projects. However, the main goal of this study is to focus on the qualitative aspects of network performance and especially the roles and strategies of boundary spanners on the projects. Therefore, in this study the case selection will be done based on the recent quantitative study by Satheesh et al. (2021) that also focusses on road infrastructure projects in the Netherlands. In their study several cases came forward as successful and unsuccessful cases for both DBFM as D&C road infrastructure projects. The high and low performing projects are listed below. From these cases, members of the projects who can be identified as a boundary spanner were asked to participate in the research.

> High performing projects:
>
> - o **for D&C:** A2 Maastricht
> - o **for DBFM:** SAA: A1-A6 Almere
>
> Low performing projects:
>
> - o **for D&C:** N50 Ens - Emmeloord
> - o **for DBFM:** Maasvlakte-Vaanplein (MaVa)

BOUNDARY SPANNER INTERVIEWS

The interviews in this study were conducted by using semi-structured interview questions. Semi-structured interviews will give room for interpretation for both the interviewer as the interviewees. With the semi-fixed structure of question, all essential aspects are covered in the predetermined list of questions. Thereby does it allow for additional and unforeseen questions and remarks during the interviews (Clifford et al., 2010). This structure suits best with this study as the current limited research on the topic will most likely result in comments that were not discussed before. With the semi-structured format, these comments can be further discussed in the interview.

The interviews are held with boundary spanners of DBFM and D&C road infrastructure projects in the Netherlands between April and May in 2021. As described in the chapter on boundary spanning, there are several characteristics that identify a boundary spanner. The participants of this study are selected based on these characteristics and the roles that are mentioned in the literature. According to Brion et al. (2012) multiple members of a project team can perform a boundary spanning role. The focus in this study lies on the boundary between the project and the environment. Therefore, interviews took place with stakeholder or communication managers. There were several subjects discussed during the interview all related to the variables mentioned in the theoretical framework and conceptual model. The structure of the interview can be found in the appendix under the heading interview guide. For each case a boundary spanner has been interviewed, which means that in total four interviews took place. Due to the COVID-19 pandemic the interviews took place online via MS Teams. Each of the interviews took between 30 to 45 minutes.

OPERATIONALIZATION

This study focusses on the five variables mentioned in the conceptual model. The first variable is contract type. The contract type consists of a DBFM or D&C contract type. They are defined by the finance and timespan. The second variable is the boundary spanning strategy. This variable can be divided in three different strategies that are used by boundary spanners: entrepreneurial, mediating, or hierarchical. The third variable is the boundary spanning roles. This variable consists of three different roles a boundary spanner play, namely broker, synthesizer, or translator. Trust is the fourth variable. Finally, also the personal network plays a role in finding out how boundary spanners influence the network performance of DBFM and D&C projects.

DATA ANALYSIS

For analysing the interviews, the interviews were recorded and transcribed. After the transcription of the interviews a coding scheme was made based on the conceptual model and literature (See coding scheme in the appendix), Afterwards Atlas Ti was used to code and analyse the interviews. The use of coding contributes to a clearer overview among the interviewees. In coding the transcripts, deductive coding was used. These deductive codes were derived from the literature on boundary spanning. Also, connecting the existing literature that was used in the theoretical framework with the results from the interviews, helped to analyse differences and similarities between the cases. In order to compare the four different cases with each other, the conceptual model was used as structure. The cases were analysed based on the variables in the conceptual model starting from the right (network performance) and ending with the variables on the left. These variables based on the literature, were being connected with the data from the interviews, as well as documents that were found online related to the cases. Tables based on the coding scheme were used to create a clear comparative structure between the different cases. Besides the tables, quotes from the interviews and online documents were being used for a more in-depth analysis on which afterwards conclusions can be made.

ETHICAL CONSIDERATIONS

Before the interview will be conducted, the participants were informed about the length and purpose of the research. In addition to this, the participants were also informed about their rights. It was possible for the participants to decline to participate at any time, end the interview or ask for the erasure of materials that the participant does not want to include in the research (Lichtman, 2013). Also, participants are guaranteed anonymity if requested. The participants also had to sign a declaration of informed consent. In this declaration the points mentioned above are described. After completing the interview, the gathered data was stored on personal storage. According to Dunn et al. (2010) personal interaction can be influenced by norms and values, expectations, and power structures. However, the researcher in this case can be seen as an outsider with interests in the concepts of boundary spanning and public-private partnerships in infrastructure projects. There are no other interests in this research than gathering the required information to make contributions to boundary spanning and the comparative performance of the contract types.

This chapter will present the findings that were gathered from the interviews of the four selected cases. Before the results of this study will be shown, a bit more context is needed on the cases that are used in this thesis. The context will provide a better understanding of the results. The focus of this chapter lies on explaining the impact of boundary spanners on the network performance in DBFM and D&C projects. Therefore, the variables network performance, boundary spanner roles and strategies, trust, personal network, and the contract type will be discussed. In the following paragraphs after the case description will be elaborated on these results. First a comparison of the selected cases is made based on network performance aspects. Then afterwards, a comparison is made based on boundary spanner roles and strategies. After analysing these variables first, an analysis can be made on how the boundary spanners' roles and strategies influence the network performance. Furthermore, an analysis is done on the effects that trust and personal networks have on the network performance of infrastructure projects in the Netherlands.

CASE DESCRIPTION

As mentioned in the case selection, a total four cases were studied that are all infrastructure projects in the Netherlands. These cases can be divided into DBFM and D&C projects. For both contract types a high and low performing case was selected to find out if the contract type affects the boundary spanner.

D&C CONTRACT

Case 1: N50 Ens-Emmeloord

The first case that was used in this thesis, is the D&C project N50 Ens-Emmeloord. This project is located in the province Flevoland. According to Project Team Verbreding Ens Emmeloord (2021), the goal of this project was to improve the safety of the road and to increase the traffic flow between the cities of Ens and Emmeloord. To achieve this, the road has been widened from a 2x1 lane to 2x2 lanes. Also, a bus crossing has been replaced by a viaduct. This adjustment made it possible to also access the N50 from Emmeloord Zuid. This project can be seen as a relatively small project with a project budget of 17 million euros (Staatscourant, 2012). The construction of the project took one year and was realized in 2015. According to the study of Satheesh et al. (2021) this project scored a low overall project performance.

Case 2: A2 Maastricht

The other D&C case selected for this thesis which showed high overall project performance according to the study of Satheesh et al. (2021) is the A2 Maastricht. Also, the study of Verweij &Gerrits (2014) showed that the A2 Maastricht project was creating high satisfactory outcomes due to its externally oriented management. The A2 Maastricht is located in the Province of Limburg and was realized in 2017 (A2 Maastricht, 2021). In this project multiple goals were set by the clients Rijkswaterstaat, the Province of Limburg and the municipalities of Maastricht and Meerssen. These goals were improving the accessibility of Maastricht, the region, and the business park Beatrixhaven, increasing the traffic flow on the A2/N2, improving the road safety and quality of life in surrounding neighbourhoods, creating new opportunities for urban renewal and removal of the barrier effect of the 'urban stretch' (A2 Maastricht, 2021). Compared to the N50 Ens-Emmeloord project, this project is considerably larger

with project cost of 890 million euros, including the real estate programme the project costs would rise to 1.2 billion euros.

DBFM CONTRACT

Case 3: Maasvlakte–Vaanplein

One of the DBFM projects selected for this thesis is the project Maasvlakte–Vaanplein. The project is located in the Province Zuid-Holland. According to the study of Satheesh et al. (2021) this was a low overall performing DBFM project. Also, this was one of the first DBFM projects in the Netherlands completed by Rijkswaterstaat (Neerlands Diep, 2016). The Maasvlakte-Vaanplein project started in the late 90's, began with the reconstruction in 2011, and was finally completed in 2015. The goal of the project was to decrease the amount of traffic jams and improve the traffic flow (Neerlands Diep, 2016). This was done by installing oone of the largest lift bridges in Europe (Ballast Nedam, 2021). The Maasvlakte-Vaanplein project can be seen as a large project with a total budget of 1.5 billion euros.

