Dealing with Uncertainty in Infrastructure Public-Private Partnership Projects

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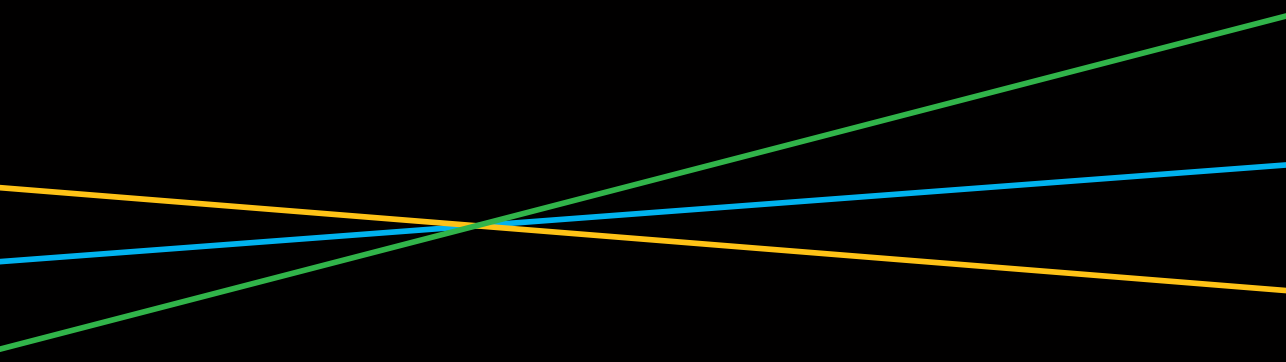
DEALING WITH UNCERTAINTY IN INFRASTRUCTURE PUBLIC-PRIVATE PARTNERSHIP PROJECTS



HATİCE ÇİĞDEM DEMİREL

Dealing with Uncertainty in Infrastructure Public-Private Partnership Projects

Hatice Çiğdem DEMİREL

Ph.D. Thesis

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Dealing with Uncertainty in Infrastructure Public-Private Partnership Projects

Dissertation

for the purpose of obtaining the degree of doctor at
Delft University of Technology
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chair of the Board for Doctorates to be defended publicly on
Monday 30 May 2022 at 15:00 o'clock

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To an uncertain world...

CONTENTS

SUMMARY

We can't just predict (Taleb, 2007).

SUMMARY

This research concerns dealing with uncertainty in infrastructure Public-Private Partnership (PPP) projects. PPPs comprise a network of actors or organizations in mutual relationships regulated by contracts. These contracts arrange a division of tasks and responsibilities between contracting parties, and they allocate risks and uncertainties. Where risk is a calculable event concerning probability and consequence, uncertainty is the unclear future state in which there is no possibility of placing a numerical probability or calculating the possible effect on an impactful event occurring. Uncertainties are inevitable in infrastructure PPPs because of the dynamic environment in which PPPs usually are implemented and the complex structure of their arrangements. Moreover, the long-term nature of the contracts increases exposure to uncertainty over the life-cycle of the project.

Although risks have been heavily discussed in the literature, the contractual and non-contractual mechanisms that each party actually applies, or may apply, in practice to deal with uncertainty are not well addressed. Therefore, the aim of this study has been to gain insight into the contractual and non-contractual mechanisms that are applied by parties involved in PPP infrastructure projects. The main research question is formulated as:

How to deal with uncertainty in infrastructure Public Private Partnership projects?

This main research question is further elaborated in the following sub-questions:

1. What potential changes typically occur in infrastructure PPP projects? How to deal with these potential changes? What is meant by flexibility in infrastructure PPP projects?
2. What mechanisms, additional to the formal contract rules, are used in practice to deal with variations in infrastructure projects, and how are these mechanisms operationalized?
3. How do financiers approach risks and uncertainty when investing in infrastructure projects? How do financiers protect their returns on investment? In what way does project governance influence the protection of financiers' returns?

The research focuses on PPP projects in the Dutch infrastructure sector. The privatization of infrastructure initially rose to prominence in the UK under the neo-

liberal agendas of national governments and expanded to other countries including the Netherlands, Australia, Canada, and the US. Since then, financiers have started to consider infrastructure as an attractive asset class for diversifying their portfolios due to their specific characteristics: long-term assets with a long economic life-cycle, low technological risk, provision of key public services, strongly inelastic demand, natural monopoly or quasi-monopoly market contexts, high entry barriers, regulated assets, a natural hedge against inflation, and stable and predictable operating cash flows. The societal trend (New Public Management) of privatization and financialization have also resulted in contracting methods for public infrastructure through PPPs. However, whereas Anglo-Saxon contractual practices emphasize the hard side of contracting, practice shows that the soft side — i.e., dialogue, cooperative behavior, good relationships, flexibility, and adaptive management — includes key factors for project success. This study therefore focusses on flexibility — i.e., the ability to deal with or adapt to changing circumstances — in infrastructure PPP projects.

The complex and inert nature of the contract arrangement and the fictitious structure of the central coordinating vehicle (Special Purpose Vehicle) in PPP projects seems to create an imbalance in the risk and uncertainty allocation within the PPP arrangement, leading to possible cost overruns, time delays, and a negative contract atmosphere (see Figure S1 below). The relatively high number of problems in ongoing PPP infrastructure projects implies that existing PPP contracts do not provide sufficient flexibility to deal with uncertainty. Hence, the focus of this study is on understanding how risk and uncertainty are managed in practice using contractual and non-contractual mechanisms by the parties involved, and what can be learned from this to improve the flexibility of PPP infrastructure projects.

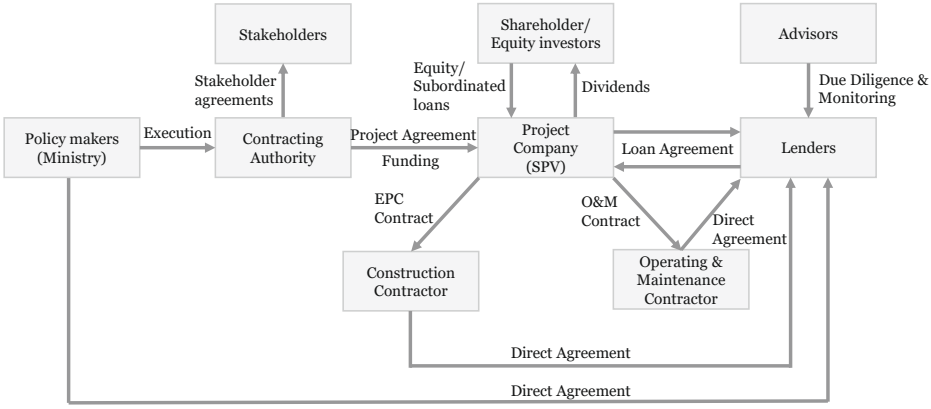


Figure S1: General Public Private Partnership structure (derived from: The World Bank, 2019)

This research is based on three empirical studies, each of which focus on a different cluster of relationships and actors. The first case study focuses on the relationship between the public contracting authority and external stakeholders such as municipalities, water boards, and port authorities. The second case study focuses on the relationship between the contracting authority and a project's SPV. The final case study focuses on financiers in types of international infrastructure PPP projects.

To answer the first research question, potential changes were identified in a typical Dutch DBFM project, the Blankenburgverbinding (BBV), a connecting tunnel between the A20 and A15 highways west of Rotterdam. Combining the various classifications of changes identified from the literature with the findings from the BBV case study resulted in the following general categories of potential changes in large PPP projects: 1) changes in the project environment, 2) financial changes, 3) changes in legislation, 4) change in politics, 5) change in organizations, 6) changes of requirements, 7) climate changes, 8) technological changes, and 9) technical changes. Having the ability to deal with or adapt to such changes and proactively incorporate dealing mechanisms in a project is in this study defined as flexibility. The study shows that the effective and continuous engagement of stakeholders - especially early in the development phase of an infrastructure project, but also throughout the life cycle of a PPP project - is a very effective mechanism for dealing with uncertainty. The continuous interaction with stakeholders provides insight into what is truly at stake and what issues are relevant or may become relevant later in the project.

The second research question focuses on the relationship between the contracting authority and the Special Purpose Vehicle (SPV) and its subcontractors. Practices in a real-life case, the Schiphol-Amsterdam-Almere (SAA) A1/A6 project, were observed to identify what contractual and non-contractual mechanisms are applied in practice - on both the public and private sides - to deal with uncertainty. The findings show that variations cannot be dealt with solely through the formal contract rules, and that additional social mechanisms between the public commissioners and the contracted companies are needed to effectively deal with uncertainty. In practice, the following dealing mechanisms were used alongside the contractual provisions: 1) the continuous building of human relationships, 2) relational governance, 3) the use of digitalized information sharing, 4) the continuous building of professional knowledge, and 5) actor competences.

To provide an answer to the third research question, the control mechanisms applied by financiers to ensure a return on their investment in PPP infrastructure projects were examined by interviewing financiers and their advisors and analysts. The results

show that financiers are mainly concerned with calculable risks that might affect their financial returns, and do not feel that uncertainties - which are inherent to a PPP infrastructure project - are their responsibility. They assume these to be essentially the responsibility of the public authority. To maximize returns, they transfer risks and uncertainties to the public contracting authority and to subcontractors through a network of contracts. The result is an unbalanced risk and uncertainty distribution in the PPP, both from the perspective of partnering (risk sharing) and from the perspective of project management (allocate risks to those who can best manage them). In current PPP projects, it is especially contractors who are placed in an unenviable position. Their relatively high-risk profile and low profit margins can threaten project success. Overall, financiers do not really act as partners in the current PPPs, but merely as resource providers. This risk-averse positioning of financiers in a PPP is contrary to the nature of a PPP, where responsibilities should be shared and allocated to those who can best manage them.

The research provides insights into and an understanding of potential fields of uncertainty and the mechanisms that actors in infrastructure PPP projects use to deal with this uncertainty. The roles that actors (public commissioner, financier, and contractors) play in current PPP arrangements tend to result in an uneven risk and uncertainty allocation. Following the general PPP definitions and logic, public authorities try to shift risks to the private sector. Financiers are, however, averse to accepting those that reduce the predicted return on investment. Quantified risks are incorporated in their financial models, but unquantifiable uncertainties are, as far as possible, either not accepted and returned to the government, or contracted away to others (i.e., the project contractors) as externalities. The consequence of all of this is that, in practice, the responsibility for most of the risks and uncertainties ends up with the contractors. Although contractors are essential for the successful realization of a project, they are in an unfavorable position in the PPP arrangement due to this uneven risk and uncertainty distribution. From a transaction cost perspective, this may lead to project inefficiencies and extra costs, and therefore threatens project success not only for the contractors involved but for all partners. Since financing is an essential part of infrastructure PPPs, public infrastructure managers need sufficient skills and knowledge to understand the dynamics of investing and financing. Part of this involves 'opening the black box' by requiring detailed information from financiers about their mechanisms for dealing with risks (and uncertainty) and the way they guard their return on investment when contracting infrastructure PPP projects.

This research also indicates that social mechanisms are essential in coordinating PPPs undergoing contract variations. Proactively building social arrangements, in addition

to the formal contract rules and throughout the project, appears crucial for flexibility, i.e., having the ability to deal with uncertain events. Relational arrangements offer flexibility by allowing partners to become more engaged and act according to the spirit of the contract rather than the letter. The focus on relationships may lead all the parties to gain a better understanding of each other's interests and to understand how parties perceive the contract. In practical terms, partners can proactively develop a common approach by translating the contract provisions into their mutual personal relationships to achieve a certain degree of cooperation. This can decrease the level of formality and ease dealing with unforeseen events, for example by creating a favorable environment of trust and transparency in the renegotiation process.

The ability to develop such a common and cooperative approach is strongly influenced by the contracting culture and nature of the contract. The Anglo-Saxon approach to contracting may exert pressure on the execution of infrastructure projects especially when applied in a Rhineland context. The reasonability and fairness basis of the Rhinish law culture may help to solve problems in a more relational way based on reasonability and fairness. Apart from the legal culture, the principle of reasonability and fairness can also be arranged on the sectoral level. For example, an overarching vision agreed between the public authorities, financiers and the contractors may help to achieve a more balanced risk and uncertainty allocation and create a basis for social arrangements.

With regard to the large societal challenges we are currently facing, public authorities may consider using PPPs not only as a vehicle to realize infrastructure but also to stimulate societal transitions. Public ambitions such as sustainability and digitalization can be incorporated into PPP contracting and contracts to increase public value and force private investors in the direction of a societal transition.

This research provides practical guidance for infrastructure managers on how to make infrastructure projects more valuable for society.

SAMENVATTING

We kunnen niet zomaar voorspellen (Taleb, 2007).

SAMENVATTING

Dit onderzoek betreft het omgaan met onzekerheid in infrastructuurprojecten die zijn opgezet als publiek-private samenwerkingen (PPS'en). PPS'en bestaan uit een netwerk van actoren of organisaties in onderlinge relaties die worden gecoordineerd en gereguleerd door contracten. Deze contracten regelen een verdeling van taken en verantwoordelijkheden tussen contractpartijen, en zij verdelen risico's en onzekerheden. Een risico is een berekenbare gebeurtenis met betrekking tot waarschijnlijkheid en gevolg, terwijl een onzekerheid de onduidelijke toekomstige toestand is waarbij het niet mogelijk is een numerieke waarschijnlijkheid of het mogelijke effect op het optreden van een impactvolle gebeurtenis te bepalen. Onzekerheden zijn onvermijdelijk bij infrastructuur PPS'en vanwege de dynamische omgeving waarin PPP's gewoonlijk worden uitgevoerd en vanwege de complexe structuur van hun contrcat arrangementn. Bovendien verhoogt het langetermijnkarakter van de contracten de blootstelling aan onzekerheden gedurende de levenscyclus van het project.

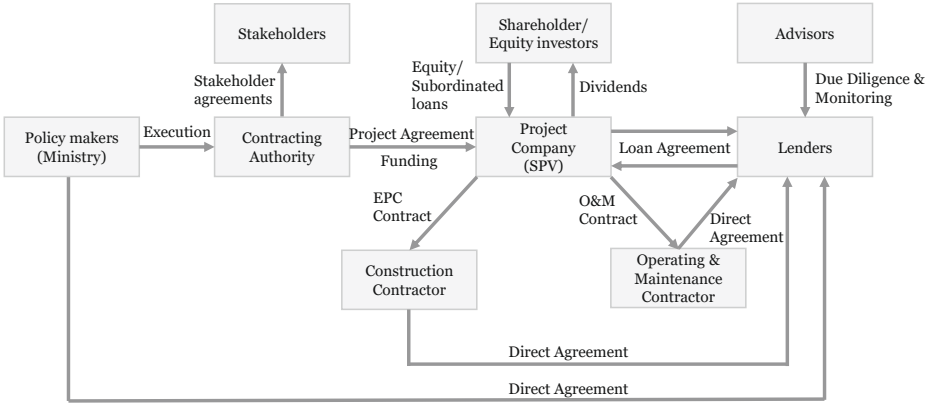
Hoewel risico's in de literatuur uitvoerig zijn besproken, is er weinig aandacht voor de contractuele en niet-contractuele mechanismen die elke partij in de praktijk daadwerkelijk toepast of kan toepassen om met onzekerheid om te gaan. Het doel van deze studie is daarom om inzicht te krijgen in de contractuele en niet-contractuele mechanismen die worden toegepast door partijen die betrokken zijn bij PPS-infrastructuurprojecten. De hoofdonderzoeksvraag is geformuleerd als:

Hoe om te gaan met onzekerheid bij infrastructuurprojecten die zijn opgezet als publiek-private samenwerkingen?

Deze hoofdonderzoeksvraag is verder uitgewerkt in de volgende deelvragen:

1. Welke potentiële veranderingen doen zich gewoonlijk voor bij PPS-infrastructuurprojecten? Hoe met deze potentiële veranderingen worden omgegaan? Wat wordt bedoeld met flexibiliteit in PPS-infrastructuurprojecten?
2. Welke mechanismen, naast de formele contractregels, worden in de praktijk gebruikt om met veranderingen in infrastructuurprojecten om te gaan, en hoe worden deze mechanismen geoperationaliseerd?
3. Hoe gaan financiers om met risico's en onzekerheid bij investeringen in infrastructuurprojecten? Hoe beschermen financiers hun rendement op investeringen? Op welke manier beïnvloedt projectgovernance de bescherming van het rendement van financiers?

Dit onderzoek richt zich op PPS-projecten in de Nederlandse infrastructuursector. De privatisering van infrastructuur ontstond in de jaren 80 van de vorige eeuw in het Verenigd Koninkrijk onder neoliberale agenda's (New Public Management) en breidde zich uit naar andere landen, waaronder Nederland, Australië, Canada en de VS. Sindsdien zijn financiers infrastructuur gaan beschouwen als een aantrekkelijke beleggingscategorie om hun portefeuilles te diversifiëren vanwege de specifieke kenmerken ervan: activa op lange termijn met een lange economische levenscyclus, laag technologisch risico, verlening van essentiële openbare diensten, sterk inelastische vraag, natuurlijke monopolie- of quasi-monopoliemarktcontext, hoge toetredingsdrempels, gereguleerde activa, een natuurlijke afdekking tegen inflatie, en stabiele en voorspelbare operationele kasstromen. Privatisering en financialisering hebben ook geleid tot specifieke contracteringsmethoden en arrangementen voor publieke infrastructuur via PPS'en. Terwijl de Angelsaksische contractpraktijken de nadruk leggen op de harde kant van het contracteren, toont de praktijk aan dat de zachte kant — d.w.z. dialoog, coöperatief gedrag, goede relaties, flexibiliteit en adaptief beheer — juist sleutelfactoren voor projectsucces zijn. Deze studie richt zich daarom op flexibiliteit — d.w.z. het vermogen om om te gaan of zich aan te passen aan veranderende omstandigheden — in PPS-infrastructuurprojecten.



Figuur S1: Algemene publiek-private-samenwerkingsstructuur (ontleend aan De Wereldbank, 2019)

De complexe en inerte aard van de contractarrangementen en de structuur van de centrale coördinerende onderneming (*Special Purpose Vehicle*, SPV) in PPS-projecten lijken een onbalans te creëren in de risico- en onzekerheidstoedeling binnen de PPS-regeling, wat leidt tot mogelijke kostenoverschrijdingen, tijdvertragingen en een negatieve sfeer in het project (zie figuur S1 hieronder). Het relatief grote aantal problemen bij afgeronmde en lopende PPS-infrastructuurprojecten impliceert dat de bestaande PPS-contracten niet voldoende flexibiliteit bieden om met onzekerheid om te gaan. Deze studie is er dan ook op gericht te begrijpen hoe in de praktijk door de

betrokken partijen wordt omgegaan met risico en onzekerheid gebruik makend van contractuele en niet-contractuele mechanismen, en wat hiervan kan worden geleerd om de flexibiliteit van PPS-infrastructuurprojecten te verbeteren.

Dit onderzoek is gebaseerd op drie casestudies, die elk gericht zijn op een ander cluster van relaties en actoren. De eerste casestudie richt zich op de relatie tussen de aanbestedende dienst en externe belanghebbenden, zoals gemeenten, waterschappen en havenautoriteiten. De tweede casestudie richt zich op de relatie tussen de aanbestedende dienst en de SPV van een project. De laatste casestudie richt zich op financiers van internationale PPS-projecten die vergelijkbaar zijn met de onderzochte casussen.

Om de eerste onderzoeksvraag te beantwoorden zijn potentiële veranderingen geïdentificeerd in een typisch Nederlands DBFM-project, de Blankenburgverbinding (BBV), een tunnel tussen de snelwegen A20 en de A15 ten westen van Rotterdam. Het combineren van de verschillende classificaties van veranderingen uit de literatuur met de bevindingen uit de BBV-casestudie resulteerde in de volgende algemene categorieën van potentiële veranderingen in grote PPS-projecten: 1) veranderingen in de projectomgeving, 2) financiële veranderingen, 3) veranderingen in wetgeving, 4) verandering in politiek, 5) organisatorische veranderingen, 5) veranderingen in eisen, 6) klimaatveranderingen, 7) technologische veranderingen, en 8) technische veranderingen. Het vermogen om zich aan dergelijke veranderingen aan te passen en deze mechanismen proactief in een project te integreren, wordt in deze studie gedefinieerd als flexibiliteit. Uit de studie blijkt dat de effectieve en voortdurende betrokkenheid van stakeholders, vooral vroeg in de ontwikkelingsfase van een infrastructuurproject, maar ook gedurende de gehele levenscyclus van een PPS-project, een zeer effectief mechanisme is om met onzekerheid om te gaan. De continue interactie met stakeholders verschaft inzicht in wat de werkelijk belangen zijn en welke kwesties relevant zijn of later in het project relevant kunnen worden.

De tweede onderzoeksvraag richt zich op de relatie tussen de aanbestedende dienst en de SPV en diens onderaannemers. De manier van omgaan met verandering in het A1/A6-project Schiphol-Amsterdam-Almere (SAA) is geobserveerd om na te gaan welke contractuele en niet-contractuele mechanismen in de praktijk worden toegepast om met onzekerheid om te gaan, zowel aan de publieke als aan de private kant. Uit de bevindingen blijkt dat variaties niet uitsluitend via de formele contractregels kunnen worden opgevangen, en dat aanvullende sociale mechanismen tussen de publieke opdrachtgevers en de gecontracteerde bedrijven nodig zijn om doeltreffend met onzekerheid om te gaan. In de praktijk werden naast de contractuele bepalingen de volgende niet-contractuele mechanismen gebruikt: 1) de voortdurende opbouw

van sociale relaties, 2) relationele governance, 3) het gebruik van gedigitaliseerde informatie-uitwisseling, 4) de voortdurende opbouw van professionele kennis, en 5) actorcompetenties.

Om een antwoord te geven op de derde onderzoeksvraag, is door middel van interviews met financiers en hun adviseurs en analisten onderzocht welke controlemechanismen financiers toepassen om een rendement op hun investering in PPS-infrastructuurprojecten zeker te stellen. Uit de resultaten blijkt dat financiers zich vooral bezighouden met berekenbare risico's die hun financiële rendement kunnen beïnvloeden, en dat zij niet het gevoel hebben dat onzekerheden, die inherent zijn aan een PPS-infrastructuurproject, onder hun verantwoordelijkheid vallen. Het algemene beeld is dat financiers die beschouwen als de verantwoordelijkheid van de overheid. Om een zo hoog mogelijk rendement te behalen, dragen zij risico's en onzekerheden via een netwerk van contracten over aan de aanbestedende (publieke)dienst en aan onderaannemers. Het resultaat is een onevenwichtige verdeling van risico's en onzekerheden in de PPS, zowel vanuit het oogpunt van partnerschap (risicodeling) als vanuit het oogpunt van projectbeheer (risico's toewijzen aan degenen die ze het best kunnen beheren). Bij de huidige PPS-projecten worden vooral de aannemers in een ongunstige positie geplaatst. Hun relatief hoge risicoprofiel en lage winstmarges kunnen een bedreiging vormen voor het slagen van projecten. In de huyidige PPS'en lijken financiers niet zozeer partners, maar slechts 'resource providers'. Deze risico-averse opstelling van de financiers in een PPS is tegenstrijdig met de aard van een PPS, waarbij verantwoordelijkheden gedeeld worden en risico's worden toebedeeld aan diegene die ze het best kan beheersen.

Het onderzoek verschaft inzicht in en biedt begrip van potentiële gebieden van onzekerheid en de mechanismen die actoren in infrastructuur-PPP-projecten gebruiken om met deze onzekerheid om te gaan. De rollen die actoren (publieke opdrachtgever, financier en aannemers) invullen in de huidige PPS-arrangementen, resulteren doorgaans in een ongelijke verdeling van risico's en onzekerheden. Volgens de algemene PPS-definities en -logica tracht de overheid risico's naar de private sector over te hevelen. Financiers zijn echter afkerig van het aanvaarden van risico's die het voorziene rendement van de investering verminderen. Gekwantificeerde risico's worden opgenomen in hun financiële modellen, maar niet-kwantificeerbare onzekerheden worden zoveel mogelijk ofwel niet aanvaard en teruggegeven aan de overheid, ofwel uitbesteed aan anderen (d.w.z. de aannemers van het project) als externaliteit. Het gevolg is, dat in de praktijk de verantwoordelijkheid voor de meeste risico's en onzekerheden bij de aannemers terechtkomt. Hoewel aannemers van essentieel belang zijn voor de succesvolle verwezenlijking van een project, bevinden zij zich in de PPS-

regeling in een ongunstige positie als gevolg van deze ongelijke verdeling van risico's en onzekerheden. Vanuit het oogpunt van transactiekosten kan (en zal) dit leiden tot inefficiënties en extra kosten voor het project, waardoor het slagen van het project niet alleen voor de betrokken aannemers, maar voor alle partners in gevaar komt. Aangezien financiering een essentieel onderdeel is van infrastructuur-PPS'en, moeten beheerders van publieke infrastructuur over voldoende vaardigheden en kennis beschikken om de dynamiek van investeringen en financiering te begrijpen. Dit houdt onder meer in dat vooraf van financiers gedetailleerde informatie wordt verlangt over de wijze waarop zij met risico's (en onzekerheid) omgaan en over de manier waarop zij hun rendement op investeringen bewaken.

Uit dit onderzoek blijkt ook dat sociale mechanismen van essentieel belang zijn voor PPS'en om met contractveranderingen om te gaan. Het proactief opbouwen en gedurende het gehele project opbouwen van sociale constructen, naast het formele contract blijkt van cruciaal belang te zijn voor flexibiliteit, d.w.z. het vermogen om te gaan met onzekere gebeurtenissen. Relationele constructen bieden flexibiliteit doordat zij de partners in staat stellen zich meer te engageren en te handelen naar de geest van het contract in plaats van naar de letter. De nadruk op relaties kan ertoe leiden dat alle partijen een beter inzicht krijgen in elkaars belangen en in de wijze waarop de partijen het contract percipiëren. Praktisch gezien kunnen partners proactief een gemeenschappelijke aanpak ontwikkelen door de contractbepalingen te vertalen naar hun wederzijdse persoonlijke relaties om een zekere mate van samenwerking te bereiken. Dit kan de mate van formaliteit verminderen en het omgaan met onvoorziene gebeurtenissen vergemakkelijken, bijvoorbeeld door een gunstige omgeving met vertrouwen en transparantie in het heronderhandelingsproces te creëren.

Het vermogen om een dergelijke gemeenschappelijke en coöperatieve aanpak te ontwikkelen wordt sterk beïnvloed door de aanbestedingscultuur en de aard van het contract. De Angelsaksische benadering van contracteren en contract kan leiden tot spanning de uitvoering van infrastructuurprojecten, vooral wanneer deze in een Rijnlandse context wordt toegepast. De redelijkheid en billijkheid die ten grondslag liggen aan de Rijnlandse rechtscultuur kunnen juist helpen om problemen op een meer relationele wijze op te lossen dan wel te voorkomen. Behalve in het project kan het principe van redelijkheid en billijkheid ook overkoepelend op sectoraal niveau worden geregeld. Zo kan een overkoepelende visie, overeengekomen tussen de overheid, financiers en de aannemerij, bijdragen tot een evenwichtiger verdeling van risico's en onzekerheden en een basis vormen voor sociale afspraken.

Met het oog op de grote maatschappelijke uitdagingen waar we nu voor staan, kan de overheid overwegen om de PPS niet alleen in te zetten als vehikel om infrastructuur te realiseren, maar ook om maatschappelijke transities te stimuleren. Publieke ambities zoals duurzaamheid en digitalisering kunnen worden opgenomen in PPS-contracten en zo private investeerders en marktpartijen te 'dwingen' in de richting van een maatschappelijke transitie.

Dit onderzoek biedt infrastructuurmanagers praktische inzichten om infrastructuurprojecten waardevoller voor de samenleving te maken.

LIST OF ABBREVIATIONS

BBV:	Blankenburgverbinding
BOT:	Build Operate Transfer
CAPEX:	Capital Expenditure
CEO:	Chief Executive Officer
CFO:	Chief Finance Officer
COO:	Chief Operational Officer
DBFM:	Design Build Finance and Maintenance
D&C:	Design and Construct
EPC:	Engineering Procurement and Construction
ESG:	Environmental, Social, Governance
GFC:	Global Financial Crisis
HM Treasury:	Her Majesty's Treasury
IPM:	Integrated Project Management
NAO:	National Audit Office
OECD:	Organization for Economic Co-operation and Development
OPEX:	Operational Expenditure
O&M:	Operations and Maintenance
PFI:	Private Finance Initiative
PPP:	Public Private Partnership
RFC:	Request for Change
RWS:	Rijkswaterstaat
SAA:	Schiphol Amsterdam Almere
SDGs:	Sustainable Development Goals
SPV:	Special Purpose Vehicle
TCE:	Transaction Cost Economics

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

From when we first turn the light on in the morning to when we return from work by road or using public transport, we are all using infrastructure assets (BNP Paribas, 2021). The term infrastructure generally covers all physical assets, equipment, and facilities of interrelated transport and energy systems, the necessary service providers, together with the underlying structures, and accompanying organizations and business models and rules, and regulations, which are used to offer certain commodities and services (Weber et al., 2011; Leendertse & Arts, 2020). Since infrastructure often comprises public structures, national and local governments play a major role in initiating and managing projects to develop and maintain infrastructure. Therefore, infrastructure is often called to serve as a real catalyst for growth precisely when the industry is undergoing a process of change as it matures (Gatti & Chiarella, 2020).

Since the 1980's, the neoliberal political agenda pursued in many countries, has stimulated private involvement in public infrastructure services, resulting in a trend of increasing private financing of public infrastructure. This transition to more private involvement has resulted in structural changes in the contracting of public infrastructure through Public-Private Partnerships (PPPs). Iossa (2013) define a PPP as 'any contractual arrangement between a public-sector party and a private-sector party for the provision of public services with the following four main characteristics: (i) the bundling of project phases into a single contract; (ii) an output specification approach; (iii) a high level of risk transfer to the private sector, and (iv) a long-term contract duration'. From a partnering perspective, - Van Ham and Koppenjan (2001) defined PPPs as a cooperation of some sort of durability between public and private actors in which they jointly develop products and services and share risks, costs and resources which are connected with these products. This means that PPPs cover a range of mutually dependent relationships and interconnections between multiple public and private parties that, due to the increased number of relationships, have increased complexity. Moreover, PPPs are generally realized over a long period of time, which will result in contextual changes over time.

A project has a predefined scope and business case, which is to be delivered by a planned process of differentiated phases (Murray, 2009). Like a funnel, each project phase includes decisions that increasingly focus on this output. Infrastructure PPP projects are characterized by complex contractual arrangements between number of parties, brought together in a network of social connections in order to achieve a service as intended (Hertogh & Westerveld 2010; Van den Hurk & Verhoest, 2015; Hodge et al., 2017). Complex projects are viewed as those that are sensitive to change in the project

set-up as well as the context (Teisman et al., 2009). With this complexity, the effects of changes are to an extent unpredictable, creating a certain level of risk and uncertainty.

Classical economics has long made a distinction between risk and uncertainty (Knight, 1921; Keynes, 1937). A risk can be defined as a potential event where both the probability and possible effect can be calculated. Broadbent et al. (2008) argue that when there is *no* possibility of placing a numerical probability on something occurring, the unclear future state should be referred to as an 'uncertainty'. As a result of such complexity, PPPs especially face major challenges because of changing circumstances that were not anticipated in the planning phase. This means that in complex projects, there generally is a need for flexibility to be able to deal with uncertainty. This requires i.e. the ability to adapt to changing circumstances while maintaining the main and/or reframed functions, such as serviceability and sustainability (Cruz & Marques, 2013; Domingues et al., 2014; Leendertse, 2015; Hueskes et al., 2017; Ruijter, 2019). These can be threats for the project, but also opportunities (Hertogh, 2014).

This research focusses on the Dutch infrastructure sector, with a particular focus on PPP arrangements in which public and private actors/parties collaborate to deliver infrastructure projects. The privatization of infrastructure initially came to prominence in the UK under the Thatcher governments and expanded to other countries including, the Netherlands, Australia, Canada, and the US (Harvey, 2007; Eversdijk, 2013; Meek, 2014). Privatization is the transfer of existing infrastructure assets to private, for-profit, enterprises. This trend was followed by the financialization[1] of infrastructure. It is financialization rather than privatization that underpins the transformation of infrastructure into an investable asset class (O'Neill, 2019). This means in infrastructure development, financiers (banks, private equity, pension funds etc.) are involved to source infrastructure which creates a return on investment. The aim of this finance structure is to lower the capital costs and maximize the investor payouts (Ashton et al., 2012; Peda & Vinnari, 2020). According to Ashton et al. (2012), the ability to create and monetize new asset classes (such as infrastructure) has become an important function of the state in a financialized economy. For financial institutions, the built environment is seen as an asset (Harvey, 1985) and project finance in PPPs can be a tool to support the accumulation and switching of capital. In financialization, an important question is how to deal with uncertainty in order to protect the invested capital and return on investment. Hence, it is significant for public sector to know how infrastructure investors assess future revenue and treat to the uncertainty.

1 Aalbers (2008) characterizes financialization as the accumulation of capital through financial channels rather than through trade and commodity production and capital switching between financial actors.

The Netherlands started to experiment with more intense market involvement in the 1990s. This was initially heavily based on Anglo-Saxon experiences, but later by developing its own instruments by main client organizations that are responsible for public assets, like Rijkswaterstaat (managing the national roads, waterways and coasts in the Netherlands), ProRail (executive agency of the main railway network in the Netherlands) and the Rijksvastgoedbedrijf (managing agency for all Dutch state owned public real estate). Given that infrastructure financing does not have borders, this automatically also broadened the view of global-oriented investors. PPPs, as a form of Design-Build-Finance-Maintain (DBFM) contracts have been promoted by several executive agencies of the Dutch government.

A risk-perspective is dominant in the literature on, and the practice of, the management of infrastructure projects (Verweij, 2015). This means that the management of PPPs is still very much focused on risk management techniques that are based on identifying risks, calculating the probability and effects of a risk event based on experience, and defining response measures (Hussain & Siemiatycki, 2018; Vecchi et al., 2017; Broadbent, 2008). A risk perspective involves seeing risk as a 'calculable probability' and multiplying this by a 'calculable effect' of a possible future event. Based on this, the risks are allocated among the parties involved in the project or contract arrangements. The basic logic of a PPP is allocating risks mutually between the parties involved. However, in reality, this described risk approach is limited, since the future is unknown and unforeseeable changes will occur (Cruz & Marques, 2013; Wang et al., 2017). Moreover, risks are not always allocated to the party best able to manage them and, due to their complexity, projects may react unpredictably to change (Liu et al., 2017; Wang et al., 2019). Dealing with uncertainty is a growing theme in both literature and practice, but still hardly studied and applied in project management (Wang et al., 2017; Xiong et al., 2018; McKinsey & Company, 2020; Warsen, 2021).

The challenge for both the public and private sector is to be prepared or be able to effectively deal with unexpected events, while at the same time ensuring the provision of infrastructure services. Risk allocation and rigid formal contracts do not always offer effective ways to cope with potential infrastructure project dynamics. Despite the burgeoning body of literature in the infrastructure project management field on the management of uncertainty in PPPs (Mishra et al., 2015; Wang et al., 2017; Liu et al., 2017; You et al., 2018) the contractual and non-contractual mechanisms that each actor actually applies (or might apply) to deal with uncertainties have yet to be well addressed. A mechanism can be described as the available option to deal with a change in a project or contract (Demirel et al., 2016). Moreover, the growing number of PPP projects that are facing problems due to changes and ineffective management

(Cruz & Marques, 2013; Keers & Fenema, 2018; Denicol et al., 2020) show that there is a need to know more about how to deal with uncertainty in practice. In response, this thesis focuses on finding ways to deal with uncertainty and respond to the need for flexibility in the dynamic environment of infrastructure projects.

1.2 SETTING THE SCENE

The construction sector

The construction sector, which encompasses infrastructure, real estate, and industrial structures, is the largest industry in the global economy and accounting for 13% of the world's GDP (McKinsey & Company, 2020). The construction sector is a major generator of economic growth and of wealth creation, contributing billions to countries' economies (Gardner, 2015) and expected to grow by an average annual rate of approximately 4% to 2030 (Global Construction Perspectives and Oxford Economics, 2015). Construction has a long history, closely aligned with the development of human civilization (Ritz, 1994). Consequently, the construction sector has faced all forms of change, such as social, technological, and business process developments (Rothwell & Zegwell, 1989). However, these changes seem to have accelerated in the twentieth century.

Currently there is a clear recognition that well-established trends are disrupting the construction sector in a way that is more rapid and more profound than experienced in the past (Global Infrastructure Hub, 2020). These trends include, the rapid evolution of technology, increasing urbanization and an engaged society, climate change, sustainability and livability, compression in expected financial returns in a low-rate world, and changing consumer and user preferences. A combination of sustainability requirements, cost pressures, skills scarcity, new materials, industrial approaches, digitalization, and a new breed of players seems to be transforming the value chain (Volker, 2019; McKinsey & Company, 2020). The industry itself has also performed unsatisfactorily in many regards (Van Wassenaer, 2016; Denicol et al., 2020; McKinsey & Company, 2020), in part compounded by unprecedented and unpredictable global events, such as the financial crisis and the recent global pandemic (Global Infrastructure Hub, 2020), for example in terms of the environmental and sustainability targets set in the Paris Agreement (2016). In addition to these events and trends, the global demand for construction projects, including newly built infrastructure and large-scale replacement, continues to grow. All these factors have been shaping the construction environment for the past decades and will continue to change in the future.

Infrastructure projects

This study limits itself to infrastructure projects in the Dutch construction sector. The word infrastructure is a combination of the Latin "infra" (meaning below) and "structure". That is, infrastructure can be seen as the underlying structure that supports activities such as transport, energy, and telecoms. Generally, infrastructure refers to physical structures, although some authors include in their definition the organizational structure, the institutions, and the management, linked to that hardware (Weisdorf, 2007). Roads are by far the dominant form of transport infrastructure, but infrastructure actually includes those assets that are involved in the movement of goods, people, water, and energy, and has been classified as a real return asset class (Weisdorf, 2007). As such, infrastructure is an accommodating basis for the wider economy.

Its real value lies in its function of connecting businesses and other functions, and making areas accessible (Arts et al., 2021). The current structure of the infrastructure sector has a number of specific features such as long value chains (from initial conception through to operation) and a large number of distinctive involved actors and, due to this, faces various types of uncertainties. To address these uncertainties, this study focusses on the relationships between the main actors in infrastructure projects, such as public authorities, contractors, subcontractors, suppliers, specialists, banks, equity investors, pension funds, and consultants with a variety of interests (Verweij, 2015; Leendertse & Arts, 2020).

The Dutch infrastructure sector

In the Netherlands, the construction industry continues to grow, in line with the overall Dutch economic performance and the gross added value of construction has increased by more than 5% year-on-year (Atradius, 2019). A few decades of privatization have caused the extension of the role of the private sector in the provision of what are generally considered to be public services such as the design, financing, building, maintaining, and operating of infrastructure assets and the delivery of associated services including the associated risks (Hare, 2013; Van den Hurk & Hueskes, 2017; Agyenim-Boetang et al., 2017). This transition toward private involvement has thus resulted in structural changes in the set-up of relationships and public infrastructure contracting. However, the widespread fraud in the Dutch construction industry in 2001 caused a turning point in the relationship between government and the market (see, for example, e.g. Leendertse & Arts, 2020). This resulted in a change in the relationship between public authorities and contractors: from a more relational cooperative approach to a strict contractual approach.

In 2004, Rijkswaterstaat, one of the biggest public clients in the Dutch construction industry due to their responsibilities to take care of a large part of the Dutch infrastructure, introduced the policy known as 'private market involvement, unless…' (in Dutch: '*markt, tenzij…*') in their business plan, based on a clear division of roles between Rijkswaterstaat and the market with an emphasis on a relationship characterized by professionalism, integrity, and healthy market forces. This meant that Rijkswaterstaat would involve the market in all its infrastructure development activities unless there is a valid (based on solid argument) reason not to do so. This policy was the result of the desire expressed by market players to be engaged more substantively at an earlier phase of the infrastructure development process and addressed questions about the legitimacy of this collaboration resulting from parliamentary inquiries into the fraud mentioned above (Tweede Kamer, 2002/2004). Consequently, so called 'integral contracts' (Design & Construct and PPP) were structurally introduced through which the market was involved in not only construction and maintenance but also in elements of the planning, the design, and in PPP contracts in financing. Before that time, Rijkswaterstaat already introduced new forms of contracting. Two examples to illustrate this, the newly built tunnel that crosses the river the Noord, was financed privately by a consortium of two banks: Postbank (currently ING) and Société Général, contract close 1988. Around that time, Rijkswaterstaat tendered the storm surge barrier Maeslantkering by Design & Construct & Maintenance (integrated contract) (5 years), contract close 1989.

After 2004 the involvement of Rijkswaterstaat became more structural especially with the introduction of PPP contracts (DBFM). Since that time, Dutch infrastructure has followed the international trend toward the financialization of infrastructure. New players (banks, pension funds, private equity) have started to take a place in the sector alongside to market parties (e.g. contractors) in the Dutch infrastructure sector. To facilitate market parties and to reduce transaction costs, Rijkswaterstaat introduced a standard DBFM contract for PPP infrastructure projects based on the standard PFI type of contract seen in the UK. In 2008, however, the global financial and economic crisis hit the Dutch infrastructure sector. Contractors felt compelled to submit low bids and accept many risks just to become involved in projects. As a result, many projects faced contractual conflicts, which sometimes resulted in bankruptcies or near bankruptcies of private parties. At the same time, projects grew in complexity and integrality. Delays and cost overruns occurred in several infrastructure projects. In one example, disputes emerged between Rijkswaterstaat and the A15 consortium over the interpretation of the contract terms regarding the allocation of unforeseen costs (Verweij, 2015; Koppenjan & de Jong, 2017).

Alongside a critical discussion in the UK about PFIs, in 2013, the Court of Audit in the Netherlands published an investigation report on the implementation of DBFM(O) projects (Dutch Court of Audit, 2013) which concluded that these types of contracts caused an increase in project costs for the government. In order to "balance the interests of the government with those of the private contractor and to realize the financial added value of DBFMO contracts if changes are made during the contract term", this report states at page 10 that "strong contract management is an important mechanism".

The frequent disputes enhanced the reputation of DBFM as a 'fighting' contract (Leendertse, 2015; Koppenjan & de Jong, 2017; Ruijter, 2019). In the tradition of the Dutch 'polder model', this led to a new market strategy (the 'Market Vision') developed jointly by Rijkswaterstaat, other public infrastructure agencies, and private contractors in 2016 (Warsen, 2021). This new Market Vision highlights the importance of good relationships and cooperation between public clients and private contractors in the development of public infrastructure. Yet, despite this vision, several major infrastructure projects suffered from substantial time and cost overruns. In response, Rijkswaterstaat initiated a research report that examined the challenges and opportunities for improving the Dutch infrastructure sector. This report, also known as the "McKinsey report – Future Agenda of Rijkswaterstaat", observed that the current sector is still very traditional, based on low margins below the European average, linear oriented, strongly based on price competition, has high failure costs, and is slow to learn and innovate and thus not prepared for the major societal challenges that face us (Ministry of Infrastructure and Water Management, 2019). Hence, there is a strong need for a transition in the sector to a dynamic and innovative market that, in the long term, can contribute to the realization of the complex social task of public infrastructure providers and deals with the uncertainties that are inherent to the projects that are performed.