Case 4: SAA: A1/A6 Diemen-Almere Havendreef

The last case that was selected for this thesis is part of the Schiphol-Amsterdam-Almere programme, which is the largest road infrastructure programme in the next ten years in the Netherlands. The selected case within the programme is the DBFM project A1/A6 Diemen – Almere Havendreef. This project can be seen as a high performing project that even won the price for 'Best Road Deal 2013 Europe' (Boskalis, 2021). Also, the largest aqueduct of Europe and largest railway bridge of the NL were built in this project. The goal of the project is to improve the traffic flow to increase the accessibility and diminishing nuisance in the area Schiphol-Amsterdam-Almere. The realisation phase was finished in 2017, almost three years earlier that the planned delivery in 2020 with a total budget of 4.4 billion euros for the entire SAA programme (Rijkswaterstaat, 2021).

NETWORK PERFORMANCE

To make sure that the higher performing projects show also higher performing network performance, and the lower performing projects show a lower performing network performance, a comparative analysis has been done based on the network performance aspects of Klijn et al. (2010). As was already mentioned in the theoretical framework the network performance can be divided into content and process outcomes. Therefore, for the analysis a table for each of the outcomes with their aspects can be found below and are analysed per selected case for this study.

Content outcome

CASES	INNOVATIVE CHARACTER OF THE OUTCOME	INTEGRATIVE ASPECT OF THE SOLUTION	RECOGNIZABLE CONTRIBUTION	PROBLEM SOLVING CAPACITY OF RESULTS	ROBUSTNESS OF RESULTS	RELATIOSNHIPS BETWEEN COSTS AND BENEFITS OF RESULTS
N50 ENS-EMMELOORD	No innovative character visible.	Lack of integration	Limited impact of the involvement of other stakeholders.	Effective solution solving the problem	The project will be effective for many years in the future.	Benefits are higher than the costs. A relatively small project with only minor construction.
A2 MAASTRICHT	An innovative double layered tunnel was implemented.	Making use of an integral design that consists of infrastructure, opportunities for the environment and real estate development	Large impact of the involvement of the stakeholders in decision-making.	Effective solution solving the problem	The project will be effective for many years in the future.	Benefits are higher than the costs. Liveability and quality of the city has increased.
MAASVLAKTE-VAANPLEIN	One of the largest lift bridges in Europe has been installed.	Lack of integration.	Limited impact of the involvement of other stakeholders.	Effective solution solving the problem	The project will be effective for many years in the future.	Due to friction between stakeholders the costs were increased. Still a lot of benefits of the project.
SAA: A1/A6 DIEMEN-ALMERE HAVENDREEF	The largest aqueduct of Europe and largest railway bridge of the NL was implemented.	Limited integrative aspects visible such as noise reduction.	Limited impact of the involvement of other stakeholders.	Effective solution solving the problem	The project will be effective for many years in the future.	Benefits are higher than the costs. The project finished three years earlier than planned.

Table 2. Network performance process outcome per case.

As can be seen in the table 2 above which compares the content outcome of the selected cases, the content outcomes that relate to network performance differs among the cases. The first thing that can be noticed from analysing the table is that the innovative character of the outcome is not visible at the low performing project the N50 Ens-Emmeloord in contrast to the other projects which show innovative

results. In case of the N50 Ens-Emmeloord this might be explained by the fact that the project was relatively small with a budget of 17 million euros (Staatscourant, 2012). Besides that, the goal of the project was to improve the safety and traffic flow of the road which could be implemented without using innovative solutions.

Also, the integrative aspect whereby multiple functions are part of the solutions are lacking in the lower performing projects, where the higher performing projects showed the opposite. Again, this might be related to the scale of the project (N50 Ens-Emmeloord) and the goal of the projects which was to improve the traffic flow (Project Team Verbreding Ens Emmeloord, 2021).

The third variable, recognizable contribution, which refers to the impact of the stakeholders on the decision-making process showed different results. Every case showed a limited impact of the other stakeholders in decision-making processes except for the A2 Maastricht case. This might partially be explained by the fact that the A2 Maastricht case was located in the middle of a large city while the other projects were road infrastructure projects between cities or ports where less stakeholders were involved.

The fourth variable, the problem-solving capacity of the results can be seen effective among all the cases. All the cases have met their goals at the end of the project.

The same can be said for the variable robustness of results. This variable refers to the effectiveness of the project in the upcoming years. So far, no indicators show that a project will not be effective in the years to come.

Lastly, the relationships between costs and benefits were being compared. Except form the MaVa case the benefits of the projects seem to outweigh the costs. For example, the A1-A6 Diemen-Almere Havendreef was even finished three years earlier than planned (Rijkswaterstaat, 2021). The cases N50 Ens-Emmeloord and A2 Maastricht also showed more benefits due to their relatively smooth projects where not much friction took place or problems were easily solvable and by reaching their project goals. The MaVa case however, showed a lot of stagnations in the project and friction among the stakeholders what made the collaboration very difficult. This became clear in both the qualitative interview as in the document of Neerlands Diep (2016). In the end the project goals were also met in this case, this means that there are of course still many benefits for the environment, but the costs seem higher than in the other cases.

Process outcome

CASES	MANAGEMENT OF THE NETWORK	CONFLICT RESOLUTION	DEADLOCKS OR STAGNATIONS IN THE PROCESS	PRODUCTIVE USE OF DIFFERENT PERSPECTIVES	CONTACT FREQUENCY AMONG ACTORS	SATISFACTION OF THE ACHIEVED RESULTS
N50 ENS-EMMELOORD	Overall satisfied	Conflicts were easily solved via conversations with the involved actors	No significant stagnations or deadlocks could be found	Limited productive use of different perspectives	In the beginning of the project a lack of communication with other actors	High satisfaction
A2 MAASTRICHT	Overall satisfied	Conflicts were easily solved via conversations and creative approaches with the involved actors	No significant stagnations or deadlocks could be found	High productive use of different perspectives	Regular meetings with other actors	High satisfaction
MAASVLAKTE-VAANPLEIN	Overall satisfied	Several conflicts took very long to solve	Stagnations in the project due to different interpretations and expectations among actors	Limited productive use of different perspectives	In the beginning of the project a lack of communication with other actors.	High satisfaction
SAA: A1/A6 DIEMEN-ALMERE HAVENDREEF	Overall satisfied	Conflicts were easily solved via conversations with the involved actors	No significant stagnations or deadlocks could be found	Limited productive use of different perspectives	Regular meetings with other actors	High satisfaction

Table 3. Network performance process outcome per case.

The first variable for explaining the overall process outcome is the management of the network. This refers to the level of satisfaction in which actors are involved in the project. In analysing the results from table 3, it seems that overall, the involved actors were satisfied with their involvement in all the projects. This was also mentioned for example in the MaVa evaluation report (Neerlands Diep, 2016).

The second element, conflict resolution was quite successful in the analysed cases. The only case that was having problems solving the conflicts was the MaVa case. The reason for this was the approach in which a large part of the responsibilities was assigned to the market parties, while the project organisation mainly played a role on the background.

Another difference that can be derived from the respondent interview and the table is that the A2 Maastricht not only made use of conversations but also more creative approaches to solve conflicts. Such as letting actors design their own plan which would then be implemented. Same as in the previous

variable, the MaVa case was the one that really differs. In the MaVa case the 'Bahama' approach, which means that the project organisation stayed on the background and assigned a large part of the responsibilities to other actors, created different expectations and interpretations among all the actors (Neerlands Diep, 2016). In the interview became clear that this created a deadlock where different actors held another accountable. In the other cases no big stagnations took place and were easily solvable.