Public-Private Partnerships (PPPs) in the Netherlands

This study focuses on PPP arrangements in the planning and realization phase of infrastructure projects in the Netherlands that are executed by Rijkswaterstaat. Rijkswaterstaat is a leading client to promote safety, mobility and the quality of life in the Netherlands (Rijkswaterstaat, 2021). It is the executive agency of the Ministry of Infrastructure and Water Management and realizes large- & small-scale infrastructure projects. Rijkswaterstaat was the only client for publicly tendered projects larger than €250 million between 2012 and 2018 (Ministry of Infrastructure and Water Management, 2019). In this context, PPP infrastructure projects are considered if it is worth over 60 million euros and decided based on a financial comparison (Verweij & Meerkerk, 2020).

PPPs cover a range of possible relationships between public and private parties. In infrastructure development, PPPs are considered beneficial to the public sector because certain risks are transferred to the private sector. In a PPP project, a private party or consortium is granted a concession to integrally design, finance, build, and operate a public project and to provide the corresponding product or service and collect the ensuing revenues (Xiong & Zhang 2014). In the Dutch infrastructure context, the Design, Build, Finance and Maintenance (DBFM) type of PPP became the new contractual mechanisms used by Rijkswaterstaat and other major infrastructure providers (Ministry of Finance, 2012).

The early versions of Dutch DBFM contracts were inspired by the PFI (Private Finance Initiative) used in UK, and based on the Anglo-Saxon culture, where contractual relationships are far more prominent than in continental Europe (Eversdijk, 2013; Reynaers, 2014; Koppenjan & De Jong, 2017). However, in practice this led to tensions between public and private actors. Whereas Anglo-Saxon contractual practices emphasize the hard side of contracting such as competition, formal procedures, standardized tools, meeting performance targets, and strict contract management continental practices are based more on the soft side of contracting (dialogue, cooperative behaviour, good relationships, flexibility, and adaptive management (Koppenjan & De Jong, 2017; Ruijter, 2019). The above-mentioned Market Vison reflects an attempt to combine both cultures.

In a PPP, the contracted partners are typically organized through a Special Purpose Vehicle, abbreviated to SPV, a legal entity with limited pre-defined purposes, and predominantly used to allocate risks between public and private institutions (Sainati et al., 2017; Wu et al., 2016). In the PPP arrangement, the SPV is usually a shell company that sub-contracts a project's tasks to related consortium members. The primary contract between the client and the SPV is the project agreement (DBFM contract), which makes the SPV responsible for the design, building, financing, and maintenance of the project. Further, the SPV obtains project financing by means of syndicated loans through a financial agreement with a group of lenders. Sometimes, to safeguard lenders from major risks a direct agreement between the lenders and the client is established. For example, in the Netherlands, Rijkswaterstaat as part of the Ministry of Infrastructure and Water Management, acts as a guarantor for the lenders through a direct agreement and provides step-in rights to the lenders if the project experiences difficulties.

The incentives structure within a PPP is based on a payment mechanism where the client makes phased reimbursements linked to the quality delivered by the SPV. For

example, in infrastructure projects the contracting authority reimburses through periodic milestone payments to the SPV based on the availability of the infrastructure during the exploitation phase. The actual building of the project is usually realized through an Engineering, Procurement, and Construction (EPC) contract between the SPV and a contractor. The maintenance of the project is usually arranged in a separate Operation and Maintenance (O&M) contract between the SPV and a maintenance contractor.

The main actors in a public infrastructure PPP include the client (for example a Ministry), external stakeholders, the project delivery organization that serves as contracting authority (such as Rijkswaterstaat), a special project or purpose company (SPV), shareholders (equity investors), lenders, EPC and O&M contractors, and advisors (e.g. financial, technical, legal experts). The main contracts involved include a Project Agreement between the contracting authority and the SPV, shareholder agreements between equity investors, a Loan Agreement between lenders and the SPV, Direct Agreements between lenders and client and between lenders and the EPC and O&M contractors, and EPC and O&M Agreements between the SPV and contractors. Figure 1.1 provides an overview of these actors and their (contractual) relationships.

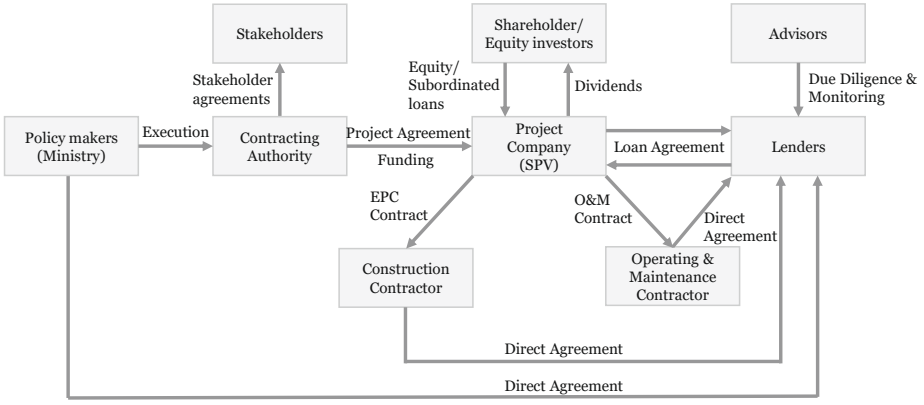

Figure 1.1: General PPP structure (derived from The World Bank, 2019)

PPPs in the Netherlands have faced, and still face, major challenges because of changing circumstances that were not anticipated in the planning phase and, often cause a project to exceed its budget and timespan. Several studies have concluded that, a significant contributor to the large sunken investments and project failures in infrastructure projects, appears to be a lack of understanding of the complex environment in which PPP contracts are realized (see, for example, Shaoul et al., 2006; Hertogh et

al., 2008; Cantarelli, 2011; Cantarelli et al., 2012; Flyvbjerg, 2013; Denicol et al., 2020). As Flyvbjerg et al. (2003, p. 6) put it: "the world of megaprojects' preparation and implementation is a highly risky one, where things happen only with a certain probability and rarely turn out as originally intended". Hertogh et al. (2008) stated in this context that "the effective project delivery organisation also has to deal with factors that may stretch beyond a projects' boundary, therefore also emphasizing the importance of 'openness' in projects. For this interaction and flexibility is necessary to ensure constant alignment of the project with its changing environment."

In PPPs, variations are inevitable, due to the lengthy duration of these contracts, the dynamic environment in which PPPs are usually implemented, and the complex structure of the PPP arrangement. Delays and cost overruns can alter the financial balance of the relationship that was understood by each party upon signing the partnership agreements (Mandri-Perrot, 2009). As a result, conflicts can arise between contracting parties, leading to dissatisfied partners and stakeholders. Most of the problems faced in the projects could be related to unforeseen events and environmental changes combined with the complex structure of PPPs which makes it sensitive for change (Xiong & Zhang, 2014; Wang et al., 2017; Song et al., 2018, Leendertse & Arts, 2020). Nevertheless, despite the good intentions of each party, mechanisms for dealing with uncertainty and change in PPP arrangements seem to be underexplored. Hence, further insight into the complex dynamics of PPP arrangements is necessary to transform PPP contracts from 'fighting contracts' to contracts that deliver both public and private value.

Financing infrastructure projects

The growing need for infrastructure along with the still dominant paradigm of New Public Management is expected to further stimulate private financing of public infrastructure. According to Hodge et al. (2017), public funds in most countries are insufficient to meet the government's ambitions for infrastructure development. It is also to be expected that this private financing will have a significant impact on the infrastructure market in the provision of equity and debt from providers, such as private equity, insurance companies, endowments, and private and public pension funds (see Table 1.1). Moreover, infrastructure, as an asset class, has certain characteristics, such as long-term, low-risk, inflation-protected and non-cyclical returns, that are attractive to financers. Bitsch et al. (2010) assert that infrastructure investments provide stable cash flows if the contract partner does not default and if the legal or regulatory conditions do not change. In this context Gatti (2018) relates the typical characteristics of infrastructure to the typical goals of private investors: long-term assets with a long economic life cycle, low technological risk, provision of key public services, strongly

inelastic demand, natural monopoly or quasi-monopoly market contexts, high entry barriers, regulated assets, frequently a natural hedge against inflation, and stable and predictable operating cash flows.

Table 1.1 Infrastructure investment community (adapted from Ashton, et al., 2012)

Infrastructure funds	Investment bank funds, hedge funds, private equity funds
Strategic investors/operators	Large engineering firms (contractors)
Equity capital	Pension funds, insurance companies, Sovereign wealth funds
Other financial intermediaries	Banks providing debt, bond underwriters

Nevertheless, although infrastructure is an attractive asset class for private investors, it does not automatically guarantee return on investment. In PPPs, a project's cash flow should ensure a return on investment and debt coverage over a long period of time. Infrastructure projects are complex endeavors and include specific uncertainties and interdependencies among a large number of stakeholders (Verweij, 2015; Benitez-Avila et al., 2018). Scholars increasingly stress that project complexity and inappropriate risk transfer may lead to adverse consequences such as significant disputes, the termination of contracts or even the bailout of private operators (Vecchi et al., 2017; Benitez-Avila et al., 2018; Denicol et al., 2020). Moreover, while infrastructure might be an attractive asset class for private investors, it is not automatically profitable for contractors. Due to the economic crisis, contractors in the Netherlands accepted, and still accept, risks just to be part of a deal and keep their businesses running in turbulent times (Demirel, 2021). In this context it is worth emphasizing that the SPV structure used to deliver PPPs facilitates equity and debt holders to protect their returns by passing important risks from the SPV to the contractors through back-to-back type contracts.

Complexity and the need for flexibility in PPP arrangements

Large infrastructure projects are often characterized as complex, nonlinear, and dynamic processes (Khan et al., 2016) that include certain uncertainties and interdependencies among a large number of stakeholders (Klijn & Koppenjan, 2016). PPPs cover a range of mutually dependent relationships and interconnections between multiple public and private parties which given the increased number of relationships, cause an increase in complexity. In the PPP arrangement most of the relationships are covered by contracts. However, these PPP contractual specifications involve, many complex documents that cannot be simply read as a precise and unequivocal set of directives, causing ambiguity or disagreement between them (Van Marrewijk et al., 2008).

Complex projects are sensitive to change in both the project setup and context and the effects of such the changes are to an extent (partly) unpredictable, i.e. uncertain. When outcomes become hard to predict and are spread over a lengthy period, projects are more difficult to define ex ante and become more vulnerable to variation (Brown et al., 2016; Xiong et al., 2018). As a result, PPPs face major challenges because of changing circumstances that were not anticipated in the planning phase. Public contracts generally are found to have limited flexibility when faced with uncertainties and, therefore, require renegotiation during execution. Many scholars (see, for example Cruz et al., 2015; Hart, 2017; Sarmento & Renneboog, 2016; Xiong & Zhang, 2014) argue that the reason for renegotiations is mostly the incompleteness of the contract(s) because of an inability to foresee all possible future events. According to Ruijter (2019), the key, however, to success in implementing complex infrastructure projects is not a more stringent plan-based rational approach or better contracts. Rather, there is a need for flexibility to be able adapt to uncertainty during a project's life cycle. It is this kind of flexibility that this research focuses on.

1.3 PROBLEM STATEMENT

The context given in the previous Section leads to the following problem statement that underpins this thesis. Despite some negative discussions about the use of PPP contracts, the growing need for infrastructure is expected to further stimulate the use of PPP projects and private financing in public infrastructure in general. This PPP usage causes several concerns. One of these concerns relate to the increased complexity and sensitivity to change. PPPs cover a range of mutually dependent relationships and interconnections between multiple public and private parties and other stakeholders. The large number of relationships create increased complexity in infrastructure projects. Complex projects are sensitive to changes in both the project setup and the context. Hence, the effects of the changes are to an extent unpredictable and uncertain. When outcomes become harder to predict and are spread over a longer period, projects are more difficult to define ex ante and become more vulnerable to contract variations.

Changes are, however, inevitable in PPPs, because of the extensive duration of associated contracts, the dynamic environment in which PPPs are usually implemented and the complex structure of the PPP arrangement. As a result, PPPs in particular, face major challenges because of changing circumstances that were not anticipated in the planning phase. Consequently, flexibility is needed to deal with uncertainty in PPP projects and this requires that projects have the ability to adapt to changing circumstances while retaining their main functions (necessary services and facilities). Current PPP contracts do not appear to provide sufficient flexibility to deal with

uncertainty. The complex and inflexible nature of contracts and the fictitious structure of an SPV creates an imbalance in the risk allocation within the PPP arrangement leading to possible consequence of cost overruns, time delays and a negative contract atmosphere. So, although the control of risk and uncertainty is a central issue in PPP studies, the contractual and non-contractual mechanisms that each of the involved parties actually apply or could apply to deal with these risks and uncertainties have not been well addressed in literature. This thesis therefore aims at creating insights in dealing with uncertainty in PPP infrastructure projects.

1.4 RESEARCH GAP

This problem statement leads to two research gaps: 1) lack of insight into contractual and non-contractual mechanisms that are applied in infrastructure PPP projects to deal with uncertainty, and 2) lack of insight into the role of financiers in controlling uncertainty in infrastructure PPP projects.

The first gap relates to the risk allocation and a rigid formal contract approach do not always offer effective ways to cope with potential infrastructure project dynamics. Prior literature focusses on the rigid contracts that require renegotiation during execution in line with incompleteness of the contracts (Cruz et al., 2014; Hart, 2017; Sarmento & Renneboog, 2016; You, 2018). Unexpected events in infrastructure projects can, however, not be dealt with solely through the formal contract rules, and additional social mechanisms between the contracting authority and the contracted companies are needed. Although the control of risk and uncertainty is a central issue in PPP studies (see e.g. Froud, 2003; Broadbent et al., 2008; Cruz & Marques, 2013; Xiong & Zhang, 2014; Wang, 2017), the contractual and non-contractual mechanisms that each party actually applies (or may apply) to deal with them have not been well addressed. A few researchers have discussed social mechanisms – complementary to the formal contract rules (Domingues et al., 2014; Brown et al., 2016; Warsen, 2021). However, the literature still offers little evidence about how these mechanisms work in practice. Moreover, the growing number of PPP projects that face problems due to change and ineffective management show that there is also a need in practice to better understand how to deal with uncertainty (Mandri-Perrot, 2009; Cantarelli, 2011; Verweij, 2015; You et al., 2018).

The second research gap refers to the lack of insight into the role of financiers in controlling uncertainty in infrastructure PPP projects. There is a burgeoning body of literature in the project management field on financing PPP approaches for the delivery of infrastructure (Sarmento & Renneboog, 2016; Li et al., 2017; Feng et al., 2017; Liu et al., 2017; Lu et al., 2019). Moreover, aspects related to public governance,

private investment, and the related risk allocations in PPPs have received growing academic attention over recent decades (see for example Keers & Fenema, 2018; Wang et al., 2019). Cui et al. (2018) and Hodge and Greve (2018) go as far as claim that governance and project finance should be fundamental topics in infrastructure PPP research. Although the protection of project cash flows against risk and uncertainties is a central issue for PPP financiers (Wang et al., 2019; Owolabi et al., 2019), the actual mechanisms that financiers apply to protect their return on investments and/or to control cash flow have not yet been well assessed. Much of the literature focuses on how risks should be allocated and transferred to private parties but fails to elaborate on the management of uncertainty after allocation. Further, only a few researchers have discussed financiers' securitization strategies in relation to risk allocation and project complexity (see, for example, Liu et al., 2017; Wang et al., 2018; Owolabi et al., 2019). Despite the many studies focusing on the governance or relationships between public clients and project companies in the management of risks, few scholars have questioned the role of financiers in risk and uncertainty control, or the interactions between parties involved (see, for example, Owolabi et al., 2019; Lu et al., 2019; Feng et al., 2017; Li et al., 2017). Both these research gaps are further elaborated in this PhD thesis.

1.5 RESEARCH AIM AND RESEARCH QUESTION(S)

Referring to the problem statement and research gaps as discussed in the previous sections, the aim of this study is to gain insight into the contractual and non-contractual mechanisms that are applied by parties involved in PPP infrastructure projects, It focusses on understanding how risk and uncertainty are managed in practice using contractual and non-contractual mechanisms by the parties involved, and what can be learned from this to improve the flexibility of PPP infrastructure projects. From these insights, conclusions and recommendations are formulated how to deal with uncertainties in infrastructure PPP projects.

The main research question to be answered in this study is:

How to deal with uncertainty in infrastructure PPP projects?

This main question is further elaborated in the following sub-questions:

1. What potential changes typically occur in infrastructure PPP projects? How to deal with these potential changes? What is meant by flexibility in infrastructure PPP projects?

2. What mechanisms, additional to the formal contract rules, are used in practice to deal with variations in infrastructure projects, and how are these mechanisms operationalized?
3. How do financiers approach risks and uncertainty when investing in infrastructure projects? How do financiers protect their returns on investment? In what way does project governance influence the protection of financiers' returns?

The Chapters 3, 4, and 5 form the basis for answering sub-questions 1, 2, and 3 respectively. These chapters have been published as stand-alone articles in refereed scientific journals. In Chapter 6 these three sub-questions are further discussed, and the main research question is answered to conclude the thesis.

1.6 THEORETICAL POSITIONING

Disciplines such as project management, governance, engineering, financing, economics, and contract law all provide various theoretical viewpoints regarding the complexity of infrastructure projects. As such, there are numerous theories related to the subject. This study acknowledges that large infrastructure projects are complex and dynamic and include specific uncertainties and interdependencies among a large number of stakeholders. Therefore, the complexity of a project is determined by the interaction of actors and their relationships (contracts). For each of the research questions, specific theoretical concepts have been identified. These are elaborated in more detail in Chapters 3, 4, and 5. Table 1.2 indicates the foci of the respective chapters.

1.7 STRUCTURE OF THE THESIS

The structure of the research is based on the general actor and relationship (contract) structure of a PPP as derived from the typical PPP scheme shown earlier in Figure 1.1. This thesis is structured in six chapters. The research methodology is presented in Chapter 2. Each sub-question is elaborated separately in Chapters 3,4, and 5 and reflects different sets of relationships in the PPP scheme. Chapter 6 brings it all together and answers the main research.

Chapter 3 focusses on the relationship between contracting authority and its stakeholders (see Figure 1.2) and identifies potential changes in a case study of a large PPP project: Blankenburgverbinding project located in Rotterdam. This project uses a DBFM contract to build a connecting tunnel between A20[2] and A15 highways west of

2 "A" indicates highway in the Netherlands.

Rotterdam. It addresses the rigidity of contracts and highlights the need for flexibility, to be achieved through proactive change management, in order to deal with changing circumstances in a long-term PPP contract.

Table 1.2: Research questions by chapter and theoretical concepts employed

Chapter	Article	Journal Published in	Research Questions	Theoretical Concepts
Chapter 3 – Dealing with potential changes in infrastructure PPPs in the planning phase	Flexibility in PPP contracts – Dealing with potential change in the pre-contract phase of a construction project	Construction Management and Economics	What potential changes typically occur in infrastructure PPP projects? How to deal with these potential changes? What is meant by flexibility in infrastructure PPP projects?	• PPPs • Contract Flexibility • Change Categorization and Uncertainty Classification • Stakeholder engagement
Chapter 4 – Dealing with changes in infrastructure PPPs in the realization phase	Dealing with Contract Variations in PPPs: Social Mechanisms and Contract Management in Infrastructure Projects	Journal of Construction Engineering and Management	What mechanisms, additional to the formal contract rules, are used in practice to deal with variations in infrastructure projects, and how are these mechanisms operationalized?	• Incomplete Contract • Contract Flexibility • Uncertainty • Dealing Mechanisms • Risk Management
Chapter 5 – The role of financiers in dealing with uncertainty in infrastructure PPPs	Mechanisms for protecting returns on private investments in public infrastructure projects	International Journal of Project Management	How do financiers approach risks and uncertainty when investing in infrastructure projects? How do financiers protect their returns on investment? In what way does project governance influence the protection of financiers' returns?	• PPPs • Transaction cost economics • Governance • Project Financing • Infrastructure Investment • Risk Management • Return on investment

The various perspectives are further focused upon and elaborated in the respective chapters.

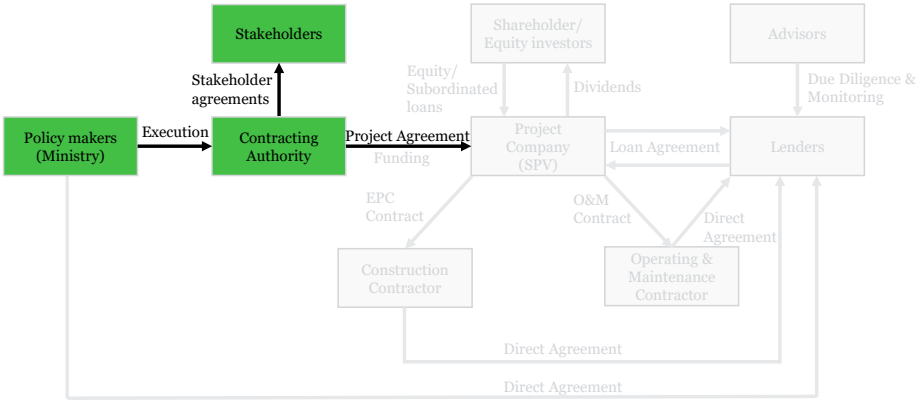

Figure 1.2: Relationship between contracting authority and its stakeholders

Chapter 4 focuses on the relationship between the contracting authority and the SPV and its sub-contractors (see Figure 1.3). It addresses the question what mechanisms are used to deal with variation in practice for infrastructure PPP projects additional to the formal contract rules and how they are operationalized. A real-life case, the Schiphol-Amsterdam-Almere (SAA)[3] A1/A6 project, is studied to reveal the contractual and non-contractual mechanisms applied in practice in the partner relationships to deal with uncertainty. The SAA A1/A6 project is based on a DBFM model involving the towns of Diemen and Almere in the Netherlands.