The fourth variable, productive use of different perspectives, only stood out in the A2 Maastricht case. This could probably be related due to its location which included many actors and common ground to make the project work. In the other cases the projects were completed without really making use of different perspectives besides the standard procedures where actors can make objections against the project.

The fifth variable, contact frequency among actors, was lacking in the beginning of the lower performing projects the N50 Ens-Emmeloord and MaVa according to the interviews. The reason for this in the N50 Ens-Emmeloord case was because of an unexperienced team that started the project and was eventually replaced which led to better communication with other actors. The MaVa case was lacking communication with other actors in the beginning due to the previously mentioned Bahama approach that Rijkswaterstaat used. Later in the project Rijkswaterstaat stepped away from this approach and started to interact more with the other actors to improve the collaboration again. The other two cases show that that interact with other actors through regular meetings. However, they did mention that when needed extra meetings were planned to avoid problems in the project. The last variable, satisfaction of achieved results, were high in every project since all the project goals were met.

When analysing both the tables it is shown that the higher performing projects, the A2 Maastricht, and A1/A6 Diemen-Almere Havendreef both also show better network performance than the overall lower performing projects of the N50 Ens-Emmeloord and MaVa. Another interesting point when analysing the tables, is that both tables don't show differences between DBFM or D&C contract types.

BOUNDARY SPANNER ROLES AND STRATEGIES

The four cases in this research were used to find out which roles and strategies were used by boundary spanners. As the tables 4 and 5 below show, a comparison was made between the cases where results can be derived from. Since this is a comparative study both DBFM and D&C projects are placed next to each other to identify the similarities and differences in general. After the tables a more in-depth analysis supported by quotes from the respondents will provide a better understanding of the differences and similarities between the cases and contract types.

Boundary spanning roles

CASES	BROKER	SYNTHESIZER	TRANSLATOR
N50 ENS-EMMELOORD (D&C)	Visible. Making use of an actor analysis to gain insights into potential obstacles and problems within the network.	Visible. A conflict got solved by finding common ground and using other perceptions to solve the issue.	Visible. Information meetings were being held to inform other actors.
A2 MAASTRICHT (D&C)	Visible. Making use of an actor analysis to gain insights into potential obstacles and problems within the network.	Visible. By making use of other perceptions the design has been adjusted for cyclists.	Visible. Information meetings were being held to inform other actors.
MAASVLAKTE-VAANPLEIN (DBFM	Partially visible. An actor analysis is only used to inform involved actors, instead of also gaining insights in potential obstacles and problems.	Not visible. In a large part of the project the boundary spanner was absent.	Not visible. In a large part of the project the boundary spanner was absent.
SAA: A1-A6 DIEMEN-ALMERE HAVENDREEF (DBFM)	Partially visible. An actor analysis is only used to inform involved actors, instead of also gaining insights in potential obstacles and problems.	Limited visible. Due to the focus on communication instead of collaboration.	Visible. Information is made understandable across organizational boundaries by informing parties such as local companies that approached the boundary spanner about construction works. But also, via traffic management.

Table 4. Boundary spanning roles per case.

Boundary spanning strategies

CASES	ENTREPRENEURIAL STRATEGY	MEDIATING STRATEGY	HIERARCHICAL STRATEGY
N50 ENS-EMMELOORD (D&C)	Not visible. No creative approaches in contacting and connecting people and organizations within the network could be found.	Partially visible. Searching for common ground between actors through trust-building and paying respect to everyone's position and opinions with the goal to create a common understanding was visible, but collaboration was lacking	Visible. Even though the N50 Ens-Emmeloord case didn't encounter any large problems they still had escalation lines with different levels in case things might go wrong.

A2 MAASTRICHT (D&C)	Visible. Via the sounding board ideas were sent in and the boundary spanner connected with the environment by literally changing seats with other actors.	Visible. By paying respect to everyone's position and opinion and trying to collaborate, common ground was being searched to keep the project running smoothly without any resistance.	Visible. Multiple times friction was encountered, but only when no solution could be found, the problem was moved to a higher level of decision making.
MAASVLAKTE-VAANPLEIN (DBFM)	Not visible. No creative approaches in contacting and connecting people and organizations within the network could be found.	Visible. By paying respect to everyone's position and opinion and trying to collaborate, common ground was being searched to restore the relationship between actors.	Visible. leading managers were being used to break through processes as a last resort when conversations and processes got stuck.
SAA: A1-A6 DIEMEN-ALMERE HAVENDREEF (DBFM)	Not visible. No creative approaches in contacting and connecting people and organisations within the network was lacking.	Partially visible. Characteristics of searching for common ground among and paying respect to everyone's position and opinion can be found, but it is lacking collaboration.	Visible. During stagnations the problems got scaled up. However, eventually the stagnation got scaled down again to solve the issue.

Table 5. Boundary spanning strategies per case.

When analysing the tables, it becomes clear that DBFM projects show different outcomes than the D&C projects regarding the boundary spanning roles and strategies. Especially in the D&C projects a more complete boundary spanner where collaboration takes place is visible than in the DBFM contracts where it is more about stakeholder management via communication. The A2 Maastricht can be seen as the project where the boundary spanner roles and strategies are the best visible.

BOUNDARY SPANNER ROLES USED IN D&C PROJECTS

The literature mentioned in chapter two that the role of the boundary spanner is to link the organization they represent with its environment Williams (2002). In doing this, three different boundary spanning roles (Feldman & Khademian, 2007) and strategies (Nederhand et al. 2018) can be applied. The three boundary spanning roles are broker, translator, and synthesizer. The three boundary spanning strategies are entrepreneurial, mediating, and hierarchical.

In the case of N50 Ens-Emmeloord as in the case of A2 Maastricht the role of a boundary spanner as a broker can be spotted. This role of a broker means that information from several perceptions is gathered and spread outside of the organizational boundary. This role as a broker offers the possibility to gain insights into potential obstacles and problems within the network (Feldman & Khademian, 2007).

This quote shows that by making use of an actor analysis several perceptions are gathered that will also give insights into potential obstacles and problems which relates to the definition of a broker.

Besides the role of a broker also in both cases the role of a synthesizer can be found. A synthesizer is helping to find common ground and foster collaboration. This is achieved by moving beyond translating information and trying to combine several perceptions in search of new ideas and concepts. The quote below from the case N50 Ens-Emmeloord shows a good example of a small conflict between Rijkswaterstaat and a local farmer, where the problem is being solved by finding common ground and adjusting the construction through insights of other actors.

''I had a conversation with a local farmer at his kitchen table about the cars shining their headlights into the kitchen at night due to the constructed road. Through this conversation we took measures to solve the problem. By taking these measures conflicts within the project can easily be solved.''
Respondent N50 Ens-Emmeloord

Next to the previous roles, also the role of a translator has come forward in both cases. A good example of the role as a translator can be found in the case of A2 Maastricht. This case shows the characteristics of a translator since it focuses on making information understandable and thereby usable across organizational boundaries. This translation of information between organizations helps to create a mutual understanding.

''I was the link between the project and the outside world, so the residents, but also interest groups and companies. I had some sort of liaison officer role. On the one hand I had to explain how we were going to do things, but I also had to collect questions, wishes and requirements from the outside world, and give them a place in the organization.''
Respondent A2 Maastricht

BOUNDARY SPANNING ROLES USED IN DBFM PROJECTS

As was already described in the previous sections and the literature, there are three different roles that boundary spanners could use to connect their organisation with the environment. The role of a broker where information from several perceptions is gathered and spread outside of the organizational boundary to gain insights into potential obstacles and problems within the network is not really coming forward in both the high performing A1/A6 Diemen-Almere Havendreef case as in the low performing MaVA case. Both cases do make use of a stakeholder analysis. However, this stakeholder analysis is more used to inform involved stakeholders than gaining insights in potential obstacles and problems. The MaVa case gives a good example of this.