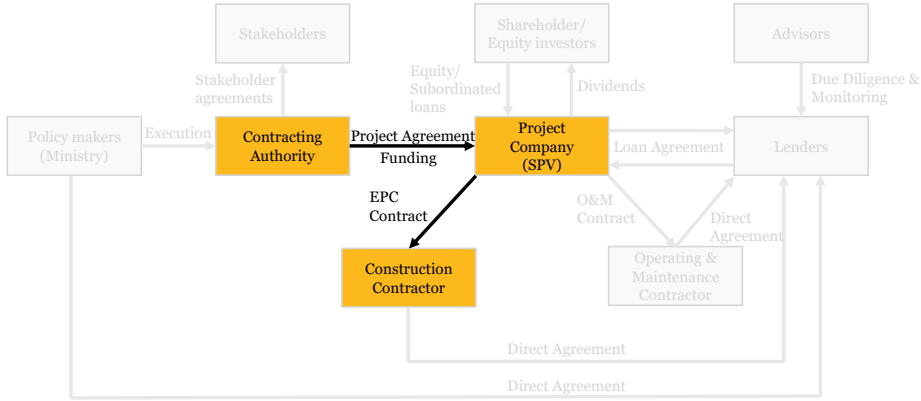

Figure 1.3: Relationships between the contracting authority, the SPV, and its contractors

3 The road expension between Schiphol, Amsterdam, and Almere. It consists of five sub projects. (1) A10/A1 Diemen (2) A1/A6 Diemen – Almere (3) A9 Holendrecht Diemen (4) A6 Almere (5) A9 Badhoevedorp Holendrecht

Chapter 5 focuses on the relationship between financiers and project companies (see Figure 1.4) to address the question of how financiers approach risks and uncertainty when investing in infrastructure projects. Moreover, how financiers protect their returns on investment and in what way project governance influences the protection of financiers' returns (see Figure 1.4). It explains the control mechanisms applied by financiers to ensure a return on their investment in PPP infrastructure projects.

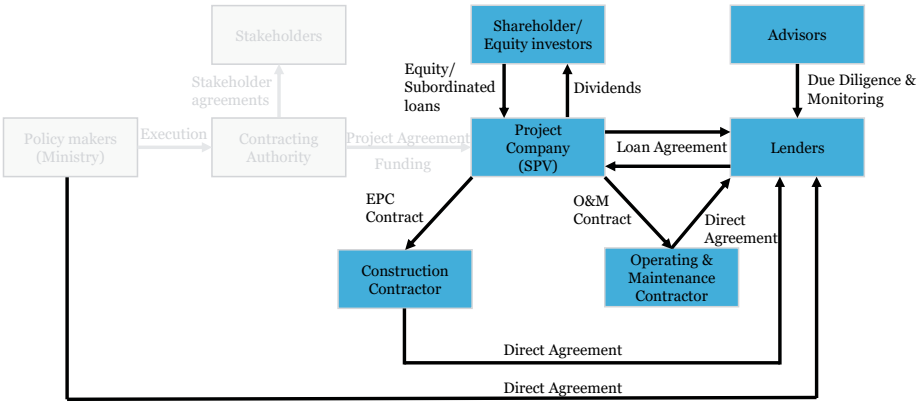

Figure 1.4: Relationship between financiers, the SPV, and its contractors

Having analyzed the three main clusters of relationships in PPPs in Chapter 3,4, and 5, these are brought together and reflected upon in Chapter 6. From this discussion, general conclusions and recommendations are defined. Figure 1.5 schematically shows how this thesis is structured.

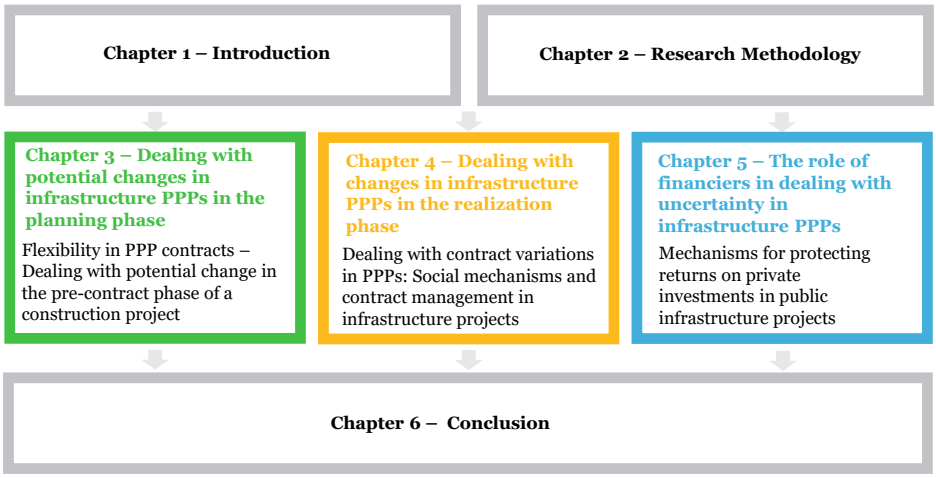

Figure 1.5: Thesis structure

CHAPTER 2

RESEARCH METHODOLOGY

2.1 RESEARCH APPROACH

All research involves philosophical assumptions concerning ontology (the nature of reality) and epistemology (the way of discovering phenomena or mechanisms) (Easterby-Smith et al., 2012; Liu, 2021). Here, the research questions formulated in Chapter 1 are 'what' and 'how' questions, primarily aiming to observe reality.

In order, to observe 'reality', the "engaged scholarship" approach has been chosen to conduct qualitative empirical research. This is a participative form of research designed to obtain the perspectives of key stakeholders in order to understand a complex social problem (Van de Ven, 2007). The approach produces knowledge by "engaging" with practice. According to Voordijk and Addriaanse (2016), there is no clear picture of what engaged scholarship means for construction management research that facilitates interactions between practice and theory to develop scientific as well as practical knowledge. The focus is on the day-to-day behavior of people and organizations, observing how they interact with each other (Ruijter, 2019; Volker, 2019). This fits with the aim of this research to understand the mechanisms for dealing with uncertainty, by taking part in or observing the environment of the relationships. Therefore, this study follows an approach that involves learning from both theory and practice and then reflecting on the theory by combining the knowledge gained from both practice and theory. The epistemological and ontological gains from this research will be acquired from real-life cases and talking with real people and discussing their relationships. The engaged scholarship methodology establishes a reciprocal relationship with the project communities (Van Marrewijk & Dessing, 2019).

During the course of the study, between 2014 and 2017, the author was provided with an employee agreement by Rijkswaterstaat. Being both a researcher and an employee of Rijkswaterstaat provided, a unique position of being actually engaged in infrastructure PPP projects (i.e. the Blankenburgverbinding (BBV) and Schiphol-Amsterdam-Almere (SAA) projects). A major advantage of this unique position was that it gave me an access to the network of employees in Rijkswaterstaat and ability to observe them in action. Furthermore, having this position opened the door to the professional networks of people outside Rijkswaterstaat.

Given the nature of the complexity in PPP infrastructure projects, this study sought to interpret the interaction in the relationships between relevant actors so as to gather insights into the mechanisms used in practice to deal with uncertainty. The research is primarily based on three qualitative studies into infrastructure PPP relationships. Each of the three empirical studies focuses on a different cluster of relationships and actors,

with attention directed toward understanding dealing with uncertainty between actors. Chapter 3 is based on a single case study that focuses on the relationship between the contracting authority and stakeholders. Chapter 4 is also based on a single case study, focusing on the relationship between the contracting authority and the project's SPV. Chapter 5 is not based on an individual case but on interviews with financiers who invest in similar types of international PPP projects to the studied cases. The empirical findings were triangulated to ensure the credibility and validity of the qualitative studies (Eisenhardt, 1989).

2.2 SCIENTIFIC LITERATURE REVIEW

Chapters 3, 4, and 5 each start with a scientific literature review to identify the current PPP knowledge specific to the particular relationship investigated in each Chapter. The theoretical perspective gained in each chapter is then used as the basis for formulating questions to understand what happens in practice through the studied relationships when dealing with uncertainty (see Section 1.6). Practical insights gained from the field are then reflected on to these theoretical perspectives to answer the respective research questions and to build conclusions and recommendations about the mechanisms that can be used to deal with uncertainty regarding the studied relationships.

In Chapter 3, background information about the characteristics of PPPs and complexity is reviewed and, subsequently, the literature on specific uncertainties linked to infrastructure PPP projects related to interactions with their dynamic environment is reviewed. Using the results of this review, a classification of 'environment-related' uncertainties is developed, which is subsequently used to structure the empirical data. Given the emerging classes of uncertainties developed from both literature and practice, it is argued that flexibility in the relationships, i.e. the contracts, is needed.

In Chapter, 4 the focus is on the relationship between the contracting authority and the contracted party (SPV) with particular attention on collaboration or partnering aspects. The theory of incomplete contracts is applied to explore the significance of informal arrangements, in addition to formal contract rules, in providing flexibility in dealing with uncertain events. Comparing empirical results from the SAA case study to this theory lead to the conclusion that informal arrangements are needed as a governance mechanism, alongside a contractual basis, to be able to effectively deal with uncertainty.

Chapter 5 examines in more detail the relationships concerning private financing and elaborates especially on the risk management by private investors in PPP projects. The

focus is on the relationships among equity investors, lenders, SPVs, and contractors. Based on transaction cost economics theory, a literature review is conducted on mechanisms that can ensure a return on investment. Insights into the practical reality are derived from multiple interviews with financiers and their advisors. Combining the results of the literature review with these empirical insights leads to the conclusion that private investors in PPPs build a financial structure to hedge against all risks and primarily guarantee shareholder value. Uncertainties are treated as calculable risks and managed based on the resulting calculations. Major uncertainties are neglected or passed to other parties through contractual relationships. As a result, there seems to be a significant imbalance between the actors involved in current PPP arrangements, which hinders flexibility when needing to deal with uncertain events in an effective way.

In Chapter 6, all the interactions in relationships within infrastructure PPPs, as elaborated in Chapters 3, 4, and 5, are combined and discussed in relation to additional literature to build general conclusions from this research and offer recommendations.

2.3 QUALITATIVE RESEARCH APPROACH

The research focuses on collecting and analyzing in-depth empirical data on the main relationships in a PPP structure from real-life cases and actors. Table 2.1 shows per chapter the relationships that were studied related to the addressed research question and the methods used to gather and analyze data.

2.4 CASE STUDY APPROACH

Flyvbjerg (2001) argues that context-dependent knowledge obtained through case studies is more valuable to social science than general theoretical knowledge. The case study method focuses on analysis of real-life phenomena, in a contemporary bounded system (a case) or multiple bounded systems (cases), over time, through detailed, in-depth data collection involving multiple sources of information (Creswell, 2013; Yin, 2014). The case study approach fits the interpretative and qualitative nature of this research and provides an adequate research strategy for dealing with a complex situation where the boundaries between phenomena and context are obscured (Liu, 2021; Ruijter, 2019). To obtain a deeper understanding of the subject under study, the researcher benefited from two single case studies - the Blankenburgverbinding in Chapter 3, and the SAA A1/A6 in Chapter 4 - in gaining deeper understanding of dealing with uncertainty in large infrastructure projects using multiple data sources including literature, archives, interviews, observations and brief work floor

conversations. The main advantage of the case study approach is that it can reflect real-life practice in an infrastructure PPP project and thereby provide a deeper understanding of the explored subject (Gustafson, 2017). In this research, case studies show how things actually work in the context of PPPs and deliver reliable detailed knowledge.

Table 2.1: Research questions by chapter, relevant relationships, and methods of data collection

Chapter	Research Questions	Main PPP Relationships	Research Method and Data Collection
Chapter 3 - Dealing with potential changes in infrastructure PPPs in the planning phase	What potential changes typically occur in infrastructure PPP projects? How to deal with these potential changes? What is meant by flexibility in infrastructure PPP projects?	• Stakeholder Agreements • Project Agreement • Ministries' Policy Decisions	• Case study: Internship Rijkswaterstaat BBV (6 months) • Archival data: Desktop review of standard PPP contracts (NL, UK, NZ); Review of archival documentation for the BBV case (DBFM contract, route decision plans and project progress documents) • Observations: Field observations, meeting observations, • Interviews: Semi structured interviews (32); work floor conversations
Chapter 4 - Dealing with changes in infrastructure PPPs in the realization phase	What mechanisms, additional to the formal contract rules, are used in practice to deal with variations in infrastructure projects, and how are these mechanisms operationalized?	• Stakeholder Agreements • Project Agreement (DBFM Contract) • EPC Agreement • O&M Agreement • Direct Agreements • Funding Loan Agreement (Financing)	• Case study: Internship Rijkswaterstaat SAA program A1/A6 project (7 months) • Archival data: Desktop review and archival document analysis • Observations: Project team meetings, workshops, team activities observations • Interviews: Semi-structured interviews (21) with managers from SAA program and SAAone; work floor conversations
Chapter 5 - The role of financiers in dealing with uncertainty in infrastructure PPPs	How do financiers approach risks and uncertainty when investing in infrastructure projects? How do financiers protect their returns on investment? In what way does project governance influence the protection of financiers' returns?	• Shareholder Agreements and Equity Agreements • Financing Agreements (Term Sheet Agreements, Security Agreements (pledge), Hedging Agreements • Direct Agreements • Advisor arrangements (due diligence, monitoring)	• Document review: Publicly available documents, agreements, due diligence reports • Interviews: Semi-structured interviews (25) with financiers, advisors, analysts.

Case Selection

In recent years, PPPs have become Rijkswaterstaat's preferred method for large infrastructure projects in the Netherlands. For this thesis, the case selection criteria were developed based on the infrastructure PPP structure provided in Figure 1.1. Two projects were selected to understand the actors involved and the external stakeholders, and their relationships, in PPP projects: the contracting authority, the project company, and sub-contractors. The following criteria were used to select cases relevant for this research goal: 1) recent, large, and complex infrastructure projects; 2) use of a PPP type of contract; 3) covering both the pre-contract and post-contract phases; 4) have been and continue to be subject to uncertainty, i.e. uncertain events.

The Blankenburgverbinding (BBV) project (Chapter 3) was chosen to reflect potential changes in DBFM projects. The BBV project was in its pre-contract phase at the time of the research and located in a very complex area of the Netherlands (Rotterdam Harbor). The environment of the project was highly dynamic (social, political, economic, legal and technical changes abound) and it included a large number of stakeholders. The SAA A1/A6 project (Chapter 4) is part of a major multi-project public infrastructure program known as the Schiphol-Amsterdam-Almere (SAA) program. It was the biggest and one of the most complex PPP projects in the Netherlands at the time of the research.

A PPP's life cycle covers two phases: a pre-contract phase (a preparation stage by the public party) and the post-contract phase (service delivery by the consortium) (see Figures 2.1 and 2.2). The BBV project was in the pre-contract phase and SAA A1/A6 project in the post-contract phase (the SPV was busy with the construction) at the time of research, and both were located in complex areas of the Netherlands (at the Rotterdam Harbor and Amsterdam corridor) with many stakeholders. Both cases were particularly suitable since they represented the most recent DBFM infrastructure projects in the Netherlands, applying the most recent DBFM contractual knowledge and incorporating all the experiences of previous DBFM contracts.

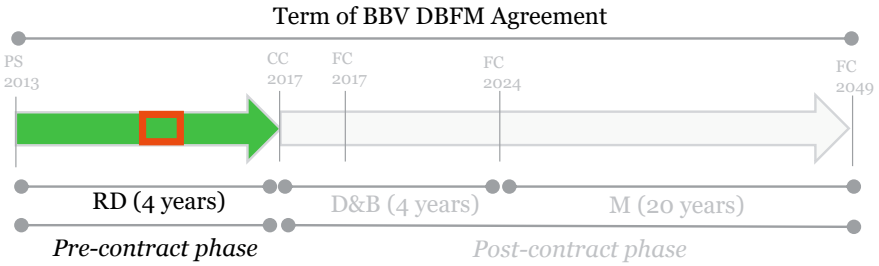

Figure 2.1: Term of Blankenburgverbinding (BBV) DBFM Agreement

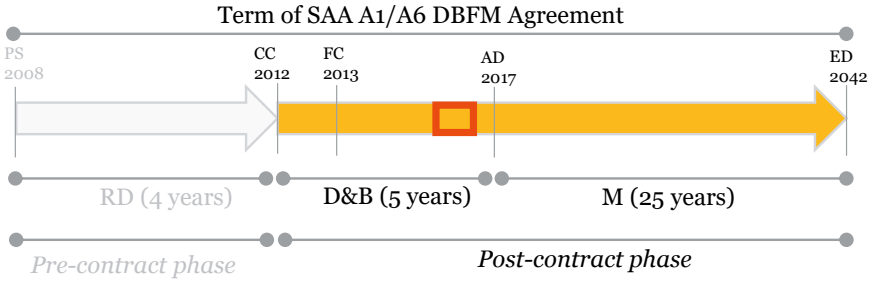

Figure 2.2: Term of SAA A1/A6 DBFM Agreement

Abbreviations used in Figure 2.1 and 2.2
PS: Project start
RD: Route Decision
CC: Contract Close
FC: Financial Close
AD: Availability Date
ED: Expiry Date
□ : Research period

Case descriptions

The Blankenburgverbinding (BBV) Project: The Blankenburgverbinding (BBV) was a new DBFM project to build a tunnel connection, under the Nieuwe Waterweg channel, between the A20 and A15 highways west of Rotterdam. The purpose of the BBV is to provide a robust infrastructure connection serving the western part of the Rotterdam Port area and to supply a solution for the growing traffic crossing the Nieuwe Waterweg. The BBV was contracted in the form of DBFM contract in 2017, with a separate contract for a toll concession. The construction started in 2017 with the opening scheduled for 2024. Since the research started, the BBV has progressed to the construction phase.

The case of the Blankenburgverbinding project was chosen as a suitable case to recognize potential changes in a typical complex DBFM project, and to capture the current practice in implementing flexibility in a DBFM contract.

The physical distance covered by the project is short – only 5 km of highway – but it is highly complex by the incorporation of both a tunnel under intensively used waterway and a land tunnel below a very sensitive populated area. The decision to go ahead with this connection was taken after decades of political discussion and the evaluation of many alternative routes. The BBV is one of a series of projects planned for the sustainable development and accessibility of the Rotterdam region (Rotterdam Vooruit, 2009). This project is particularly suitable for this research since it was one of the most recent DBFM infrastructure projects in the Netherlands at the time of the research. As such, it applied the most recent DBFM contractual knowledge, incorporating all the experiences from previous DBFM contracts. The environment of the project is highly dynamic (social, political, economic, legal, and technical changes abound).

At the time of the research, the project was in the pre-contractual phase. In 2014, the total project costs were estimated at approximately €1 million contract value (2014 prices). The project would be partly financed by tolls imposed on users. Besides the realization of the infrastructure, a maintenance period of 20 years following the construction phase was part of the contract. Rijkswaterstaat, the executive department of the Dutch Ministry of Infrastructure and Water Management was the contracting authority and the contract is based on the Dutch DBFM contract model. The contracted partner was BAAK, a consortium consisting of Ballast Nedam, DEME and Macquarie. The contracted partners were typically organized through a Special Purpose Vehicle (SPV), which represents all the contractual private stakeholders through separate contracts, such as credit agreements with lenders and D&C contracts with contractors. Due to the dynamic environment of the BBV project, and its complex characteristics, including a large number of actors, major changes with considerable impacts on the project can be expected during the 24-year contract period.

The Schiphol-Amsterdam-Almere (SAA) program's A1/A6 Project: The SAA A1/A6 Motorway extension is part of a major multi-project public infrastructure program referred to the Schiphol-Amsterdam-Almere (SAA) program. Traffic along this corridor has greatly increased over the past 15 years, primarily due to economic growth and a growing population in the area. Traffic growth is expected to continue due to the expansion plans for the cities of Amsterdam and Almere. The purpose of the

SAA program is to improve traffic flow, accessibility, and livability (i.e., socioeconomic conditions) within the SAA corridor.

The A1/A6 project is the largest and most complex project in this program. The motorway is approximately 23 km long and is located between the towns of Diemen and Almere Haven. On realizing the project, the capacity of the infrastructure will roughly double. The project involves a total of 70 new civil engineering structures, including a 60m wide aquaduct (Europe's widest), a rail bridge near Muiderberg with a span of 380 m, and an additional bridge adjacent to the existing bridge over the Randmeren (the Hollandse Brug) of similar length. The A1/A6 project has a nominal contract value of EUR 1 billion (excluding taxes) and a duration of 30 years (2012–2042).

Rijkswaterstaat tendered for this project using the third edition of the standard DBFM contract. The successful bidder SAAone is a Special Purpose Vehicle (SPV) company. SAAone includes major construction companies such as the German company Hochtief and the Dutch companies of VolkerWessels and Boskalis, as well as the fund management company, the Dutch Infrastructure Fund (DIF) Capital Partners. The closing of the contract tendering process was in 2012, with a financial close in 2013. The latter refers to the point at which all the interlinked conditions mandated through the project contracts, including the funding, were met. The construction activities started in 2013 and it is now (2021) in its operational phase. Recently, DIF Capital Partners agreed to sell their stake in the SAA A1/A6 project to Equitix, a UK and European Infrastructure Fund Manager (DIF Capital Partners, 2021).

The DBFM contract is the key contract between the client and the SPV, through which the SPV is responsible for the design, building, financing, and maintenance of the project. The SPV has a financial agreement with financiers through syndicated loans through which a group of financers provides finance to the SPV for the implementation and maintenance of the project. The Ministry of Infrastructure and Water Management acts as a guarantor for the financers through a direct agreement with them. The client is expected to repay the finance through periodic milestone payments to the SPV provided the latter satisfies predetermined availability and safety specifications.