''We made a stakeholder analysis and approached the stakeholders form there. This was more public-oriented, whereby it is more about informing the stakeholders instead of collecting information. In addition, we used blue organizations (municipal or government) that have a very large reach, but this was more to inform than to really involve and see what kind of solution you can create.''
Respondent MaVa

Also, the synthesizer role which focusses on finding common ground and foster collaboration trying to combine several perceptions in search of new ideas and concepts is lacking in the cases of the A1/A6 Diemen-Almere Havendreef and MaVa. This became already clear in the previous quote of the MaVa case that the focus is more on communication instead of creating solutions together.

Despite the overall lacking synthesizer role, the case A1/A6 Diemen-Almere Havendreef did show a minor synthesizing role in the project where the boundary spanner in this project described that boundary spanner changed the project on a minor point due to complaints from residents. By adding the perceptions of the residents into the project and striving for common ground, a new noise barrier was implemented in the project

''In one of the conversations at home of the residents I got the question if we could also build a noise barrier. I told them that the project was already fixed in the Infrastructure Act and therefore couldn't change the project. However, at a certain moment I did manage to give a small neighbourhood a noise barrier. Those people who lived there were very happy because of the reduced noise, which improved their liveability.''
Respondent A1/A6 Diemen-Almere Havendreef

In the MaVa case the boundary spanner also had a different role that was not mentioned in the theory of Feldman & Khademian (2007). In this project there was a lot of friction between the contractor and other stakeholders. In this case the boundary spanner's role was to resolve the disputes between the other actors. This has been done by a lot of talking and finding common ground among all the actors. This shows some similarities with the synthesizing role, but instead of bringing different perceptions together to create new concepts and ideas, it is more about solving the friction between parties by placing the boundary spanners as a point of contact to each of the actors to build a better relationship.

''The port authority no longer wanted to speak to the contractor. We had to restore this, we had to talk to each other again and sort out the demands from each actor. We solved this by first talking again and adding people from my team to a designated stakeholder who they were responsible for. From this point we slowly started the contact between the actors again.''
Respondent MaVa

Same as the broker and synthesizer roles, the translator role cannot be found in both the high performing A1/A6 Diemen-Almere Havendreef case and the low performing MaVa case. This boundary spanning role focuses on making information understandable and thereby usable across organizational boundaries. The translation of information between organizations helps to create a mutual understanding. Only in the case of A1/A6 Diemen-Almere Havendreef a translating role was visible by making information understandable across organizational boundaries by informing parties such as local companies that approached the boundary spanner about construction works. But also, via traffic management with the help of road signs.

Compared to the D&C projects, the DBFM projects showed different results in the roles that were applied. Especially in the case of MaVa. A possible explanation for this could be related to the age of the project. The MaVa was one of the first DBFM projects completed in the Netherlands and the role of Rijkswaterstaat was different than in the other cases. In this case Rijkswaterstaat handed out the contract to the contractor and let them work together with all the other actors involved, while Rijkswaterstaat was watching on the sideline until the friction became too problematic and they had to intervene.

Next to the roles of Feldman en Khademian (2007) also the strategies mentioned by Nederhand et al. (2018) can be identified in both the high and low performing D&C cases. Same as in the boundary spanning roles section, also multiple strategies can be found in both cases. However, only in the A2 Maastricht case the entrepreneurial strategy was being used. As previously was mentioned in the literature, characteristics of this strategy are finding creative approaches in contacting and connecting people and organizations within the network. With this strategy people are carefully selected to contact. Also, the carefully picking and avoiding conflicts and classifying relevant initiatives is part of this strategy (Nederhand et al., 2018). The entrepreneurial strategy shares similarities with the boundary spanner as a synthesizer, since a synthesizer is combining and adding perceptions in the search for new, creative ones to align diverging positions. The quote below from the A2 Maastricht gives an example of a creative approach to connect and contact actors. In the N50 Ens-Emmeloord case no creative approaches in contacting were being used. Therefore, these cases differ slightly in their strategies.

''What we also have done, was collecting ideas from a sounding board. In one case I literally changed seats with a resident who commented that he didn't like the noise barriers. This resident was then given the opportunity to create his own design with the budget I gave him. We have actually realized his plan since the noise barrier was now hidden from view''
Respondent A2 Maastricht

Where the entrepreneurial strategy could only be found in the A2 Maastricht case, the mediating strategy was used in both cases. As mentioned before, the characteristics of the mediating strategy are searching for common ground between actors through trust-building and paying respect to everyone's position and opinions with the goal to create a common understanding on which a collaboration can be based (Nederhand et al., 2018). However, it is important to mention that in the N50 Ens-Emmeloord case less collaboration took place due to the low number of stakeholders and simplicity of the project. Therefore, it can be argued whether pure boundary spanning took place or a mix of good stakeholder management with some boundary spanning characteristics regarding the minor collaboration. The quote below from the A2 Maastricht case shows that by paying respect to everyone's position and opinion and trying to collaborate, common ground was being searched to keep the project running smoothly without any resistance.

''At a certain moment during the project an important crossroad was being closed. In order to realize this, we have discussed the possibilities extensively with the neighbourhood platform. We even had them make suggestions. We made choices based on these suggestions and fed them back to the neighbourhood platform.''
Respondent A2 Maastricht

Besides the previously mentioned strategies, also the hierarchical strategy comes forward in the N50 Ens-Emmeloord as the A2 Maastricht case. According to Nederhand et al. (2018) this strategy is being used to break through processes with the help of leading managers and seen as a last resort when conversations and processes are stuck. Both cases showed examples of this strategy when conversations got stuck. In the A2 Maastricht case multiple times friction was encountered, but only when no solution could be found, the problem was moved to a higher level of decision making. However, even though the N50 Ens-Emmeloord case didn't encounter any large problems they still had escalation lines with different levels in case things might go wrong in the project.

''Within the organization of Rijkswaterstaat, there is also a division. The project manager does more of the administrative consultation, which also includes the mayor and the provincial executive. This means that you have contacts on multiple levels behind which your escalation lines lie, so to speak''
Respondent N50 Ens-Emmeloord

A possible explanation for the lacking entrepreneurial strategy in the N50 Ens-Emmeloord case compared to the A2 Maastricht can be due to the complexity of the project. Whereas the N50 Ens-Emmeloord case took place in a more rural environment and relatively small project often fewer creative approaches are needed to satisfy the actors and less actors were involved. While the A2 Maastricht case was a much larger and more complex project and creative ideas were needed to succeed. This difference in complexity and project size might also explain why in the high and low performing D&C cases only the A2 Maastricht shows examples of the entrepreneurial strategy. Again, this difference in complexity and project size might also explain why the hierarchical strategy was not being used in the N50 Ens-Emmeloord case since the project impact on the environment was not as big as in the A2 Maastricht case.

BOUNDARY SPANNING STRATEGIES USED IN DBFM PROJECTS

In order to make a comparison with the D&C projects also the DBFM cases are analysed on the three strategies mentioned by Nederhand et al. (2018) The entrepreneurial strategy was not really visible in the A1/A6 Diemen-Almere Havendreef. As was also often the case with the boundary spanning roles, in both DBFM cases the strategies do not fully align but share some of the characteristics. For example, in the A1/A6 Diemen-Almere Havendreef case, the characteristic of carefully picking people with the use of a stakeholder analysis to avoid conflicts was visible. However, no creative approaches in contacting and connecting people and organisations within the network was visible. Therefore, the strategy leans more towards stakeholder management than the entrepreneurial boundary spanning role.