The actual construction of the project was realized using an engineering procurement and construction (EPC) arrangement through a contract between the SPV and the contractors in the EPC. A separate contract would be signed later for maintenance. The SPV receives equity from shareholders (or sponsors) through equity contribution

agreements. Usually, the shareholders are connected to (or the same as) the EPC contractors, thereby creating a direct relationship between the risk management of the SPV and the EPC. As the final element of the contract structure, Rijkswaterstaat has administrative agreements with 13 local authorities to guarantee stability within the environment of the project. In addition, several external companies were contracted during the tendering phase and the realization phase of the project to support and advise Rijkswaterstaat and SAAone on legal, technical, and insurance aspects.

2.5 EMPIRICAL DATA COLLECTION

To achieve a better and more accurate interpretation of reality, multiple qualitative data gathering methods have been used including a document review, observations, and in-depth semi-structured interviews (Creswell, 2013; Yin, 2014). The methods used will be discussed in the subsequent subsections.

Document review

Each case study started with a desktop review of archival documents looking back into the project history, which was supplemented with observations to obtain a greater understanding of the case. Through internships at Rijkswaterstaat, the researcher was granted access to not only all the project-related documents, but also to internal Rijkswaterstaat PPP-related documents (including evaluations, standard contract documents, tendering documents, and, stakeholder consultation documents). A key part of the document review was a detailed investigation of the PPP project agreements. On the national level, many countries have developed standardized PPP contracts, along with guidance manuals. Of these, the Standardized PFI2 Contracts issued by HM Treasury (2012) in the United Kingdom, the Dutch DBFM Model for Infrastructures issued by Rijkswaterstaat (2014), and the 'Standard Form Public Private Partnership Project Agreement in New Zealand (New Zealand Government, The Treasury 2013) were examined. Further, the archival research included examination of specific project contracts, such as Rijkswaterstaat's draft version of the BBV DBFM Agreement, the SAA A1/A6 DBFM Agreement signed between Rijkswaterstaat and SAAone (the Special Purpose Vehicle of the SAA A1/A6 project), and parts of the M25 DBFMO Agreement provided by the UK's Highways Agency.

In addition to these contracts, organizational and, technical reports, maps, and drawings were also examined. Further, annual reports, newspaper articles, and publicly available reports of the client, external stakeholders and the SPV backbone companies were consulted. Additional information, from memos, minutes of meetings, and contract amendments provided insights into how variations came into being i.e. the way of

dealing with change. Access was also granted to all the digital sharing tools between the authority and the SPV and, therefore, to all the variations and contract amendments, and to all the minutes of contract change meetings. In addition, standardized financing documents (i.e. common term agreements), hedging and security documents, and equity arrangements (i.e. shareholder participation agreements) were also examined.

Observations

To gain further insights into the actual modus operandi, field observations were carried out in both cases. The purpose of these observations was to obtain a greater understanding of what actually happens daily in organizing the projects. The majority of the observational time was spent at the Rijkswaterstaat offices, but with some time spent at partner offices, such as the SAAone office in Diemen. Observations were conducted in various ways, such as participating in meetings, workshops, employee team events, and construction site visits. All the observations, for example how Rijkswaterstaat employees interact with each other and what conversations they have with stakeholders, the SPV, and contractors were noted in a research diary. As part of the observation, 'sketches' of meetings, similar to Shipton et al.'s (2014) 'vignettes', with the Rijkswaterstaat project team were recorded to represent relationships between organizations and actors. Sketches were drawn to present the organizational charts, sitting arrangements in meetings, frequency of conversations, etc. This proved helpful in identifying how relationships between actors in the meetings functioned in reaction to change, who was interacting with who, and what the foci of the interactions were.

Interviews

In total 116 formal and informal (explorative) interviews were conducted across the course of the study from 2014 to 2020. The formal interviews were conducted in a semi-structured way. This style of interview allows for flexibility in pacing and structuring the questions. A guide was established to predefine the general research questions. This guide functioned as a starting structure, and the interviews themselves were flexible in the sense that participants were free to direct the discussion to related and relevant topics. The informal interviews ranged from small chats to long discussions. These conversations provided considerable space for elaborating on the understanding of dealing with uncertainty in practice, and played a supporting role in collecting data. Sometimes these small talks would lead to quicker access to confidential information. Notes on both the formal interviews and the informal conversations were taken with permission of the informant. In addition, informal interviews were held with academic experts to gain more insight into the mechanisms identified.

Interviewees were selected based on their knowledge of the projects, the actors they represented, and their experience. Interviewees were identified from different hierarchical levels and different organizations, such as government officials, infrastructure industry experts, financiers, and consultants. This ensured that the perspectives of all the actors who were involved in PPP relationships were gained. Profiles of the interviewees are provided in Appendices 2, 3, 4, and 5. In broad terms, interviewees were selected from the organizations indicated in Table 2.2.

Table 2.2: Interviews

Chapter	Number of interviews	Organizations interviewed
Throughout the thesis	38 (Explorative interviews)	Court of Audit Government officials Advisors Academics
Chapter 3	32 (Formal interviews)	Government officials (NL: Ministry of Infrastructure and Water Management and Rijkswaterstaat, UK: Highways Agency) Affected key stakeholders (i.e. Port of Rotterdam, Water Board Authority Delfland)
Chapter 4	21 (Formal interviews)	Government officials (Rijkswaterstaat) Infrastructure industry experts and engineers (SAA program managers, SAAone managers)
Chapter 5	25 (Formal interviews)	Institutional investors (Private Equity and Pension Funds) Lenders (Commercial banks, Development banks) Advisors (Financial, Legal and Technical) Infrastructure analysts and journalists, and credit agencies

Further, interviewees were identified through the author's personal network of infrastructure professionals and here supervisors'-contacts. Some of the financier and consultant interviewees were identified from the "Infrastructure Journal Global Investor" (IJ Global, 2019) database. Further, snowballing was used in that contacted interviewees provided information to identify further participants. The selection of specific interviewees is further elaborated in Chapters 3, 4, and 5. At the request of the interviewees, their identities remain anonymous. Each interview was conducted in English and lasted approximately 1 to 2 hours. The interviews took place in the Netherlands, UK, Luxemburg, and Germany, the majority in person but several by telephone. All the formal interviews were recorded and transcribed for later coding and analysis.

2.6 DATA ANALYSIS

Data analysis involved a set of steps building on the information collected. Chapters 3, 4, and 5 each have their own analysis sections as described in those chapters, and follow the same steps into analyzing the empirical data. In all chapters a thematic analysis approach was used to systematically analyze and code the data (Nowell et al., 2017). In general, the primary codes were derived from the studied literature. The researcher then went through all the archival data, interview transcripts, and notes from observations seeking supporting evidence. Codes and sub-codes further evolved while processing the empirical data, which organized the material into chunks and segments (Creswell, 2013). These codes and sub-codes were integrated into themes. A more detailed description of the analyses of the data is given in each Chapter.

The main emphasis of thematic analysis is to identify common themes or patterns (Braun & Clarke, 2006). The found patterns of each chapter (related to the subcluster of relationships in the PPP structure being addressed) are summarized as 'findings' at the end of the respective chapters. These findings are subsequently used to reveal more general patterns across the cases and the chapters related to the overall PPP structure. These patterns, or general findings, are formulated and discussed in Chapter 6.

CHAPTER 3

DEALING WITH POTENTIAL CHANGES IN INFRASTRUCTURE PPPS IN THE PLANNING PHASE

This Chapter is based on: Demirel, H.C., Leendertse, W., Volker, L., & Hertogh, M. (2017). Flexibility in PPP contracts–Dealing with potential change in the pre-contract phase of a construction project. Published in *Construction Management and Economics, 35*(4), 196-206.

This Chapter focusses on the relationship between the contracting authority and its stakeholders, by studying uncertainty mainly caused by the context of an infrastructure PPP project is dealt with in the pre contract phase (Figure 3.1). Large infrastructure projects are often characterized as complex, nonlinear, and dynamic processes (Khan et al., 2016) that include specific uncertainties and interdependencies among a large number of stakeholders. Understanding the complex environment of PPPs in the pre-contract phase is especially important for decision-makers seeking to prevent the proposed project from becoming less controlled, due to changes during the construction, maintenance and exploitation phases. Therefore, this study aims to get more insight in the potential changes to be expected within the relatively long term of DBFM contracts, and the ways in which these contracts can effectively anticipate such changes. The case of this study was the Blankenburgverbinding project which will provide a new lane highway connection between the highways A15 and A20 to the west of Rotterdam, the Netherlands. Given the size and complexity, requirement of flexibility has been also examined. Flexibility has been explored from two perspectives: from business management and legal perspective point of views. As the nature of the development of a transportation PPP project, continuously having relationships with external stakeholders throughout the life cycle of the project would benefit solving complexity. A pro-active way of dealing with uncertainty is engagement of stakeholders early and continuously in the project. This helps PPP actors to understand their pre contract project environment and subsequently create the one they need for the future.

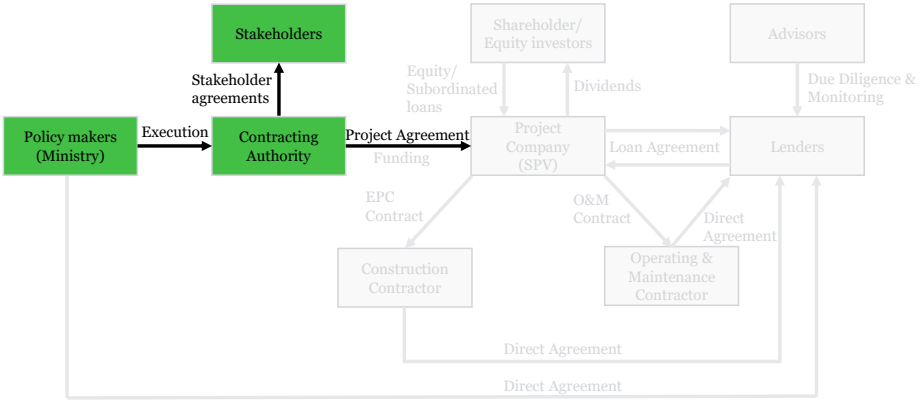

Figure 3.1: Relationship between contracting authority and its stakeholders

3.1 INTRODUCTION

Public Private Partnerships (PPPs) cover a range of possible relationships between public and private parties. According to Iossa et al. (2013, p. 10) a PPP can be defined as '... any contractual arrangement between a public-sector party and a private-sector party for the provision of public services with the following four main characteristics: (i) the bundling of project phases into a single contract; (ii) an output specification approach; (iii) a high level of risk transfer to the private sector, and (iv) a long-term contract duration'. PPPs regularly face major challenges because of changing circumstances that were not anticipated in the planning phase, which often cause a project to exceed its budget and timespan. To illustrate the magnitude of the problem, we refer to an investigation of the Court of Audit in the Netherlands (2013), which audited five DBFM projects in the Netherlands. A DBFM (Design, Build, Finance and Maintain) contract is a PPP which facilitates private investment in public assets over an extended period of time, often 20–30 years. The investigation included three major road projects and two utility projects. Between the five contracts, a total of 157 uncalculated changes resulted in cost overruns amounting to 61 million euros. This example shows that there is considerable room for improvement in the management of changes within DBFM contracts. This is in line with the findings of the UK National Audit Office (2008): 'An estimated 180 million pounds was paid by public authorities to private finance initiative (PFI) contractors to undertake changes in 2006'.

A significant contributor towards large sunken investments and project failures appears to be a lack of understanding of the complex environment in which PPP contracts are being realized (Shaoul et al., 2006, Cantarelli, 2011, Cantarelli et al., 2012). As Flyvbjerg et al. (2003, p. 6) put it: 'the world of megaprojects' preparation and implementation is a highly risky one, where things happen only with a certain probability and rarely turn out as originally intended'. Similarly, Kwak et al. (2009) point out that PPPs are not easy to apply to infrastructure projects, due to their contractual complexity and the high level of uncertainty that arises from their long concession periods. Large construction projects are characterized by complex contractual arrangements between multiple actors, brought together in a network of social connections, mutual agreements and contract clauses, in order to achieve a service as intended (Hertogh & Westerveld, 2010). It is a common experience that the interactions between the various stakeholders in complex projects are the most prominent source of changes (Ward & Chapman, 2008, Hertogh & Westerveld, 2010). Not only do they each bring different strategies and procedures to a project, but they also vary in their priorities and loyalties (Bourne, 2005). Coupled to their inter-relatedness, this leads to a high level of unpredictability.

In PPP contracts neither the activities to deliver a contract outcome, nor its environment are stable. PPPs will always be affected by changing circumstances due to their long-term commitments. Hwang and Low (2012) state that project changes and/or adjustments are inevitable as they are a fact of life at all stages of design and construction. Hence, change is a given in construction projects and should therefore be dealt with in its context (Verweij, 2015).

Rather than dealing with contingencies in the post-contract phase, 'the period after the award of the contract when actual construction begins through to its completion' (Kodwo and Allotey, 2014, p. 54), PPP stakeholders increasingly prefer to anticipate potential change in the pre-contract phase, 'the period between the initial conceptions of the project and the signing of the contract' (Kodwo & Allotey, 2014, p. 54). Hence, PPP contracts ideally contain clauses that enable an effective response to changing circumstances throughout the term of the contract. Given that at the time of drafting the contract the exact nature of these changes is unpredictable, such clauses need to have a high level of flexibility, and can only be formulated from an extensive knowledge of what kind of changing circumstances might be expected. Flexibility in PPP contracts is therefore dependent on the ability to proactively anticipate and address possible contingencies and their solutions.

Most of the growing body of literature on the pre-contract phases of projects is focused primarily on identifying the causes and effects of changes and how to cope with them if they occur (Price & Chahal, 2006; Sun & Meng, 2009; Hwang & Low, 2012). Understanding the complex environment of PPPs in the pre-contract phase is especially important for decision-makers seeking to prevent the proposed project from becoming less controlled, due to changes during the construction, maintenance and exploitation phases. Therefore, a focus on any expected and unexpected changes that might occur within a project – the latter also referred to as 'black swans' (Taleb, 2007) – and its environment is vital for effective project management. An understanding of the sources of both uncertainty and complexity is necessary, in order to be able to formulate appropriate management strategies. Furthermore, the interaction between the network of stakeholders and project actors must be used to manage the needs of stakeholders, and simultaneously cope with potential changes (Hertogh & Westerveld, 2010).

DBFM contracts normally include standard processes to control and coordinate changes known as 'change procedures' (Highways Agency, 2011, Rijkswaterstaat, 2014). A change procedure is part of a legally binding contract (Rijkswaterstaat, 2014), which facilitates dealing with changes during the contract period. The schedule outlines changes of various impact levels, and prescribes how changes are to be contractually

evaluated and settled. However, these change procedures provide a reactive way to specify and evaluate project changes when they occur. Any difference in perception between the contract partners is then a source for possible dispute. The need for a more pro-active way of addressing potential changes is regularly highlighted in the literature (Cruz & Marques, 2013), but studies on how to achieve this are rather uncommon. Moreover, research related to DBFM implementation and practitioners' experiences with the change mechanisms provided in DBFM contracts is scarce (Lenferink et al., 2013). This Chapter aims to fill this gap by providing a more practical view of contractual flexibility in long-term PPP, i.e., DBFM, contracts. The study is focused on finding practical ways to prevent, reduce or effectively manage any negative effects of changes, in which we specifically concentrate on a more proactive management approach. This study aims to get more insight in the potential changes to be expected within the relatively long term of DBFM contracts, and the ways in which these contracts can effectively anticipate such changes. We set out to achieve four main objectives. Firstly, to identify what sort of changes stakeholders typically expect to occur in the post-contract phase of a DBFM project. Secondly, to develop a categorization of potential changes based on the available literature. Thirdly, to establish how the various stakeholders define flexibility. The fourth and final objective is to identify how stakeholders currently deal with potential changes.

3.2 THEORETICAL INSIGHTS

Contract flexibility

Flexibility of contracts is studied in areas such as contract law, finance, social and relational issues, business and systems design. This leads towards different perspectives on contract flexibility. De Neufville and Scholtes (2011) have tackled flexibility from a technical point of view regarding the design of projects detailing why flexibility in design – and subsequently in the contract – are needed, in order to deliver significantly increased value. Domingues et al. (2014) examined contractual flexibility in infrastructure PPPs and found that flexibility is more likely to contribute to the project's success when implemented in the contract design. Based on a study on flexibility in health care PPP projects, Cruz and Marques (2013) propose in line with this notion a double entry matrix based on real options theory as a new model for contract flexibility. According to Nystén-Haarala et al. (2010), flexibility is often introduced in contracts through social methods, relying on good personal relationships between business partners rather than through the contract itself. Therefore, contract documents often do not contain mechanisms for dealing with contingencies. According to Saleh et al. (2009, p. 307), the concept of flexibility is 'vague and difficult to improve, yet critical to competitiveness' and as such comparable to the notion of 'quality' about 20 years ago. Hence, they propose to

transform flexibility, as currently adopted in various design strategies, into a quantifiable engineering attribute, thus expanding the concept to an instrument of optimization and robustness in system design. Finally, Barton (2015) distinguished between two important perspectives on flexibility: the legal viewpoint and the business viewpoint. Closer collaboration between those drafting and those implementing the contracts would decrease the issues with contract flexibility. Furthermore, introducing flexibility to the contracts could lead to better integration of the commercial, personal and business relationships that contracts require (Barton, 2015).

In general, the literature about contract flexibility mostly concentrates on legal and financial issues, but is scarce in relational issues. Stahl and Cimorelli (2005) for example state that, in some cases, uncertainties are – more or less deliberately – ignored by decision-makers. This finding is in line with Flyvbjerg et al. (2003, p. 7), who claim that 'power play, instead of commitment to deliberative ideals, is often what characterises megaprojects'. The consequences can be devastating, with unpleasant surprises in the long term. Hertogh and Westerveld (2010) therefore stress the need for adaptive management, which is characterized by monitoring and evaluating results and adjusting actions based on what has been learned. This means that there should be a strong feedback link between monitoring and decision- making, which allows for effective learning. The initial arrangements made in the contract should facilitate this.

Potential changes

The significance of the dynamic project environment to a complex contract arrangement in the construction sector is broadly recognized (see for example Hagan et al., 2012). However, only few studies address potential changes in long-term PPP or DBFM contracts. Many publications mention changes in the context of specific case studies, with a general classification; for example, Hsieh et al. (2004); while others focus on a single, influential change, such as the study by Rahman et al. (2008) on the uncertainty surrounding infrastructure planning and development in the Netherlands in view of climate change. Similarly, Bock and Linner (2015) focus on the trend for robotics becoming ubiquitous in the construction sector.

The scholars that do provide a useful classification adopt various approaches. Koppinen and Rosqvist (2010) (reported by Komonen et al., 2005), for example, grouped uncertainties into four broad categories: (1) Market oriented changes; (2) Technological changes; (3) Changes in networks; and (4) Societal changes. According to Love et al. (2002) dynamics that impinge upon a project system are derived from three basic sources, namely planned activities, attended dynamics and uncertainties, and finally unattended dynamics. In the category of unattended dynamics, they further

distinguish between internal uncertainties related to the project, to the organization, to the people and finances involved and external uncertainties related to government, economy, social and legal uncertainties, technological developments, intuitional (organisational) influences, physical conditions and force majeure. De Weck et al. (2007) divided uncertainties into two main categories; exogenous and endogenous in system design. Endogenous include product context and corporate context. Exogenous uncertainties are outside of the companies' direct control and they arise from the market, their operational environment and the cultural and political context. Wu et al. (2005) found a total of 34 change order causes, such as changes in policy or regulations, changes due to an incomplete geological survey and changes due to contractors working on different contracts who may force change.

Sun and Meng (2009) present a kind of summary of these findings in their classification of changes in a hierarchical structure. At level 1, changes are divided according to their causes into three broad categories; external, internal and organizational causes. Level 2 explains the determining factors of changes, such as environmental, social and political factors. Level 3 describes the root cause of the changes, for example changes in government policies, market competition, and changes in legislation and culture. Hsieh et al. (2004) distinguish between two main dimensions, namely technical and administrative. The technical dimension refers to planning and design, underground conditions, safety considerations and natural incidents; while the administrative dimension relates to changes of work rules/regulations, changes of decision- making authority, special requirements for project commissioning and ownership transfer, and neighborhood pleading.

Organizational, financial and political changes can also be of influence. Van Gils et al. (2009) investigated change catalysts that occurred during the governance process in the ports of Hamburg and Rotterdam, while Koppinen and Lahdenpera (2004) predict that globalization will create a demand for increased international cooperation on transnational issues, which could be a major obstacle for international commerce and could affect long-term projects financially. This could influence the level of collaboration between parties in the long term during the project implementation. The work of Van Marrewijk et al. (2008) on the management approaches of two megaprojects in the Netherlands and Australia, shows that project cultures also play a significant role in the way managers and partners cooperate to achieve project objectives. In 2012, the UK HM Treasury reported that the Eurozone crisis of 2008, combined with a downturn in the global economy and a change in bank regulatory requirements, has had a major impact on (financial) markets. This resulted in increased long-term borrowing rates for infrastructure projects and a significant reduction in the availability of long-term bank debt. This relates to the findings of Henckel and McKibbin (2010) who observed that the global crisis refocused the

international community onto the nature and role of infrastructure spending. Changes in bank accounting systems can be categorized under financial changes.

The various classifications of changes as found in the literature provide the basis for the classification offered in Table 3.1. It recognizes nine main categories of potential changes based on particular features: changes in project environment, financial changes, changes of legislation, change in politics, change in organizations, change of requirements, climate changes, technological and technical changes. The changes identified within these categories are important considerations for PPP contract preparation: if they are likely to occur, they can be prepared and/or negotiated for well in advance. As Sun and Meng (2009) mentioned, using the list allows project teams to conduct analyses on both the causes and effects of change.