''At the start of a project a stakeholder analysis will be made. Based on the stakeholder analysis the stakeholders will be divided whether they have a lot of importance or little importance, and if they have a lot of influence or little influence. This is a sort of x and y axis, in which much or little influence is plotted, and much or little importance. The stakeholders with a lot of importance and influence will then be more focused on than the stakeholders with little influence and less importance''.
Respondent A1/A6 Diemen-Almere Havendreef

The other strategy mentioned by Nederhand et al. (2018), the mediating strategy, can both be found in the high performing DBFM project A1/A6 Diemen-Almere Havendreef as in the low performing MaVa project. However, the mediating strategy used in the A1/A6 Diemen-Almere Havendreef does not align perfectly with the literature.

In this case the characteristics of searching for common ground among and paying respect to everyone's position and opinion can be found, but it is lacking collaboration. The quote that was already used at the synthesizing role of this case shows similar characteristics, where a noise barrier was installed to find common ground and paying respect to the position and opinion of other actors. The MaVa case showed in the synthesizing role section with their quote that common ground was needed again through by letting the parties talk with each other again to strive for better collaboration. However, despite the efforts made by the boundary spanner the friction in the project became too high to fully restore the relationship.

''There was a lot of recovery with MaVa, and I wonder whether it ever turned out well. At one point the relationship was workable, but it has never again quite worked out between the stakeholders and the contractor''
Respondent MaVa

In contrast to the previously mentioned strategies, the hierarchical strategy can be found in both cases. Both cases show examples whereby scaling up to leading managers was being used to break through processes as a last resort when conversations and processes are stuck. Again, the hierarchical strategy does not perfectly align with the literature in the case of A1/A6 Diemen-Almere Havendreef. At a certain moment the project got stuck to the highest level of governance in a discussion about the ownership and responsibility shifting of the bus lane. In this case the scaling up didn't work eventually, due to this result the problem was then scaled down to the boundary spanner who eventually solved the problem. At the end this example shows similarities with the mediating strategy where a common understanding was at the basis of a collaboration to solve the issue.

''This problem got the highest level, at the level of the director-general and the deputy of the province. The director-general and the deputy of the province didn't manage to solve the issue, then it came back to my level again. When I got allowed to solve it, I entered a discussion with the colleagues working at the province and talked about our strategy to solve the issue. At the end the problem was solved in collaboration with the province.''
Respondent A1/A6 Diemen-Almere Havendreef

The MaVa case also shows characteristics of the hierarchical strategy during the interview with the boundary spanner. In this case the boundary spanner explained that some decisions can only be made at a certain level. Especially when the financial aspect is involved.

''Colleagues from my team often don't have the mandate. Especially when it comes to money you can't provide the mandate on the workplace level, these decisions are made on a higher level.''
Respondent MaVa

Same as in the role section of DBFM boundary spanners also in the strategies section there are differences between the projects. This difference in strategies can likely be related to the same reason that explained the difference in roles between both DBFM cases, namely that the boundary spanning strategies were not present until the deadlock between the contractor and other actors took place.

THE EFFECTS OF BOUNDARY SPANNERS ON THE NETWORK PERFORMANCE

The analysis of the boundary spanning strategies and roles shows that multiple roles and strategies were used in both the D&C contracts and the DBFM contracts. The identifying of the roles and strategies makes it possible to find out how the roles and strategies influence the network performance. As the section on network performance showed, the network performance can be divided into content and process outcomes. Due to the use of multiple roles and strategies both in the DBFM as in the D&C cases it is not possible to apply a single role or strategy to a network performance aspect. Despite this fact the analysis shows that some aspects of the network performance might be related to certain boundary spanner strategies or roles.

First the content outcome was analysed and compared with the boundary spanning strategies and roles to find out if the content outcome might be influenced by strategies and roles that were used by boundary

spanners in the project. Table 6 shows that the boundary spanner might influence the innovative character of a project. The role of synthesizer might be responsible for the innovative character since the synthesizer is trying to combine several perceptions in search of new ideas and concepts. This boundary spanner role was visible in the A2 Maastricht where an innovative tunnel was built, and in the A1/A6 Diemen-Almere Havendreef where the synthesizing role was limited visible minor adjustments were made to the project.

The integrative aspect of the solution was partially related to boundary spanning roles or strategies since the project differ a lot in complexity not always multiple goals needed to be integrated. An example of this was already given in the analysis on network performance. N50 Ens-Emmeloord is a much simpler and smaller project where less actors where involve than the A2 Maastricht for example. Due to the process that leads to the integrative aspect of a solution it is not possible to apply a single role or strategy to this aspect. However, boundary spanning roles and strategies do help to create an integrative solution via the mediating strategy which searches for common ground and collaboration, and the entrepreneurial strategy which gives movement to the mediating strategy as was mentioned by Nederhand et al. (2018). Also, roles such as a synthesizer or broker might play a role.

The third aspect, recognizable contribution of stakeholders in decision-making can be related to boundary spanning roles and strategies. Again, this is related to multiple strategies and roles since some of the characteristics overlap. The roles that can be related to this aspect are the role of a broker and synthesizer. Since the role of a broker is to gain insights into potential obstacles and problems within the network that can be used in decision-making. Besides that, the synthesizing role comes back again due to the focus on combining several perceptions. These roles were all visible or partially visible in both the A2 Maastricht and A1/A6 Diemen-Almere Havendreef. However, the A1/A6 Diemen showed only limited recognizable contribution, but this might be related to the limited collaboration and more focus on communication as mentioned in the previous section on boundary spanner roles. Besides the roles, also the entrepreneurial and mediating strategy can play a role. For the same reasons as mentioned by the integrative aspect.

The aspect of problem-solving capacity of results is difficult to relate to boundary spanning since this is not only related to the communication and collaboration with other actors but also external factors. Same can be said for the robustness of results. Lastly the the boundary spanner does seem to have an influence on the relationships between costs and benefits of results. An example was already given in the MaVa case where due to a lack of boundary spanning in the beginning of the project stagnations took place and therefore the costs increased.

CONTENT OUTCOME	INNOVATIVE CHARACTER OF THE OUTCOME	INTEGRATIVE ASPECT OF THE SOLUTION	RECOGNIZABLE CONTRIBUTION OF STAKEHOLDERS IN DECISION-MAKING	PROBLEM SOLVING CAPACITY OF RESULTS	ROBUSTNESS OF RESULTS	RELATIOSNHIPS BETWEEN COSTS AND BENEFITS OF RESULTS
BOUNDARY SPANNING ROLES OR STRATEGIES THAT HAVE AN EFFECT.	The synthesizer role.	The broker and synthesizer role. The mediating and entrepreneurial strategy.	The broker and synthesizer role. The mediating and entrepreneurial strategy.	Not affected by boundary spanners.	Not affected by boundary spanners.	Partially related to the presence of boundary spanners.

Table 6. The effect of boundary spanners on the content outcome.

Besides the content outcome, also the process outcome was analysed and compared with the boundary spanning strategies and roles to find out if the process outcome might be influenced by strategies and roles that were used by boundary spanners in the project. Table 7 gives an overview on the effect that boundary spanners have on the process outcome. The management of the network referred to the level of satisfaction in which actors are involved in the project. As the previous sections on boundary spanning roles and strategies made clear the boundary spanners play an important role in collaboration and communication, otherwise stagnations or frictions will arise. Both the N50 Ens-Emmeloord and the MaVa case showed that this network management was lacking when boundary spanners were absent.

The second aspect, conflict resolution showed again the importance of boundary spanners. Especially the mediating and hierarchical strategy were used here. The MaVa case used the mediating strategy to bring actors closer together, but also the hierarchical strategy was used to break through processes in the A1/A6 Diemen-Almere Havendreef project. Besides strategies the boundary spanner was also using the role as a broker or synthesizer to solve conflicts. In the cases that used the role of a broker. First this role was used to gain insights into potential obstacles and problems, afterwards the synthesizer role was used to search for common ground. The same roles and strategies were also used when deadlocks or stagnations were encountered in the process of a project.

The aspect productive use of different perspectives also seems to be influenced by boundary spanners. Again, multiple roles and strategies are related. The role of a broker played a role due to its character of gathering and spreading information. Same can be said for the synthesizing role that tries to combine several perceptions in search of new ideas and concepts. Also, the entrepreneurial and mediating boundary spanning strategies are related. The A2 Maastricht showed that the entrepreneurial strategy connects different actors and thus their different perspectives which were used in the project. Same can be said for the mediating strategy that focusses on collaboration and therefore actors with different perspectives have worked together.

The aspect of contact frequency can also be related to be affected by boundary spanners. In the section of network performance, the results showed that in for example the N50 Ens-Emmeloord and the MaVa project, contact frequency started to increase when boundary spanning took place. This was done by using the mediating strategy and by using the entrepreneurial strategy which could be found in the A2 Maastricht project. Next to the strategies, all the boundary spanner roles seem to play a role in the contact frequency with other actors since these are all related to contact with actors.

The last aspect, satisfaction of achieved results are probably related to boundary spanners too. However, this aspect is difficult to analyse since in this study no projects were analysed that did not include boundary spanners. Therefore, no analysis on the effect of boundary spanners on the satisfaction of the achieved results can be made, besides the fact that all projects showed satisfactory outcomes.

PROCESS OUTCOME	MANAGEMENT OF THE NETWORK	CONFLICT RESOLUTION	DEADLOCKS OR STAGNATIONS IN THE PROCESS	PRODUCTIVE USE OF DIFFERENT PERSPECTIVES	CONTACT FREQUENCY AMONG ACTORS	SATISFACTION OF THE ACHIEVED RESULTS
BOUNDARY SPANNING ROLES OR STRATEGIES THAT HAVE AN EFFECT.	All boundary spanning roles and strategies.	The mediating and hierarchical strategy. The broker and synthesizer role.	The mediating and hierarchical strategy. The broker and synthesizer role.	The mediating and entrepreneurial strategy. The broker and synthesizer role.	The mediating and entrepreneurial strategy. All boundary spanning roles.	The effect of boundary spanners on this aspect is unclear.

Table 7. The effect of boundary spanners on the process outcome.

THE EFFECTS OF THE PERSONAL NETWORK ON NETWORK PERFORMANCE

Besides the roles and strategies that boundary spanners use, also the role of their personal network was being investigated. The effect of the personal network was being investigated based on the theory of Brion et al. (2012). In their theory they stated that personal networks have a positive impact on the boundary spanning activities, which improve the performance of a project. The results show that the boundary spanners in the cases that were selected for this thesis did not make use of their personal network besides work relations. One of the reasons that was given and applies to the other cases, can be found in the N50 Ens-Emmeloord case.

''In a project you are always part of a project team together with people from the province of municipality. Also, after organizing information evenings with other actors at a certain moment, you will get to know the others. However, you are only working in the area during the time of the project. When the project is finished you move on again. This means that the relations are only temporary for the time of the project.''
Respondent N50 Ens-Emmeloord

This quote clearly highlights that only working relations are being formed and used as a personal network. Another reason why only work relations are used can be found in the A2 Maastricht case, but also applies to the other cases. The A2 Maastricht case shows that the boundary cares a lot about their integrity.

'I have never used my personal network. I am extremely wary of using my personal network besides work relations. I also notice that Limburg is known for their 'old boys' network, well that is not going to help. That will rather work against you.''
Respondent A2 Maastricht

While no private personal network is being used in all the cases, it is worth noting that the communication and collaborations led to work relations. In multiple cases it seemed that these personal work relations also increased trust. As the quote below shows, maintaining work relationships with other actors, trust can be managed.

THE EFFECTS OF TRUST ON THE NETWORK PERFORMANCE

According to the literature trust was seen as one of the most important variables for a good network performance. Therefore, also trust was analysed in the cases. The variables mentioned by Sorensen & Torfing (2009) were used to identify and analyse the trust in the selected cases. Trust can be identified by looking if there is agreement among actors, absence of opportunistic behaviour and showing goodwill. As was mentioned by Vangen & Huxham (1998) building trust is also a cyclic process due to expectation forming and risk taking, when the expectations are met, trust was increased. Every case that was analysed in this research showed that the boundary spanner played an important role in gaining trust and therefore improve the network performance. Especially meeting the expectations seemed to be an important aspect. A good example can be found in the A2 Maastricht case where meeting the expectations every time leads to less friction in the project.

''I think we have been very proactive in approaching. In addition, we had a generous budget, an extensive communication strategy and were transparent. We also kept to the agreements. If we said that the construction would take ten weeks, then it was ten weeks maximum, usually less''
Respondent A2 Maastricht

In contrary to this example, the MaVa case showed that when trust is lacking, also collaboration and thus the network performance is lacking. As previously mentioned in the sections of boundary spanning roles and strategies, the MaVa case was struggling with bringing actors together due Rijkswaterstaats' approach of handing out the project and watching from the sideline, which eventually led to the parties not trusting each other anymore due to conflicts and no interventions from Rijkswaterstaat till it was too late. However, when Rijkswaterstaat intervened as a boundary spanner by connecting different stakeholders and trying to collaborate, trust increased, and the relationship became workable again.

CONCLUSION

By analysing the interviews in combination with policy documents and the literature, several conclusions can be made from the results. The analysis showed besides the expected results also a few surprising results in contrast to the literature mentioned in the theoretical framework. To answer the main research question of this study, first the sub questions will be answered. The main research question of this study is: ***How do boundary spanners impact the network performance of DBFM and D&C infrastructure projects?*** By combining the conclusions on the sub questions a clear answer can be given on the main research question.

SUB QUESTION 1: DOES THE USE OF BOUNDARY SPANNERS LEAD TO MORE TRUST BETWEEN ACTORS?

The theory of by Vangen & Huxham (1998) stated that building trust is a cyclic process due to expectation forming and risk taking, when the expectations are met, trust was increased. The case of

MaVa shows very clear that a boundary spanner can play an important role to improve trust between actors by meeting expectations. Later in the project the project a boundary spanner was implemented to improve collaboration again which is created by trust. Therefore, it can be concluded that making use of boundary spanners lead to more trust between actors.

The research of Koppenjan et al. (2020) showed that DBFM has a slight network performance advantage over D&C projects. However, the cases that were studied in this research showed that there is no network performance advantage of DBFM projects over D&C project according to the analysed cases. The results showed that the overall high performing projects (A2 Maastricht (D&C) and A1/A6 Diemen-Almere Havendreef (DBFM)) also showed better network performance. While the lower overall performing cases (N50 Ens-Emmeloord (D&C) and MaVa (DBFM)) also showed lower network performance. The network performance was measured based on the multi-criteria scale used by Klijn et al. (2010) in previous studies for measuring network performance. In their scale a distinction is made between content outcomes (hard performance) and process outcomes (evaluations). This result means that there is no network performance advantage of DBFM projects over D&C projects in this study.

CONCLUSIONS OF D&C BOUNDARY SPANNING ROLES AND STRATEGIES

Based on the results from the interview it is possible to conclude that in both the high and low performing D&C projects multiple roles are being used by persons who can be identified as a boundary spanner. Especially the role of the translator coming back in both cases seems very logical, since the boundary spanner needs to connect the organisation with its environment. To be able to connect, making information understandable and thereby usable across organizational boundaries is a requirement. All three roles, broker, synthesizer, and translator, as described by Feldman & Khademian (2007) can be found in the D&C cases. Therefore, the conclusion can be made that the different roles don't have an influence on the overall project outcome.