Table 3.1: Change categorisation based on reviewed literature

Change categorisation	Themes	Sources
Changes in project environment	Influence of projects in surrounding networks	Wu et al. (2004); Van Gils et al. (2009)
	Environmental conditions	De Weck et al. (2007); Sun & Meng (2009)
Financial Changes	Effects of economic crisis	Henckel & McKibbin (2010); HM Treasury (2012)
	Bank regularity requirements	HM Treasury (2012)
	Market changes	De Weck et al. (2007); Sun & Meng (2009); Koppinen & Rosqvist (2010)
	Internationalisation, globalisation	Koppinen & Lahdenperä (2004); Henckel & McKibbin (2010)
Changes of Legislation	Specifications and law	Love et al. (2002); Van Gils et al., (2009); Sun and Meng (2009)
Change in Politics	Fluctuating policies	Wu et al. (2004); De Weck et al. (2007); Sun & Meng (2009)
	Change of decision-making authority (external)	Hsieh et al. (2004)
Change in Organisations	Organisational culture changes	Van Marrewijk et al. (2008); Sun & Meng, (2009)
	Social changes	Love at al. (2002); Koppinen & Rosqvist (2010)
	Decision makers alterations (internal) institutional influences	Love et al. (2002); Hsieh et al. (2004)
Changes of requirements	Safety requirements	Hsieh et al. (2004); Wu et al. (2004)
	Environmental requirements	Van Gils et al. (2009)
	Governmental requirements	Love et al. (2002)
Climate changes	Global warming	Rahman et al. (2008); Sun & Meng (2009)
Technological changes	Use of new materials	Love et al. (2002); Wu et al. (2004)
Technical changes	Automated systems	Bock & Linner (2015)
	Physical conditions	Love et al. (2001), Wu et al. (2004); Van Hsieh et al. (2004); Van Gils et al. (2009)

3.3 RESEARCH APPROACH

This research is based on a case study of Blankenburgverbinding DBFM project (see figures 3.2 and 3.3).[4] The case of the Blankenburgverbinding was chosen to recognize potential changes in a typical complex DBFM project, and to capture the current practice of implementation of flexibility in a DBFM contract. In this study, data collection encompasses a set of semi-structured interviews and project archived records.

Case study

The Blankenburgverbinding (BBV) project will provide a new main highway connection between the highways A15 and A20 to the west of Rotterdam, the Netherlands. The distance covered by the project is short – only 5 km of highway – but it is highly complicated by the incorporation of both a tunnel immersed in the intensively used waterway and a land tunnel crossing a very sensitive populated area. The decision to realize this connection was taken after decades of political discussion and the evaluation of many alternatives for this route. The BBV is one of a series of projects planned for the sustainable development and accessibility of the Rotterdam region (see Rotterdam Vooruit, 2009).

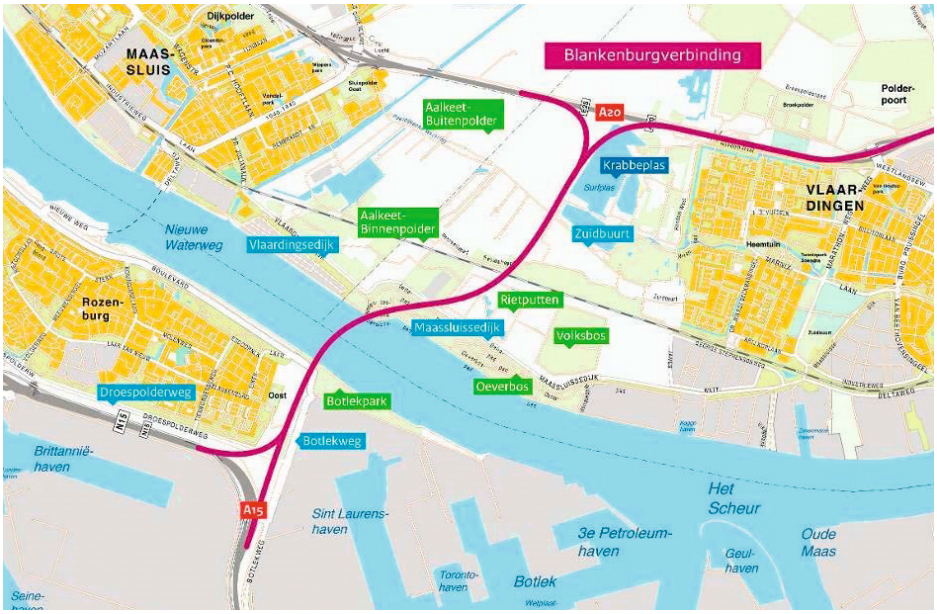

Figure 3.2: Blankenburgverbinding project (source: Rijkswaterstaat)

4 The case description represents the information at the time of research of this case Blankenburgverbinding. For the actual status of the project see Section 2.2 Cased based study, case descriptions.

Figure 3.3: Blankenburgverbinding project (source: Rijkswaterstaat)

This case is particularly suitable since it is one of the most recent DBFM infrastructure projects in The Netherlands, so it applies the most recent DBFM contractual knowledge, incorporating all experiences of previous DBFM contracts. The environment of the project is highly dynamic (social, political, economic, legal and technical changes abound) and still in the pre-contractual phase. The purpose of the BBV is to provide a robust infrastructure connection for the western part of the Rotterdam Port area and to supply a solution for the growing traffic crossing the Nieuwe Waterweg river. In 2014, the total project costs were estimated at approximately €1000 million. The project will be partly financed by toll. Currently the project is still in the planning- and contract preparation phase: the final project decision is expected in April 2016. The BBV will be contracted as a DBFM contract, with a separate toll concession. The construction is planned to start in 2017, and the opening is scheduled for 2022. Besides realization of the project, a maintenance period of 20 years starting after the construction phase will be contracted.

The Dutch DBFM contract model is strongly influenced by the Anglo-American contract nature (PFI – Private Finance Initiative). Since there was no specific legal structure for Dutch PPP contracts, a standard DBFM contract model for infrastructure was developed by the Dutch Highway Agency Rijkswaterstaat (Rijkswaterstaat 2014), the executive department of the Dutch Ministry of Infrastructure and Water Management, which is responsible for the realization and exploitation of the main

road and waterway network. Rijkswaterstaat also standardized the tender guidelines for the procurement process, using the competitive dialogue procedure (see Hoezen, 2012). The case study focuses on the practical implementation of the change procedure as part of this standardized DBFM contract. Due to the dynamic environment of BBV and the complex characteristics of the project, including a large number of actors, major changes with considerable impact on the project can be expected during the 25-year contract period. The contract partners are typically organized through a Special Purpose Vehicle or SPV (National Audit Office, 2008), which represents all the contractual private stakeholders through separate contracts, such as credit agreements with lenders and D&C contracts with contractors. Contract changes will be implemented by contractors via a change procedure, and the SPV will manage the change process, which can influence all underlying contractual arrangements.

The inter-relationship of actors and the complex nature of the BBV project are schematically based on Figure 3.1. It shows the current pre-contract phase and prospects for the post-contract phase. The potential changes mentioned result from interviews with stakeholders involved in the pre-contract phase. The requirement to adapt to changes in this complex environment extends to future stakeholders as well. However, the case study is limited to currently involved actors and focuses purely on a specific set of dominant actors.

Interviews

Interviews in this study were used to illustrate how practitioners from different organizations explain and understand potential changes, specifically in relation to the context of the BBV project and of DBFM contracts. Furthermore, the interviews provide insights into how to cluster and rank the changes and increase the understanding of how planners can deal with a dynamic environment, especially in DBFM contracts. A total of 32 interviews were conducted between April and July 2014. The data illustrate the different perspectives of the stakeholders on the flexibility needed and the flexibility provided in the PPP contract. Twenty-nine Dutch stakeholders from the Ministry of Infrastructure and Water Management (MI&WM), Rijkwaterstaat, the Water Authority of Delfland (WAD) and the Port of Rotterdam (POR) were interviewed. A further three interviews were conducted in the UK with the Highways Agency, for the purpose of comparison. All the participants held senior positions in project management, contract management, risk management, stakeholder management, technical management, asset management or contract law. Appendix 3 shows the interviewees' profiles.

The interviews started with a predetermined set of questions to explore specific issues. However, some questions were more general in their nature and the sequence of the questions varied per interviewee with new questions evolving during the interviews (Bryman, 2012). The interviews concentrated on the experienced and expected changes in projects, the dealing mechanisms of DBFM contract to cope with the changes and the potential flexibility of a DBFM contract. Braun and Clarke's (2006) thematic analysis approach was used to systematically analyse and code the interviews. The codes for the categorization of changes (related to interview questions 1 and 2) were defined prior to the interviews, based on the categorization given in Table 3.1. Codes and sub-codes also evolved while analysing the transcripts. Once the change categorization was conducted and the identification of themes completed, sub-codes were created, such as accidents in other tunnels, new dykes and tunnel safety standards.

3.4 RESULTS

Potential changes

In line with Hertogh and Westerveld (2010), all of the 32 interviewees characterized the environment of the BBV project as complex due to the many actors involved. The dynamic environment of the Rotterdam area and the political emphasis on the development of the main Port of Rotterdam were mentioned in particular. A general concern about the effects of political decisions on the DBFM contract was also expressed by some of the interviewees. A project manager from Rijkswaterstaat observed that 'political decisions to boost the economy are very important during the design phase of the project'. This corresponds with Moura and Teixeira (2010) and Flyvbjerg et al. (2003), who argue that politicians are very important stakeholders and a main cause of changes, because they have the power to influence project decisions by issuing final approvals on the project.

It was a political decision to use toll to (partly) finance the BBV project. Politics being fickle, a change of this decision may be expected in the next 25 years. Most interviewees predicted that changing toll prices will be a very big issue to deal with, because it strongly influences traffic intensity. A contract manager from Rijkswaterstaat explained that 'if they cut the toll, the number of cars passing through the tunnel will be higher, the cost of the maintenance will get higher and Rijkswaterstaat will have to pay more'. By contrast, other contract managers interviewed argued that toll is not a big issue, since the project's directors decided to separate the DBFM contract and the toll concession. One of them stated that 'it does not matter if toll is there or not. The DBFM contract will be based on the availability of payments from the client. That would make it easy to deal with these changes in the contract period'.

In general, interviewees stated that the most important potential changes in the BBV project will be centred around adjustments to the surrounding highways, railways, cables and pipelines, and accidents in the surrounding network. The connection to the highway A15 – which is also a DBFM contract – is also susceptible to potential change, and a major issue. A policy advisor from the Ministry of Infrastructure and Water Management explained that 'any maintenance activity linking highways can affect the BBV Tunnel availability which will cause changes in the DBFM contract'. A project manager from the Ministry of Infrastructure and Water Management added that 'accidents in other tunnels in Rotterdam port area and ship accidents can cause changes'.

The stakeholders interviewed also discussed potential changes in port facilities, especially any expansion projects causing changes in traffic intensity and composition. Since the M-component in DBFM is strongly influenced by traffic intensity and composition, this change can have significant impact on a DBFM contract. According to a project manager from the Port of Rotterdam the extension of the 'Maasvlakte 2' area to the west of the Blankenburgverbinding will strongly affect future transportation, and therefore cause major changes for the project in the future.

Directors and project managers expect legislative changes as well, especially in the field of tunnel safety and EU standards regarding environmental impact, such as noise and air quality. One of the interviewees mentioned a huge change in tunnel safety regulation (the new tunnel law) during the construction of another current tunnel project in the Netherlands, the Tweede (second) Coen Tunnel, which he suspects could be a potential issue for the BBV Tunnel too. Interestingly, when asked to identify potential organizational changes, the interviewees mainly pointed to internal organizational changes within Rijkswaterstaat. Additionally, interviewees stated that changes in requirements mostly originate from external stakeholders, such as the Port of Rotterdam and the Municipality of Rotterdam. Stakeholders themselves will change and so will their needs.

The interviewees also identified climate change as an important and prevalent issue. Interviewees expect changes in water protection safety regulations and laws, due to the expected rise in sea levels. A Port of Rotterdam project manager and a contract manager from an adjacent Water Authority pointed out that due to climate change, there will be saltier water running through the main waterway, thus affecting the submersed part of the BBV. A contract manager predicted that 'more rainfall will affect the pumping systems of the tunnels. Also, the dyke system has to be adjusted which will affect the construction of the tunnel entrances.

A number of respondents argued that it is vital to recognize technological changes in transportation with regard to the long-term relationships in DBFM contracts. A risk manager posited that in this context '... smart highways, self-driving cars, will change the context of DBFMs in general'. Decision-maker alterations during the long-term construction can be an important issue. However, none of the respondents argue about this potential change. There is a tendency for public participants to ignore (Flyvbjerg, 2011) or be unaware of potential changes. With regard to this, Stahl and Cimorelli (2005) state that 'since the uncertainty cannot be eliminated with more information or better science, many choose to ignore it'. Ignorance leads to reactivity instead of proactivity. However, the interviewed participants in the BBV case mainly demonstrated unawareness of uncertainty rather than ignorance. It can therefore be concluded that unawareness reinforces the need for proactive information on potential changes in the pre-contract phase.

On the whole, all the interviewees identified some potential changes to the BBV project. Striking is that the focus of these changes is mostly on the realization phase of the project. For example, legislative changes in relation to the tunnel design, to be implemented in the realization phase of the contract were mentioned. Possibly, this is because the participants interpret a DBFM contract as a Design & Build contract with additional maintenance. Most concerns regarding potential change focused on the short-term rather than the complete project-cycle or the post-realization management of the asset. Participants did not recognize the effect that changes in the DBFM contract could have, resulting from the life-cycle mechanism incorporated in this type of contracts. Again, this seems to relate merely to unawareness rather than ignorance.

In general, the interviewees agree that a good understanding of any potential changes in the pre-contract phase of a project can help both public and private project managers to effectively deal with them during the construction and maintenance phases. In Table 3.2, the change categorization from Table 3.1 is coupled to the findings from the interviews in the BBV case. The resulting categorization can be used as a basis for a more detailed investigation of uncertainty. These classifications can help contract managers to develop their change management process.

Table 3.2: Findings of the BBV case related to the categorisation of changes as given in table 3.1.

Change categorisation	Themes	Potential changes mentioned in the BBV project
Changes in project environment	Influence of projects in surrounding networks	Port expansion (Maasvlakte 2)
		Highway expansions
		Railway expansions
		Cables and pipelines
		Accidents in other tunnels in Rotterdam port area
		Ship accidents
	Environmental conditions	New dykes
Financial Changes	Effects of economic crisis	Toll prices
	Bank accounting systems	Loans
	Fluctuations in budgets	Toll cuts
	Market changes	
	Internationalisation, globalisation	
Changes of Legislation	Specifications and law	Tunnel safety standards
		EU laws
Change in Politics	Fluctuating policies	Ministerial decisions changes
	Change of decision-making authority (external)	Municipal decisions change
Change in Organisations	Organisational culture changes	Internal changes in management
	Social changes	Roles of parties
	Level of competition	
	Decision maker alterations (internal), institutional influences	
Changes of requirements	Safety requirements	Safety system
	Environmental requirements	
	Governmental requirements	Mobility, performance, quality levels (noise and air)
Climate changes	Global warming	Sea level
Technological changes	Use of new materials	New type of products
	Automated systems	Robotics in construction
		Car technology
		Smart highways
		Traffic information system
Technical changes	Physical conditions	Geological survey, tunnel installations

Flexibility

Stakeholders' understanding of flexibility differs from person to person. In general, interviewees assess the flexibility in DBFM projects from two different perspectives. On the one hand, when an interviewee says a contract is flexible, the statement conveys mostly a legal understanding: the contract clauses can easily deal with changes. On the other hand, interviewees who approached flexibility from a business-managerial perspective stated that each stakeholder has a role to play and some will be more dominant than others. For example, contractors under a DBFM contract are obliged to pay their loans in time to the lenders or investors. Changes can compromise this obligation. Having contractual flexibility through change procedures does not automatically imply that the same flexibility exists in the complex network of relations between the actors involved. A contract assumes a relation between two contract partners, but any change will in reality affect several relations incorporated in these contract partners.

A number of participants suggested that uncertainties can be dealt with in any type of contract through change procedures, yet because of the dominance of actor relations and cost and time issues, especially in DBFM contracts, these contracts need additional flexibility measures. The two different perspectives as observed in the interviews correspond with Barton (2015), who reported on flexible contracting from two different and seemingly opposed perspectives, namely the legal and the business-oriented viewpoint.

Contract managers viewed flexibility as an essential ingredient for the success of projects under a DBFM contract, because of the long-term relationship in a dynamic environment. They also stated that the basis for flexibility is laid in the tendering or pre-contract phase of a project. One of the contract managers from Rijkswaterstaat stated that, in particular, the 'client's procurement procedures need to deal with potential changes in the dialogue phase'. In the dialogue the setting for the later phases is discussed, such as risk allocation, risk perception and coping mechanisms in case risks occur. These are mostly pre-determined potential threats to the project regarding scope, time and budget. In current practice, the dialogue does not (yet) include a discussion about addressing potential changes and unexpected events.

A few participants were of the opinion that contractors bear no responsibility for any changes, since changes are not part of the contract scope. Hence, their response is mostly reactive instead of proactive. This usually does not lead to optimal solutions. However, private parties were not interviewed in this case study. Introducing change

anticipation and a flexibility approach in the pre-contract and tendering phases (like the competitive dialogue) may force private parties into a more pro-active attitude.

Several project managers added that flexibility and contract efficiency can be enhanced through good communication between the actors. Those who approach contracts from a more relational perspective argued that 'we should continuously sit at the same table with client and service provider over the contract period to build up good relations and express our needs'. This is in line with Nystén-Haarala et al.'s (2010) findings that introducing flexibility into contracts via relational methods relies on good personal relationships between the actors. As mentioned in the introduction, Hertogh and Westerveld (2010) stress that interaction is an important instrument to manage the needs of stakeholders, and to anticipate the consequences of potential changes.

Overall, the interviewees' perception and understanding of flexibility reflects Saleh et al. (2009), who conclude that flexibility, despite its popularity, is not yet an academically mature concept. As the interviews show, this seems also true in practice.

3.5 DISCUSSION AND CONCLUSION

The results of this case study lead to several observations. Firstly, top managers and specialists involved in the project are unanimous in their expectation that many changes will occur during the life cycle of a DBFM project. The potential changes are mostly related to changing politics and the dynamic environment of the project itself (stakeholders). The literature describes a tendency, especially in public clients, to 'ignore' potential changes and rely on the flexibility of the contract. The interviews, however, show a tendency of unawareness rather than ignorance, which reinforces the need for pro-active anticipation of potential changes in the pre-contract phase, in order to be better prepared for changes in later contract phases.

Secondly, the BBV case study can easily be related to the change categorization as found in the literature. However, expected changes in practice are largely focused on the short-term realization phase. The majority of interviewees perceive the DBFM contract as a Design & Build contract with additional maintenance. In general, actors do not realize that any changes occurring during the term of the contract, which in a typical DBFM contract extends to its complete life-cycle, can have significant consequences, such as high contract disturbance and high-cost implications. Reactive management in the maintenance phase may result in further financial burdens on the PPP actors or the client.

Results indicate that stakeholders should proactively identify the measures necessary to deal with potential changes, and implement them in the contract and contracting strategy. Reactiveness leads to inefficiency and disturbance of the project progression. Since most changes are predictable and 'black swans' are rare, it is much more effective and efficient to act pro-actively on anticipated possible changes.

Furthermore, the interviews show diverse perspectives on flexibility. This corresponds with the statements of some scholars that flexibility is a rather vague concept. Categorizing and reporting on practical perspectives (through case studies for example) regarding these categories can help to make the concept of flexibility more robust. In general, as stated by the interviewees, perspectives on flexibility can be divided into those from social, legal and business relation viewpoints. However, all perspectives should be taken into account in an adequate contract strategy.

The findings generate additional insight into potential change in large construction projects and the perception of contract flexibility by the various parties involved. This helps DBFM actors to understand their current project environment and subsequently create the one they need for the future. Furthermore, these insights can help to allocate project risks to the parties best able to manage them, especially in case of change. Risk allocation should be consistent with expected changes and should have sufficient flexibility to also deal with unexpected changes. Classified changes from stakeholders' perspectives can be a useful starting point for the development of such a risk framework. From the contractors' side, being prepared to manage changes will reduce future difficulties regarding the (financial) contract arrangement.

A proper understanding of potential changes is essential for effective post contract management. How to deal with these changes in PPP contracts is an important issue worthy of further research, and as such will be investigated in a follow-up study by the authors. This investigation will look at the perception of flexibility in the realization and maintenance stages in different types of DBFM projects, and analyse the actual causes and effects of changes in these DBFM projects.

CHAPTER 4

DEALING WITH CHANGES IN INFRASTRUCTURE PPPS IN THE REALIZATION PHASE

This Chapter is based on: Demirel, H. C., Volker, L., Leendertse, W., & Hertogh, M. (2019). Dealing with Contract Variations in PPPs: Social Mechanisms and Contract Management in Infrastructure Projects. *Journal of Construction Engineering and Management, 145*(11), 04019073.

Main changes: The main difference between Chapter 3 and published version of the above titled article is that, in section 4.2, "need for flexibility" has been used instead of "need for adaptability".

This Chapter focusses on the relationship between public contracting authority and the project company and its sub-contractors (Figure 4.1). There is a need for appropriate design of contracts and for procurement methods to be able to adopt to uncertainty during the project life cycle. Especially the relationship between contracting authority and project company is vulnerable to change since most of the risks of change are divided between the public authority and the project company. It appears that only relying on the written contract(s) is insufficient to deal with uncertainty since these provide insufficient room for adaptation. This Chapter focuses on mechanisms that are used in practice to deal with variations both contractual and additional social arrangements between the contracting partners. The study observed the daily real-life practices of dealing with variations in the SAA A1/A6 highway project in the Netherlands, a major PPP project as part of a larger infrastructure program containing 6 PPP projects.