Besides the multiple roles being used in both D&C cases, also multiple strategies by boundary spanners were used. In contrary to the roles, a slight difference can be found between the high and low performing cases. Only in the high performing case A2 Maastricht the entrepreneurial strategy where creative connecting, and contacting could be found. The mediating strategy was used in both D&C cases. This means that in both cases finding common ground and collaboration with other actors is important in a project. However, it is important to mention that in the N50 Ens-Emmeloord case less collaboration took place due to the low number of stakeholders and simplicity of the project. Therefore, it can be argued whether pure boundary spanning took place or a mix of good stakeholder management with some boundary spanning characteristics regarding the minor collaboration. Next to the mediating strategy there was also no difference in the hierarchical strategy that is being used when processes or conversations got stuck. Both cases showed that the strategy could be used if needed. However, only in the A2 Maastricht the hierarchical strategy was being used due to some friction in the project. While in the N50 Ens-Emmeloord case easily solvable stagnations took place, which did not require the hierarchical strategy.

CONCLUSIONS OF DBFM BOUNDARY SPANNING ROLES AND STRATEGIES

In contrary to the boundary spanning roles in D&C cases, not every role was visible in the DBFM cases. The high performing A1/A6 Diemen-Almere Havendreef project and the low performing MaVa project both showed that the role of a broker was not as clearly visible as in the D&C cases. Both cases showed that the focus is more on communication than collaboration. Also, the synthesizing role is not being used by the boundary spanner in the MaVa case based on the interview. However, the boundary spanner in the A1/A6 Diemen-Almere Havendreef case did show minor similarities with the synthesizing role. In this case the perceptions of other actors were being used to strive for common ground, but the collaboration part of the synthesizing role was lacking. Also, the translating role was not used in the MaVa case, whereas the A1/A6 Diemen-Almere Havendreef case did show some examples of a translator role where information was made usable across organizational boundaries to create mutual understanding. Where most cases went quite smoothly in solving friction the MaVa case was a bit different. This probably also affected the role of the boundary spanner in the project. The main role of the boundary spanner in this project was to resolve the disputes between the other actors. The boundary spanning role looks like the synthesizing role, but where the synthesizing role bring different perceptions together to create new concepts and ideas, in this case perceptions and ideas were brought together to solve friction between parties. This was done by placing each of the members of the boundary spanning team as a point of contact to each of the actors involved.

In this case the boundary spanner's role was to resolve the disputes between the other actors. This has been done by a lot of talking and finding common ground among all the actors. This shows some similarities with the synthesizing role but instead of bringing different perceptions together to create new concepts and ideas it is more about solving the friction between parties by placing the boundary spanners as a point of contact to each of the actors.

Same as in the role section of the DBFM projects, also in the strategy section became clear that in both the A1/A6 Diemen-Almere Havendreef and the MaVa case mainly the mediating and hierarchical boundary spanning strategies were visible. Whereas in the D&C cases the strategies were better visible, in the DBFM cases often not every characteristic of a strategy was visible, mainly due to the lack of collaboration.

COMPARING THE D&C AND DBFM BOUNDARY ROLES AND STRATEGIES

By comparing the results of D&C and DBFM projects, there is not much difference in both the strategies and roles that are being used by boundary spanners in the selected cases. The two cases that stand out are the DBFM MaVa case and the D&C A2 Maastricht case. It is possible to conclude that due to absence of a boundary spanner in the beginning of the MaVa project led to a different role and strategy that the boundary spanner had to apply due to the deadlock between the contractor and other involved actors. Another small difference was that the DBFM cases seemed to focus more on communication which relates more to stakeholder management than collaboration aspect that clearly comes forward in the definitions of the boundary spanning roles and strategies.

By answering the sub questions mentioned above related to the boundary spanner, network performance and contract type it is now possible to answer the main research question.

First, it is possible to conclude that overall making use of the boundary spanner in a project has a positive impact on the outcome of a project. Both the MaVa and N50 Ens-Emmeloord cases showed that when the boundary spanner was absent frictions or stagnations started to arise. While the high performing cases A2 Maastricht and A1/A6 Diemen-Almere Havendreef showed that making use of a boundary spanner since the beginning of the project leads to better network performance. This conclusion confirms previous studies by Koppenjan et al. (2020) for example that indeed boundary spanners lead to better network performance. However, the focus of this research was especially 'how' boundary spanners impact network performance of DBFM and D&C contracts. By using the boundary strategies of Feldman and Khademian (2007) and the boundary spanning roles of Nederhand et al. (2018) it became possible to identify the characteristics of the boundary spanner per case. By analysing the aspects that create network performance with the boundary spanning roles and strategies it can be concluded that boundary aspects influence almost all the network performance aspects, both on the process as the content. The boundary spanner influenced process aspects are the management of the network, conflict resolution, deadlocks or stagnation in the process, productive use of different perspectives, and the contact frequency among actors. The boundary spanner also influenced the content aspects, the innovative character of the outcome, the integrative aspect of the solution, the recognizable contribution of stakeholders in decision-making, and the aspect relationships between costs and benefits of results. Only the aspects of Satisfaction of the achieved results, the problem-solving capacity of results and the robustness of results were not influenced by boundary spanners. When analysing the aspects of network performance with boundary spanner roles and strategies, it can be concluded that often multiple roles and strategies might affected the network performance.

Especially the broker and synthesizer boundary spanning roles seem to influence the network performance since these are coming forward multiple times in table 6 and 7. Also, the mediating and entrepreneurial boundary spanning strategy seem to be influencing the network performance a lot. However also the translator boundary spanning role and the hierarchical strategy seemed to influence the network performance but not as much as the previous mentioned roles and strategies.

The conclusion from this can be made that boundary spanners are not bound to a single role or strategy that they use, but often a combination of multiple roles and strategies are used. Furthermore, it can be concluded that there are no differences in the impact of the boundary spanner between the DBFM and D&C contracts. Therefore, it can be concluded that for a successful impact on DBFM and D&C infrastructure projects always multiple strategies and roles are applied.

DISCUSSION

COMPARING THE EXPECTATIONS WITH THE CONCLUSIONS

This study was based on theories and studies regarding boundary spanning and differences between public private partnerships and traditional contracts. In the case of this study the focus lied on DBFM and D&C contracts since these are the most common contract types in infrastructure projects in the Netherlands. The main goal was to find out why DBFM infrastructure projects (PPP) deliver higher network performance than D&C infrastructure projects in practice and how boundary planners influence this performance.

Based on the network performance difference between DBFM and D&C contracts it was expected that also different boundary spanning roles and strategies were used when comparing the contract types. Surprisingly, the analysed cases in this study showed that DBFM contracts do not outperform D&C contracts in terms of network performance. Arguably the best network performance was even found in the D&C project A2 Maastricht. This result was in contrast to the recently performed study of Koppenjan et al. (2020). Since their study showed that DBFM contracts performed slightly better than D&C contracts.

Besides the theories on network performance also the theories on boundary spanners showed some clear results. Beforehand it was expected that the boundary spanner played an important role in creating high network performance and that selected cases would show similar roles or strategies that were defined by Nederhand et al. (2018) and Feldman & Khademian (2007). Despite being previously used in identifying boundary spanners within organisations instead of between organisations, this study showed that multiple roles and strategies as defined by Nederhand et al. and Fledman & Khademian (2007) were used by the boundary spanners in this study and that boundary spanners indeed lead to higher network performance.

Based on the theory, also trust was expected to play an important role in creating high network performance. The results of the study showed that trust was being created by meeting expectations and this improved the overall collaboration that leads to high network performance. Therefore, this study is confirming the importance of trust that was mentioned in the previous study of Sorensen & Torfing (2009) and the study of Vangen & Huxham (1998). Especially the theory of Vangen & Huxham (1998) of meeting expectations that were formed seemed to play an important role in creating trust since multiple respondents were referring to expectation management as an important factor.

Other than the variable of trust, the variable personal network was also expected to be a very important variable. in the literature on personal networks, Levina & Vaast (2005) mentioned that a personal network develops and maintain sustainable relationships which will increase trust and lead to a better project outcome. However, the personal network was not being used by boundary spanners in this study.

EXPLAINING THE FINDINGS COMPARED TO THE THEORY

For multiple variables there are differences between the literature and the findings of this study. One of the differences was the network performance of DBFM and D&C contract types. As mentioned in the previous paragraph, the DBFM projects were expected to perform better than D&C projects while the findings of this study show otherwise. This difference in result might be explained by the difference in

analysis. The study of Koppenjan et al. (2020) was a large quantitative study, while this study was qualitative. Besides confirming Van Meerkerks' (2014) theory that boundary spanners lead to better network performance, this study seems to be confirming the expectations that the boundary spanning strategies and roles can also be applied between organisations to improve network performance instead of just within organisations. These strategies and roles could especially be beneficial for stakeholder managers both working for private or public organisations, but also others who are often contacting or collaborating with different organisations or actors. By making use of these roles and strategies from the beginning of a project, stagnations or deadlocks which eventually lead to extra costs in terms of money and time could be prevented.

Next to organisations such as Rijkswaterstaat or other organisations in infrastructure projects, also the persons who identify themselves as a boundary spanner (stakeholder managers or communication managers) can benefit by using this study as a guideline to achieve high network performance by using the strategies and roles correctly.

The conclusions on the variable of trust confirms the literature and therefore no further explanation on the outcome of the variable is needed. This means that it is important for future infrastructure projects to maintain a high level of trust in order to reach high network performance. The variable personal network does show contradictory results compared to the theory. The respondents of this study mentioned that they didn't make use of their personal network due to integrity. Therefore, this study is contradicting the importance of personal networks. However, the work relations that were gradually formed during the projects did seem to be important relationships that improved trust. It is therefore recommended that boundary spanners such as stakeholder or communication managers, and organisations related to infrastructure projects invest in their working relations. By creating these sustainable relationships trust can be increased, which in their turn lead to high network performance.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Besides the valuable conclusions that contribute to the literature on boundary spanning and the comparative performance of public-private partnerships with non-public-private partnerships, there were also a few limitations on this study. As mentioned in the previous paragraph, the outcome of this study showed different results than previous studies on the comparative network performance between DBFM and D&C contracts. Despite the interesting conclusion of this study that the DBFM contract type does not show a higher performance, it is important to mention that this might be the result of only selecting a limited number of cases that were qualitatively analysed compared to the large quantitative study of Koppenjan et al. (2020). There is the possibility that when more qualitative research will be done on infrastructure projects in the Netherlands, the results of the network performance between DBFM and D&C infrastructure projects in the Netherlands will be similar. This means that there is still room for more research on comparing the network performance on infrastructure projects. Also, the analysed boundary spanners in this research were all part of a public organisation. This does not mean that the conclusions of this study cannot be relevant for private organisations since both private and public organisations are collaborating with each other. However, this does mean that there is still room for more research on the boundary spanners working in private organisations to found out if their roles and strategies differ or align with the boundary spanners working in public organisations. Furthermore, it is recommended to also study the boundary spanning roles and strategies and their effect on network performance in other countries or fields of planning since there is still limited research on the subject.

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CODING SCHEME

Main code	Sub code	specification
Contract type		
	DBFM	Long timespan. Private financing. Design, construct and maintenance.
	D&C	Short timespan. Public financing. Design and construct.
Boundary spanning strategies		
	entrepreneurial strategy	Creative approaches in contacting and connecting people and organizations within the network. Carefully picking people to contact. Avoiding conflicts.
	mediating strategy	Searching for common ground between actors via: trust-building, paying respect to everyone's position and opinions, or argumentatively persuading officials in showing the importance of bending rules to move beyond existing tensions.
	hierarchical strategy	Focussing on breaking through processes with help of leading managers. Used when processes and conversations are stuck.
Boundary spanning roles		
	broker	Information from several perceptions is gathered and

			spread outside of the organizational boundary. The possibility to gain insights into potential obstacles and problems within the network.
	translator		Making information understandable and thereby usable across organizational boundaries. The translation of information between organizations helps to create a mutual understanding.
	synthesizer		Moving beyond translating information. Try to combine several perceptions in search of new ideas and concepts.
Trust			
			Showing goodwill. Agreement among actors. Risk Taking. Meeting expectations.
Personal network			
			Strong ties with other actors. Internal and external relationships.
Network performance			
	process outcomes		The level of satisfaction of the ways in which actors are involved in the project. Conflict resolution. To which extent the project has encountered deadlocks or stagnations in it process. The productive use of differences in perspectives.

		Contact frequency among.
		The extent to which the actors involved in the project are satisfied with the results that are achieved.
	content outcomes	How projects show innovative results.
		Is the integrative aspect of the solution.
		Recognizable contribution that is made.
		To what extent solution within the project address the problems.
		How robust the results in the future are.
		The relationship between the costs and benefits of results.

Interview ten behoeve van masterthesisonderzoek van Ewoud Zomer, student Environmental and Infrastructure Planning aan de Rijksuniversiteit Groningen. Dit onderzoek wordt onder begeleiding van Stefan Verweij uitgevoerd.

Onderzoeksdoel

Het vergelijken van de rollen/strategieën van boundary spanners in DBFM en D&C projecten, en onderzoeken hoe dit de netwerk prestaties van deze projecten beïnvloedt.

Voorwaarden deelname respondent

- Ik weet dat meedoen vrijwillig is en ik mij op elk moment, zonder opgave van reden, terug kan trekken;
- Ik geef toestemming voor het verzamelen, bewaren en gebruiken van de door mij verstrekte gegevens voor de beantwoording van de onderzoeksvraag van dit onderzoek;
- Ik kan deze gegevens ten allertijden inzien en heb de gelegenheid om te reageren op de inhoud;
- Mijn gegevens zullen, indien gewenst, anoniem verwerkt worden in de publicatie van het onderzoek;
  - **O** Ik wens dat mijn gegevens en de door mij verstrekte gegevens anoniem verwerkt worden.
- Ik wil meedoen aan dit onderzoek.

Toestemming

Datum:

Naam respondent:

....

Handtekening respondent:

....

Introduction

How were you involved in the project?

What was/were the goals of the project?

How would you describe your role in the project?

Have you worked on similar projects in the past?

Boundary spanning

How does communication with other actors take place?formal informal (example)

How is the quality of communication with other actors?

To what extent do you see yourself as someone who networks a lot with other people?

How do you connect/link different people and processes across organizational boundaries? (example)

If an obstacle arises in a project aimed at collaboration, how do you ensure that the collaboration improves again? (example)

How did you collaborate/cooperate with different actors that are involved in the project? (example)

Are you satisfied with the actor involvement in the project? (example)

What was the main objective of your strategy? (example)

What was your own role in this approach? (example)

To what extent was your approach successful? (example)

Trust

When do you think there is trust between actors? (example in the project)

How did you manage to build trust among actors? (project example)

How was this trust maintained during the project?

Personal network

To what extent do you use your personal network during projects?

To what extent did your personal network with other actors helped to achieve certain project goals?

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To what extent did these relationships of your personal network affect the performance of the project?

Do you often handout favors?

Network performance

How are conflicts regarding collaboration with other actors solved or averted in the project?

To what extent do differences in perspectives lead to productivity in the project?

To what extent are you satisfied with the contact frequency with other actors?

To what extent are you satisfied with the results that are achieved in the project?