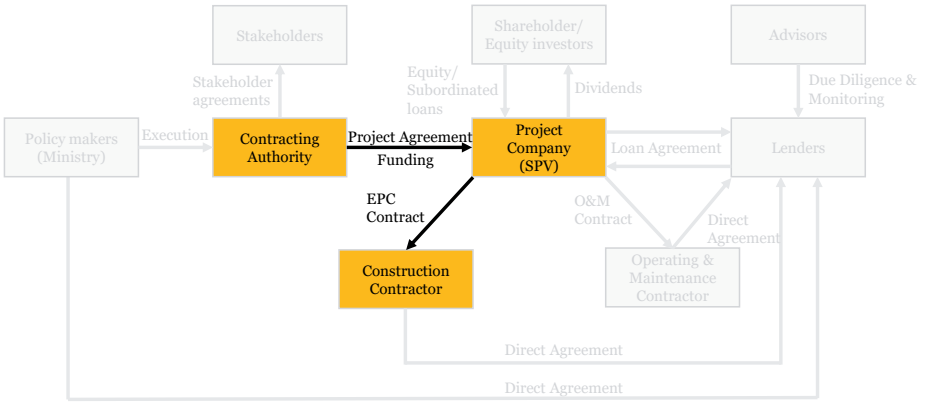

Figure 4.1: Relationship between contracting authority and SPV and its contractors

4.1 INTRODUCTION

A public–private partnership (PPP) is a delivery method frequently used to enhance the economic and societal value of public infrastructure projects. In a PPP project, a private party or consortium is granted a concession to finance, build, and operate a public project and to provide the corresponding product or service and collect ensuing revenues (Xiong & Zhang, 2014). The PPP approach may increase the economic value of infrastructure outputs because management by a private entity can bring important efficiency gains to the public authority body in question (Liu et al., 2014; Iossa, 2015). However, in the case of unexpected events, a project can suffer high-profile failures. Long-term arrangements (usually around 25–30 years) increase exposure to changing circumstances during the life cycle of a project. According to Taleb (2007), unexpected events or "black swans" are, therefore, a fact of life. Such events can, however, also alter the financial balance of the relationship that was assumed by each party upon signing of the partnership agreement, making the agreement sensitive from a commercial or financial perspective (Mandri-Perrot, 2009). Breaking a PPP contract can be expensive, and counterparties can suffer if early termination takes place (Liu et al., 2017). Scholars in PPP emphasize that when PPP projects encounter unforeseen risk events (e.g., Cruz et al., 2015), the parties should conduct renegotiations and attempt to take steps to resolve the imbalance rather than seeking early termination of the contract (Song et al., 2018).

Renegotiations usually arise because of the inadequacy of the contract to address contingencies (Cruz et al., 2014). According to Domingues and Zlatkovic (2015), current PPPs are controlled by a rigid contractual structure. Scholars agree that there are still research gaps in the fields of flexible or adaptive contracting regarding PPPs. For example, Neto et al. (2016) and Cui et al. (2018) believe that the interest in more dynamic contracting will develop into a key research area. This is partly due to the adverse effects of variation as experienced in current practice. Related to this, there is also an ongoing discussion concerning whether PPP procurement and contracts deliver the promised infrastructure project outputs or value for money (e.g., National Audit Office, 2018).

Given these concerns, there is a need for the appropriate design of contracts and for procurement methods to be able to adapt to uncertainty during the project life cycle, whether a PPP is involved or not. Thus, public and private interactions need mechanisms to coordinate their future partnerships under changing circumstances. In this Chapter, we review practices in a large PPP infrastructure project during its realization phase to identify and discuss mechanisms that are used in practice dealing

with variations. We will call these mechanisms "dealing mechanisms": a constellation of elements and/or activities that can be used by partners to adapt an initial agreement under variation. Dealing mechanisms are essential to coordinate PPPs under contract variations, ensuring that the contract adequately governs the parties' relationship over the term of the contract and that both parties maintain the associated benefits.

Changes and contractual mechanisms are extensively discussed in project management literature. Also, the use of social mechanisms - complementary to the formal contract rules–is stressed. However, the literature offers little evidence about how these dealing mechanisms work in practice. The primary aim of the study is to achieve a better understanding of the range and elaboration of different contractual and noncontractual mechanisms in the practice of PPPs, and their mutual relationship and interaction. The study thus starts from the following research question: What mechanisms to deal with variation are used in practice for infrastructure projects additional to the formal contract rules and how are they operationalized?

This Chapter first describes general experiences from previous research on dealing with variations in construction projects from relevant recent literature, and identification of mechanisms currently used in the PPP infrastructure sector are identified. The following "Results" section presents the results of an in-depth case study looking at the modus operandi of a large-scale PPP infrastructure project with regard to dealing mechanisms employed in the realization phase. The case reflects real-life practice in a PPP project and reveals how various dealing mechanisms are interactively employed in an actual contract under variation. It is concluded that noncontractual mechanisms are especially required for PPP coordination providing the necessary additivity to ex-ante agreed formal contracts. Based on the results, conclusions and implications for both researchers and practitioners are then formulated with respect to setting up and improving interaction between public and private parties in the context of infrastructure projects.

4.2 THEORETICAL INSIGHTS - DEALING WITH VARIATIONS IN CONTRACTS

Need for contract flexibility

Large infrastructure projects are often characterized as complex, nonlinear, and dynamic processes (Khan et al., 2016) that include specific uncertainties and interdependencies among a large number of stakeholders (Klijn & Koppenjan, 2016). Increased stakeholder involvement may create more interaction, and consequently more unpredictability and risks. When outcomes become harder to predict and are

spread over a longer period, projects are more difficult to define ex ante and become more vulnerable to variation (Brown et al., 2016; Xiong et al., 2018). According to Shrestha et al. (2018), uncertainties may even be magnified.

In the context of PPPs, many scholars address the fact that contracts have to be dynamic or adaptive to potential challenges and should provide the possibility to renegotiate. Spiller (2018), for example, stated that public contracts are generally inflexible when faced with uncertainties and, therefore, always require renegotiation during execution. According to other scholars (e.g., Cruz et al., 2015; Hart, 2017; Sarmento & Renneboog, 2016; Xiong & Zhang, 2014) the reason for renegotiations is mostly incompleteness because of the inability to foresee all possible future events. The literature describes several mechanisms that have been introduced to deal with this kind of flexibility (Domingues et al., 2017; Javed et al., 2014).

Cruz and Marques (2013) proposed to divide a PPP infrastructure contract into two components: a long-term concession (30 years) for building and maintaining infrastructure and an accompanying short-term contract (10 years) for managerial services. Xiong and Zhang (2016) suggested a renegotiation model that enables governments to compare different measures in the case of variation, such as toll adjustment, contract extension and annual subsidy or unitary payment adjustment, and a possibility to suggest a more suitable combination in renegotiation. Domingues and Zlatkovic (2015) proposed the idea of using SWOT (strengths, weaknesses, opportunities, threats) analysis as a tool to agree to more contractual flexibility. They suggest regularly analyzing potential benefits that could be captured and pitfalls that could be avoided and using this analysis for ongoing mutual agreement. Mouraviev and Kakabadse (2015) presented ways to reduce government overregulation (e.g., bureaucratic tariff setting and excessive procurement restrictions) to achieve more "action room" and thus greater flexibility in the management of PPPs.

On the national level, many countries have developed standardized PPP contracts, along with guidance manuals. For example, the Standardisation of PF2 Contracts issued by HM Treasury (2012) in the United Kingdom, the Dutch DBFM Model for Infrastructures issued by Rijkswaterstaat (2014), and the 'Standard Form Public Private Partnership Project Agreement in New Zealand (New Zealand Government, The Treasury, 2013). These standards allow for renegotiation under changing circumstances. According to the Standardisation of PF2 Contracts, a variation protocol is to be put in place as an appropriate change dealing process, in combination with transparency in the pricing of the change. Standardized contract versions generally include changes proposed by the contracting authority and changes proposed by the

private party. Most PPP contracts recognize a right of the contracting authority to propose changes to the terms of the contract (including the agreed terms of the asset's design, construction, operation, and maintenance) and that the private partner is entitled to relief and/or compensation for the consequences of complying with those changes (e.g., Eurostat, 2016). If renegotiation is initiated, the public and private partners will negotiate which measures should be taken to compensate for any loss by the concessionaire, such as debt service coverage ratio, loan life coverage, internal rate of return, and revenues (Xiong & Zhang, 2016).

Dealing mechanisms for contract flexibility

Brown et al. (2016) identify two interrelated categories to deal with uncertainty in complex projects: contract rules and relationships. They argue that, rather than one all-encompassing ex-ante detailed contract, the contract governance should be based on a more general formal contract and additional informal arrangements based on mutual relationships (Brown et al., 2016). Earlier, Ling et al. (2014) discussed that relational contacting is based on cooperative approaches, such as partnering, alliancing, joint venturing, long-term contracting, joint risk-sharing mechanisms, and integrated project delivery, where formal contracts spell out the rights, responsibilities, and liabilities of the parties concerned. In the respect of relational contracting, contractual incentives may include clear and equitable risk allocation in contract documents, whereas noncontractual incentives may include a change in the attitude for such equitable risk allocation (Rahman and Kumaraswamy, 2008).

Many studies (e.g., Ling et al. 2014; Xiong and Zhang 2016) have confirmed that collaborative relationships are an important addition to formal contracts, and that they can facilitate the solution to an issue or problem at hand. Suprapto et al. (2015) defined collaborative relationship in a project as the behavioral interaction between owner and contractor working together for the purpose of achieving specific project and business objectives by effective utilization of each party's specific resources and capabilities based on shared values and norms. Related to this, Zou et al. (2014) found that the commitment of senior executives and the integration of the different divisions and multidisciplinary teams were critical success factors in PPPs. Additionally, Mistarihi et al. (2012) discussed the need for PPP managers to be knowledgeable and qualified to manage the social, constructional, operational, and financial aspects of PPP projects. For a PPP setting, they stress the importance of interpersonal skills, the skill of "scoping in/out," conceptual skills, project management skills, and communication and coordination skills.

Several scholars have focused on mechanisms that allow constant adaptation to potential challenges in the delivery of infrastructure projects. For example, Hertogh and Westerveld (2010) claimed that the success of large and complex infrastructure projects is determined by five factors: a higher order of cooperation, meaning that stakeholders in the system use their cooperative capacities to align their interests in such a way that they produce system outputs that are mutually beneficial; project champions; competent people making the difference; capability to find unique management solutions; and using windows of opportunity.

Kumaraswamy and Rahman (2006) considered working in teams as a form of cooperation and discussed how effective and successful teams can generate benefits in complex projects. They found that teams generate a wider range of ideas than individuals working alone. Teams can respond to change more effectively, since improved trust and communication will help a team to gain greater clarity in expressing ideas through group discussion. Additionally, it has been argued that (Xiong et al., 2018) increased information availability between the actors in projects contributes to responsiveness.

4.3 RESEARCH APPROACH

A single case study

Because of the complex and uncertain nature of large infrastructure projects, there is a need to be able to deal with variations. In the literature, several dealing mechanisms are identified, such as standardized contracts with clauses that provide for flexible agreements, but also more social-relational solutions, such as increasing teamwork. However, there is little evidence about how these dealing mechanisms work in practice. Yin (2014) writes that a case study can contain either a single study or multiple studies. The case study method explores a real-life, contemporary bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information and reports a case description and case themes (Creswell, 2013). According to Creswell (2013), it is not primarily aimed to analyze cases, but to explore a setting in order to understand it. It makes the researcher have a deeper understanding of the exploring subject (Gustafson, 2017).

This Chapter presents a real-life case study to examine which mechanisms are applied in practice and how they are used in a project context. A Single Case approach is not uncommon in studies of complex project environments. For example, Cruz and Marques (2013) examined contract flexibility and coping with uncertainties in a single hospital that was developed as a PPP project. Because we were especially interested in

the social interaction taking place in the practice of dealing with uncertain situations additional to the formal rules, we chose to focus on the practice of a particular case (see also Gustafson, 2017) and come to know it well: "an empirical inquiry that investigates a contemporary phenomenon (the 'case') in depth and within its real-world context."

It is a research strategy that concentrates on understanding the dynamics that are present within single settings (Eisenhardt, 1989; Flyvbjerg, 2006). We particularly studied the practice of a largescale PPP infrastructure project by looking at what actually happens when coordinating and dealing with variations. Concentrating on a Single Case instead of multiple cases enabled us to observe all the steps in the variation process in detail and to study the formal and informal modus operandi of the management of the legal, technical, contract, and stakeholder aspects in a trusted environment. The aim was to capture managers' actions as they dealt with variations and to understand how formal and informal procedures facilitated or impeded their resolution in the execution phase of project. Because of the confidential character of the observations and the complex nature of the phenomenon, such depth would not have been possible within a different research approach. This unique case study showed that informal dealing mechanisms are considered necessary in practice in addition to the contract. It also showed what kinds of informal mechanisms are used in practice and how they are used. This knowledge is in itself valuable for consideration in future contracts and for creating favorable conditions to deal with variation in projects in general. Hence, it also forms a start for further research.

A1/A6 motorway case[5]

The case of our study was the A1/A6 motorway extension in the Netherlands. This PPP project is part of a major multiproject public infrastructure program called the Schiphol-Amsterdam- Almere (SAA) programme (see figure 4.2). Traffic along this corridor has greatly increased over the past 15 years, primarily due to economic growth and a growing population in the area. Additional traffic growth is expected due to the expansion plans of the cities of Amsterdam and Almere. The purpose of the SAA program is to improve traffic flow, accessibility, and livability (i.e., socioeconomic conditions) within the SAA corridor.

5 The case description represents the information at the time of research of this case SAA A1/A6. For the actual status of the project see Section 2.2 Cased based study, case descriptions.

Figure 4.2: The infrastructure Program Schiphol-Amsterdam-Almere (SAA) (source: Rijkswaterstaat)

The A1/A6 project is the biggest and most complex project in this program. The motorway is approximately 23 km long and is located between the towns of Diemen and Almere Haven (see Figure 4.3).

Figure 4.3: SAA - A1/A6 project (source: Rijkswaterstaat)

By realizing the project, the capacity of the infrastructure will roughly double. The project involves a total of 70 new civil engineering structures, which include a 60-m-wide aquaduct (Europe's widest); a rail bridge near Muiderberg with a span of 380 m; and an additional bridge adjacent to the existing bridge over the Randmeren (the

Hollandse Brug), also 380 m in length. The A1/A6 project has a nominal contract value of EUR 1 billion (excluding taxes) and a tenure of 30 years (2012–2042).

Rijkswaterstaat (the executive agency of the Dutch Ministry of Infrastructure and Water Management) tendered this project under the third edition of the standard DBFM contract to the Special Purpose Vehicle (SPV) company SAAone. SAAone includes major construction companies such as the German company Hochtief and the Dutch companies of VolkerWessels and Boskalis, as well as the fund management company, the Dutch Infrastructure Fund (DIF). The contract close of the tender was in 2012, while the financial close was in 2013. The latter refers to the point at which all the interlinked conditions mandated through the project contracts, including the funding, were met. The construction activities started in 2013 and are scheduled to proceed until 2020.

The DBFM contract is the key contract between the client and the SPV, where the SPV is responsible for the design, building, financing, and maintenance of the project. The SPV has a financial agreement with financers through syndicated loans. This means that, on the debt side, a group of financers provides finance to the SPV for the implementation and maintenance of the project. The Ministry of Infrastructure and Water Management acts as a guarantor for the financers through a direct agreement with them. The client can repay financing through periodic milestone payments to the SPV if the latter performs according to preset availability and safety specifications.

The actual construction of the project is realized through an engineering procurement and construction (EPC) arrangement through a contract between the SPV and the EPC contractors. A separate contract will be signed later for maintenance. The SPV receives equity from shareholders (or sponsors) through equity contribution agreements. Usually, the shareholders are connected to (or the same as) the EPC contractors, which creates a direct relationship between the risk management of the SPV and the EPC. To complete the contract structure, Rijkswaterstaat has administrative agreements with 13 local authorities to guarantee stability in the environment of the project. In addition, several external companies were contracted during the tender phase and the realization phase of the project to support and advise Rijkswaterstaat and SAAone regarding legal, technical, and insurance aspects.

Research methods and data analysis

As mentioned in the Introduction, the study started with a review of the project management literature regarding dealing mechanisms for variation. In essence it is a design and construct contract with additions turning it into a combined project

delivery and service contract. Interestingly, the case studied evolved to a kind of relational contract with its foundation in a traditional contract setting. We were especially interested in how this came about and what happened in practice. This gave us the opportunity to look at the interaction mechanisms that enhanced this evolvement. Relational governance is about the processes and institutional settings in which relationships may evolve. Because we studied the practice in the realization phase of the project, the focus of a project is then more on management than on governance. Most governance literature stays at a high level to look into phenomena. We wanted to go a step deeper and therefore especially focused on (relational) project management and related literature.

Data were gathered through a combination of archival research into the project history, observations, and semi-structured interviews in the period of September 2016 to February 2017. A case study protocol was used to carry out data collection (Eisenhardt, 1989; Yin, 2014). To construct validity (Creswell, 2013; Yin, 2014), information was gathered from all available sources to understand the phenomenon within the context of the entire project. The archival research comprised the DBFM project and the contract documents, including the maps and drawings. Additionally, annual reports, newspaper articles, organizational documents, and reports of the client and the SPV backbone companies were studied. Additional information from memos, minutes of meetings, and contract amendments provided insights into the playing field of variations. Access was granted to all the digital sharing tools between the authority and the SPV and, therefore, to all variations and contract amendments, and to all the minutes of contract and change meetings after financial close.

To gain a better understanding of the mechanisms described in the documents, 21 semi-structured interviews were conducted with a diverse group of people from different organizations and backgrounds, among them directors, contract and project managers, engineers, advisors, and lawyers. In this study, client representatives were grouped as contracting authority practitioners (CAP1– CAP11), while SPV and its backbone company practitioners were classed into 10 groups (SPVP1–SPVP10). Organizational organograms were used to make a first selection of interviewees. This selection was done together with the contract manager of the project. A brief introduction to the research objectives and the interview questions was provided to the interviewees via email 1 week before the interview. All interviews were conducted in face-to-face meetings of about 1.5–2 h by the first author. In some cases, the researcher invited two contract managers to the same interview to encourage further discussion. Appendix 4 shows the interviewees' profiles.

To gain further insight into the actual modus operandi, three different kinds of participant observations were carried out by the researcher during a 7-month research period: site visits, contract meetings, and informative visits to the offices of the client and the SPV. Informative questions were asked to several members of the SAA team throughout the complete period of observation. The site visits helped the researchers to understand the issues encountered during the execution of the project and the difficulties arising from these issues. The visits to the client and SPV-offices were helpful to understand the relational networks within which the different managers worked.

Additionally, multiple authority-SPV contract meetings, authority- SPV variation meetings and internal authority meetings were attended. In these meetings, the observation focused on various aspects, such as the mechanisms used to deal with variation, styles, processes used to find solutions and interactions of different managers to elaborate; discuss; solve problems; and allocate responsibilities for the solutions. Detailed sketches of these meetings were recorded, similar to Shipton et al.'s (2014) 'vignettes' to represent relationships between organizations and actors. The atmosphere, modes of communication, and flexibility of the actors were noted during and analyzed directly after the meetings. Simultaneously, feedback was received from contract managers and, as a result, suggestions for improvements in the dealing mechanisms were incorporated into practice so that their effects could subsequently be observed.

According to Yin (2014), a data management strategy is imperative in case study research. An Excel spreadsheet was used to organize and conduct the data collection. This sheet included objectives; relevant readings; and data collection procedures, such as sources of data, contact names, and case study questions. As suggested by Nowell et al. (2017), the researchers familiarized themselves with the data while all files were named with a unique identifier of a source specific to the case. Qualitative data were captured in various forms, including records of observations, transcripts of interviews and meetings, archival documents, multimedia, sketches, maps, drawings, and photographs.

The analysis of all the data was done by way of coding. First, the researchers produced initial codes with attributes to differentiate among the different ways of dealing with contract variations based on the studied literature. The data were identified, organized, and indexed relative to these themes. Second, the miscellaneous coded data supported new themes, resulting in a second consistent workable set of themes and codes. Third, we bundled themes into specific dealing mechanisms and related the codes accordingly. This method resulted in the following categories of dealing mechanisms: contract provisions, human relationships, relational governance, digitalized tools, professional

knowledge, and actor competences. Contract provisions refer to DBFM agreement articles; human relationships include personal relationships between parties. Relational governance refers in this study to the project management systems in the organizations. Digitalized tools refer to shared IT systems. Knowledge means tacit and explicit knowledge, while actor competences refer to the skills of the project participants. The findings for each category of dealing mechanisms are discussed below.

4.4 RESULTS

The results are presented in this section according to the categories of dealing mechanisms as described above.

Contract provisions

The Netherlands has no specific law for PPPs. The Dutch DBFM model agreement complements certain sections of the Dutch civil code with specific contract clauses. For example, the standard model DBFM contract declares that "with respect to the occurrence of unforeseen circumstances, parties agree that they have willingly and wittingly entered into this long-term Agreement and that the mechanisms that are included in this Agreement are already intended to deal with the consequences of any possible unforeseen circumstances that may arise." This clause thus stipulates that parties cannot ignore variations that occur over the long life span of a project. In addition, it acknowledges that the standard DBFM contract is incomplete. Therefore, parties agree to the need to renegotiate provisions for dealing with variation. On this point, SPVP1 mentioned that "circumstances can always arise: there are known knowns, known unknowns and unknown unknowns at the time of signing. We add new clauses when there is a need for variation on the physical asset. This provision provides flexibility, accepting uncertainties under our law." CAP1 stated that "there are unknowns in the project, and one cannot be accountable for these unknowns. We act reasonably and fairly regarding our law."

The process of dealing with variation takes place within the boundaries set by the agreement. Regarding this, the agreement can be seen as a foundation for this process. CAP1 added "The DBFM agreement is applied under Dutch civil law with a Standard Contract form. It has specific rules and regulations for contract application and progress of variations (change procedures, changes in law and dispute resolution). For example, when a physical asset has a variation, contract clauses explain how compensation can/should be achieved, who has the responsibility, and allocation of risks under variation. Provisions of Contract comprise a foundation and explain who will take which action".

The provisions in the standard DBFM agreement specify features and characteristics of variation, information exchange, and each party's responsibility during the renegotiation process. These provisions have an important consequence for the allocation of risks under variations. Provisions that deal with variations include, for example, the change procedure (Article 13 and Schedule 5) and the dispute resolution (Article 21). The change procedure includes the right of each party to propose changes. Change is characterized as a "contracting authority change" and/or as a "contractor change." There are no limits to the size of variation that the government may require. The change procedure is further elaborated in "Schedule 5 Changes," which contains the formal change management process of the authority and the private party, to be agreed upon by the partners. Once agreed by both parties, this process is documented as an amendment to the initial contract. In this process, the private party has to provide full details of the costs and timing that will occur when implementing the variation. The types of provisions are designed to promote win-win outcomes by identifying compensation events and to regulate the process of renegotiation. Parties agree on how the variation will be implemented based on this procedure.

An expression of the contract provisions mechanism of the Standard DFBM contract is illustrated in a statement made by CAP4 during an interview: "We use the contract as guidance. We follow Article 13 and Schedule 5 of the DBFM contract for the variation process. [...] When a change occurs, we add new clauses or subclauses to our output specifications and payment schedule. [...] We use written rules as a complementary mechanism to our relationship." But CAP10 also explained that "If there is a big shock, we should be able to put in place a mechanism to handle it, which should be the contract. There is a need for managers to have extensive knowledge about the contract clauses."

In the DBFM-standard contract, the distinction between the contracting authority and the contractor's view of change is a significant factor with respect to action, and it explains the way changes are proposed. The change procedure differentiates between "small changes" (below a certain financial threshold) and "other changes." In Schedule 1 of the standard model DBFM contract, small changes are explained and a threshold has to be decided on between the client and SPV during contract close. In the A1/A6 project, an extra category of very small changes was added during the construction phase for practical reasons, which refers to changes that do not have any financial consequences for the project. During an interview, CAP4 explained that "we added this formality to reduce complexity and the number of changes; some changes are too small, have no financial consequences, but still take time to manage."

For small variations, the contractor must respond to the change request made by the contracting authority within 10 days. For big changes, they have 20 days. However, in practice, we observed that these boundaries are not considered very important to either party. The focus is on the overall availability date for completion rather than these response dates, which means a response is given as soon as possible in practice. If the work is not finished by the availability date, the SPV will receive the completion fee later than envisioned. According to SPVP6, "We are forced to be very quick in our response to the changes, because the availability date is very close, so we take a collaborative approach to changes."

The contract article that was used most to deal with variation was Article 13.1e: "If the contractor can demonstrate to the contracting authority that change has had an adverse effect on the risk profile of the work or on the financiers then the contractor must receive a guarantee that the contracting authority will pay compensation for or bear the additional risks." According to CAP7, "This article is important when tensions occur around benefit sharing [...] Financiers are likely to see variations as a source of risk. However, in some circumstances, we help [our contractor] to solve problems caused by change, bearing the additional risk".

Human relationships

One of the aspects that was mentioned most frequently during the interviews was that relationships are more predominant than contractual terms when dealing with variations. There appears to be a strong need for relational mechanisms additional to the fixed rules. In this respect, the new business strategy (Market Vision) of Rijkswaterstaat, "Working with the Market," was frequently mentioned. In January 2016 (during the implementation phase of the A1/A6 project), this strategy was mutually agreed on by Rijkswaterstaat and several other client organizations and contractor organizations as a way of doing business together and dealing with problems encountered in practice through more collaboration.

The Market Vision aims to create a better atmosphere and more value for society by encouraging all parties to collaborate closely. By increasing openness between the public client and the contractors through the sharing of knowledge and by stimulating cooperation, it is expected that changes can be dealt with in a more effective manner by both parties, and added value can be generated by cooperation, rather than losing value through contractual battles. According to CAP9, "We apply the Market Vision to create synergy with our private partners. When we deal with variations, we use the contract as a basis, but we give our relationships a more important place in the life cycle of the contract." CAP10 explained that "Unexpected changes can cause tensions, but

being aggressive toward each other does not bring any gains. [...] We do not tend to go to our lawyers to solve issues (avoiding disputes)."

Workshops were regularly organized to develop relationships, to gain trust and create openness, and to discuss specific issues or events. These methods proved successful: "After some negotiations we got a pre-order to realize a new design for the Zilverstrand [a particular part with a small beach] that had to be checked by all seven stakeholders. [...] We organized it as a design studio, with a plan and a schedule meant to help us to come to an agreed design. We started in October 2015, and the agreed design was realized in March 2016" (SPVP9).

It was also found that the better the contracting partners know each other, the more willing they are to manage changes in a relational way. This applies especially to the contract managers, as mentioned by CAP8: "In this agreement, our contract manager has a very good personal relationship with the SPV counterpart; being friends [...], if managers do not get on, the end result will be no problem-solving." SPVP10 indicated that "We do not rely solely on a rigid formal contract mechanism or formal arrangements. I can call my counterpart anytime to discuss any event, like friends would do, to be more effective." Most of the interviewees indicated the importance of being open to each other: "We exchange our thoughts on pros and cons while managing changes. It is very important to understand each other's interest while dealing with change" (CAP11). Similarly, SPVP6 indicated that "We are transparent with each other and this strengthens our trust. [...]. We can think in a cooperative way and understand each other; information flows from one party to another party while dealing with changes." The results indicate that trust and openness facilitate cooperation, and vice versa, and allow for the effective solving of unexpected problems. This kind of openness also became visible in the seating arrangement during the meetings between the SPV and the client: the various participants sat next to each other rather than in their own groups, and this seating arrangement evolved naturally over time.

Relational governance

The governance structure was set up at the beginning of the project but evolved during the project execution. The authority used a standardized 'Integrated Project Management Model' (IPM) as their organizational structure, which acknowledges the integration of different management functions (project manager, stakeholder manager, technical manager, contract manager, and manager of information and control) into a single integrated project team. The IPM model provided an important mechanism to manage variations. When a change occurred, it was discussed with all team members of the IPM team, which ensured integrated information flow, coordination, and

transparency of the issues. During the interviews, CAP5 pointed out that "IPM model can be illustrated as the firm's philosophy. [...] Under a significant event, the IPM model provides an effective way of communicating and understanding different interests." CAP3 added to this that "the lack of formal hierarchy between managers from different disciplines allows for a speedy flow of information."

Working with the IPM model also regulated the counterparts in the various parties. The SPV attempted to mirror this model in its own governance structure. The business plan for the project included a communication matrix, which lays out who does what, and explains who will meet with whom during change management. According to the matrix, the client project manager was the counterpart of the chief executive officer (CEO) of the SPV. However, we observed that this initial mirror shifted over time and the contract manager became the counterpart of the CEO, while the project manager became the counterpart of the shareholder alongside the program director. Major issues regarding changes were discussed and actions were decided on this level.

The SPV organization structure also demonstrated integrated management of several organizational units. Their organization was divided into three parts: ground works, civil works, and design work. As SPVP1 explained in an interview, "The SPV and EPC Company have become very large; we have employed thousands of people from different backgrounds in a short time. Coordination is challenging. [...] It is people management. Collaborative relationships help with the daily management of variations. Also, a flexible organization structure helps coordination during the variations process." Organizational flexibility was regularly mentioned as a significant factor in the variation process. According to one interviewee, in such a large organization, "We should be more flexible in the roles during the process of management. Better understanding of the other's contribution by all team members is important when dealing with variations" (SPVP4). SPVP5 added to this that "more integration brings effective responses to the events."

Digitalized tools

Information technology was heavily used in the variation processes of the A1/A6 project. The SPV created an "information cloud" to coordinate information about variations. Most of the information used to make decisions was stored digitally in this cloud. This presented a single and coordinated information tool that enabled data sharing and facilitated coordination between actors. It is interesting that this information cloud was also made accessible to the authority.

The standard Request for Change (RfC) tool was used by the authority to follow the variation process in chronological order. This RfC tool was adjusted to the contract provisions of the variation management procedure in the DBFM contract, and as such supported the decision-making process. Thus, the RfC tool acted as the central database with regard to variations for the client. Every variation had a serial number and was included in the variation list data. It was observed that this list comprised big/small/very small variations and was updated every week in the system. Many interviewees highlighted the importance of this tool. According to CAP1, "It is an easy way to follow the steps of the variation process, control, budget, and time. This also makes it easy to visualize all variations." CAP10 explained the importance of feedback loops in this tool, to anticipate, resolve, and approve variation. According to CAP2, "It is the quickest way to see and respond to changes. This tool improves our performance."

Relatics and Think Project tools (both cloud systems for sharing data) were used as the central information database for the contract and thus formed an information backbone for the variation process on the SPV side. A variety of data were linked to this database, such as designs, plans, output specifications, contract documents, International Organization for Standardization (ISO) forms, manuals, and maps. It was observed that when a change occurs, there is a need to update documents related to the variation. CAP3 indicated that "the SPV provided login details for Relatics and the Think Project. This creates openness between us and the SPV which also strengthens our relationship." According to SPVP3, "shared access tools support our cooperation strategy giving clarity to hundreds of pages of formally written contract." Both parties maintained good record keeping using these tools. Any variation was recorded and clearly documented by both organizations. It was observed that the cloud system fostered integration and collaboration between actors.

Professional knowledge

The observations indicate that the professional knowledge that is available within the project environment is an important mechanism during the variation process. The authority ensured that the IPM team understood the PPP contract provisions very well, as did the SPV for its contract management team. It was observed that expertise was consciously combined with explicit knowledge (documented information) in both organizations. During an interview, SPVP2 pointed to the Spoorbrug Muiderberg Bridge (see figure 4.4) on the map and stated, "We use the information that is available in our parent organizations. We have been building these bridges for 100 years; we know best what we are doing. Our experience helps us with the contractual variation process. Also, we are familiar with coordinating all interfaces and risk under variations." Another example of knowledge exchange was provided by SPVP7: "Involving an

international partner brings positive opportunities, due to their extensive knowledge of the correct way to respond to the changes in PPP projects all around the world."

Experience and understanding of the contract appeared to be very important factors in recognizing and managing the network of dependencies in the contracts. During several meetings about variations, it was observed that the managers checked all dependent (and sometimes conflicting) variables in the key contracts (financial contracts, stakeholder contracts, etc.) based on their respective experience. According to CAP6, "The complex nature of PPP type contracts creates a need for technical, financial, and legal knowledge of related contracts to deliver project imperatives on the contract variation process." SPV3 mentioned that "In our project, the contract manager of the client is extremely knowledgeable, which helps him to understand issues, and at the same time is able to consider financial constraints or technical challenges, which is unique for PPPs." Additional financial and technical knowledge was gained from specialist advisors if necessary. According to SPVP3, "Our lender technical advisors helped us a lot with regard to dealing with changes, because they have experience from all over the world. They acted as a bridge between the bankers and us. Without good lender advisors, very few new loan agreements can be signed."

The SAA program of Rijkswaterstaat also used a strategy of sharing experiences across projects within the entire program. Daily informal face-to-face meetings were organized and the client organization provided its employees with opportunities to attend workshops on PPP contracts, performance, risk, and variation management in order to develop their knowledge on these specific types of contracts. During an interview, CAP9 suggested that "Intra-project knowledge creation and learning was explicitly used as a management strategy in the SAA program." CAP9, from the adjacent A6 project, indicated that "The A1/A6 project contains extensive knowledge. This information flows to my team." The SPV parent organizations also provided in-house and external training programs to managers to improve their knowledge with regard to PPPs and infrastructure projects.

Figure 4.4: Spoorbrug Muiderberg Bridge during construction (current name: Zandhazenbrug) (source: Rijkswaterstaat)

Actor competences

The last mechanism relates to a wide range of competences of the actors, which vary from hard to soft skills. During an interview, SPVP8 mentioned the importance of competence, adding "Our PPP managers who are dedicated, well aware of the environment and contract network, with the competence to build relationships, contribute most while dealing with variations." CAP11 stated that "Our biggest variation (i.e., the amendment of the new Spoorbrug Muiderberg Bridge) [...] cannot be compared to any DBFM solution. It is not copied from any other project. Having leadership, social, and communicative skills are highly important in our relationships with the SPV, as it helps us to find unique solutions when there is a big event."

Tensions rose during the negotiation of big events, especially in relation to funding and financial discussions. Power and dominance play a role when discussions focus on the root cause of issues and how they will affect the financial model. The competences of the contract managers on both sides appeared to be especially important in handling these tensions using leadership skills and openness in discussion. CAP5 explained that "The managers need to know how to act in dynamic situations. Social skills are

very important for public managers, for example, conversations being neither too formal nor too informal. There should be a balance between the interests of public and private." SPVP5 added that negotiation skills such as "verbal communication and facial expressions and emotional control are important for our interests, also in discussions about problems caused by variations." It was considered especially important for PPP actors "to have the necessary leadership and communicative skills ... to be effective in variation management and to deliver value for money to society" (CAP8). This was also valued by SPV, as indicated by one interviewee, who said that "we are very lucky that our client organization is well aware of our binding financial contracts to DBFM" (SPVP4).

Summary of the results

The results of the study confirmed that contract provisions are generally written ex ante and change over time through the addition of new clauses or subclauses, or by removing clauses ex post. Therefore, the contract is continuously adapted to reality by renegotiations (Cruz et al., 2014; Hart, 2017; Xiong & Zhang, 2014). The Dutch DBFM standardized contract, as used in our case, was actually designed to be incomplete due to the impossibility of specifying every element ex ante, and in this way, it allows for the renegotiation of provisions. The case also demonstrates that several dealing mechanisms were used and developed to cope with variation in practice additionally to the ex-ante contract provisions. The different mechanisms for dealing with variations as observed in the case study and described in this section are summarized in Table 4.1.

Table 4.1: Dealing mechanisms

Attributes	Refer to	Dealing Mechanisms
• Standard Change Procedure • Allocation of initiative • Classification of variation • Mutually agreed change management process • Agreement about information exchange in case of variation • Compensation arrangement • Contract flexibility	DBFM Articles that presents formal mechanisms to deal with variations	Contract provisions
• Reasonability and fairness • Having a shared vision on collaboration (the new market strategy of Rijkswaterstaat encourages collaboration) • Shared workshops to discuss issues or events • People in key roles knowing each other • Openness and transparency	Personal relationships between managers of SPV and managers of Authority	Human relationships

Table 4.1: (Continued)

Attributes	Refer to	Dealing Mechanisms
• Influence of Authority structure (IPM model) • Role and position of project manager and contract manager and their counterparts • Flexible structure over time • Integrated management in SPV and EPC (many people and many sub-organizations)	Role and position of the people in the organizational structure Flexibility of the structure over time	Relational governance
• Shared cloud systems used between parties for variation information • Coordination between parties • Shared 'Relatics' tool used for contract information • Standard 'Request for Change' tool used by the client, adapted to the agreed change management process	Digitalized shared IT systems	Digitalized tools
• Contract understanding, awareness of project environment, technical, legal and financial knowledge • Knowledge of key contract structure and relationships (network of contracts) • Sharing knowledge and learning combining experience with contract understanding	Specific knowledge of PPPs	Professional knowledge
• Leadership, social and communicative skills • Competence to build relationships • Conflict handling (especially for contract managers)	Personal skills of SPV and Authority managers	Actor competences

4.5 DISCUSSION

This study observed the daily real-life practices of dealing with variations in the context of a PPP project. Many of the mechanisms as identified in the literature are reflected in our case findings. Contract provisions are not only an important mechanism for dealing with variations in PPP coordination but are seen as an essential foundation to the process. However, the case also revealed that projects do not or cannot rely solely on contract provisions. In line with the findings of Song et al. (2018) and Xiong and Zhang (2014), the results show that PPPs offer incentives to all partners not to end the collaboration and stimulate parties to conduct renegotiations and attempt to resolve variation issues caused by project dynamics. The foundation of this incentive is the principle of reasonability and fairness, guaranteed by the contract provisions. This principle means that if one cannot reasonably foresee an issue or its consequences, one cannot be held responsible and/or accountable. Reasonability and fairness (good faith) play a noteworthy role in the Dutch legal system and prove to have a major influence

when dealing with variations. Relying on the legal guarantee of fairness, parties want to act reasonably when dealing with variations during the implementation period beyond the ex-ante allocated risks. They want to deliver the best value and obtain long-term future benefits.

As also indicated by Brown et al. (2016), relational dealing mechanisms are an important addition to the contract for handling variations. The complementary character of relational mechanisms allows partners to be more engaged and act according to the spirit of a contract rather than the letter. The contract might stay in the drawer, only being taken out in exceptional situations.

The case study showed that relationship practices are more predominant than contractual provisions when dealing with variations. In line with the literature on incomplete neoclassical contract forms (e.g., Klijn & Koppenjan, 2016; Hart, 2017), the case shows that actors mainly consult contractual agreements for guidance and/or consider them as a baseline on which to rely. As was also found in the study of Ling et al. (2014), the actual dealing with variation is more dependent on the development of interpersonal relationships, the formal/ informal structure of the organization and its flexibility, and the knowledge and skills of the relevant employees. The specific forms of these dealing mechanisms will depend on the type of project, the constitution and character of the project teams, and the context of the project.

The study revealed that partners develop a common approach by translating the contract provisions into their mutual relationships to achieve a certain degree of cooperation. The focus on relationships leads all parties to have a better understanding of each other's interests and to understand the ways that parties perceive the contract terms. In the case study, the pursuit of collaborative relationships was apparent throughout the daily management of variations. For example, partners phoned each other daily and freely, revealing a high degree of communication and transparency; they sat next to each other in meetings, rather than opposite each other with their peers; the parties organized shared interactive workshops to keep relationships active and look for solutions through cocreation; and they also shared login details for digital tools, even when this was not a contractual obligation.

These personal relationships decreased the level of formality of dealing with unforeseen events. Notably, effective and personal communication creates a favorable environment of trust and transparency in the renegotiation process. What helped was that the fairness provision in Dutch Civic Law safeguards parties against potential abuse of trust and transparency and the fact that the client and the contractors involved in the

EPC agreed to work according to the Market Vision, in which private entities and authorities are encouraged to act in cooperation. In line with the findings of Hertogh and Westerveld (2010) and Mistarihi et al. (2012), it was observed that highly skilled and experienced project participants make a real (positive) difference when confronted with variations. Both organizations ensured that they had competent managers in the project, who were well aware of the project environment and the network of related contracts in the DBFM, among other aspects.

The study showed that knowledge was considered an important mechanism for dealing with variations. On the one hand, understanding the PPP contract and its procurement is essential to dealing with variations. On the other hand, knowledge development and continuous learning increase the capacity to deal with variations (adaptive capacity). In our case study, activities such as exchange programs between the authority's contract managers from adjacent projects supported the leverage of internal knowledge, improving the public sector's position in the PPP contract. Both organizations were well aware of the importance of knowledge sharing and developing joint knowledge on PPPs. Both organizational managers were involved in constant PPP training during the project, facilitated by their own organization. Furthermore, external companies, such as lenders, technical advisors, and international partners, contributed to knowledge development by bringing in technical advice and international examples of possible solutions. The findings confirm the importance of tacit knowledge gained by experience. However, experience alone is insufficient, if not combined with extensive contractual and financial knowledge.

Furthermore, relationships rely heavily on the communication skills and characters of the actors, with the combination of actors particularly important. This requires a flexible organizational structure in which project participants can be replaced if necessary. Informal communication paths rather than formal meetings were intensely used to deal with variations (see also Spiller 2018).

The standard internal integrated project management approach (IPM model) of the authority provided the opportunity for each discipline to align their views and deal with variations in an integrated way. In practice, contractors normally shadow this model in their organizational structure. It might be asked whether this actually is the right governance structure from the contractor's perspective, since they have different roles and responsibilities from those of a public client. It was observed that in practice the predefined structure naturally evolved during the process, with counterparts changing during the project implementation, due to personal relationships and different competences.

Finally, the results indicate that shared digitalized tools contribute to dealing with variations. These tools are designed according to contractual rules and provide an information flow between partners. Digitalized cloud-based tools enabled an easy flow of information between the authority and the private party and encouraged openness and transparency between partners. The shared cloud systems improved the speed of information sharing, enabled the exchange of ideas, and fostered collaborative behavior. This also showed a foundation of trust and created more trust in the project and its partners, which in turn strengthened the relationship between all parties and actors. Additionally, the renegotiation process was expedited and the decision-making process improved by the availability of open and adequate information.

4.6 CONCLUSION

The aim of this study was to achieve a better understanding of the range of different contractual and noncontractual mechanisms employed in the coordination of a PPP to deal with contract variations. We chose to study a Single Case to get in-depth insight into current working practices of dealing with variation in a PPP contract setting. This allowed us to better understand the role of social interaction in the practice of dealing with uncertain situations additional to the formal contract rules. The results indicate that, in addition to contractual provisions, five interrelated and complementary mechanisms are considered important and necessary: human relationships, relational governance, digitalized tools, professional knowledge, and actor competences.

From the findings, it can be concluded that contract provisions governed by formal legal systems are an essential foundation for dealing with variations in infrastructure but need to be adaptive. Contract provisions are written ex ante and are not able to deal with all variations over time. Therefore, they need to be able to be adapted over time by adding new subclauses, removing clauses ex post, or even adding a new contract. This means that the contract should be able to continuously adapt to reality.

To make flexibility possible, social dealing mechanisms based on interaction between the partners proves to be essential. Based on the principle of reasonability and fairness, Dutch Civic Law creates the opportunity to use different mechanisms rather than solely relying on contract provisions.

Strong relationships support collaborative problem-solving and aligned actions. Transparency and openness between partners, in particular, encourages the development of a positive renegotiation atmosphere based on trust rather than formal rules. A mutual vision on how to relate to each other is also important, such

as the authority's new market strategy, in which private entities and authorities are encouraged to act collaboratively. In fact, the contract provisions that were observed suggest that the rigidity of a contract can be tackled through ex-post mechanisms when managers are explicitly steered toward this.

It was found that managers with good communication and coordination skills, who are well aware of the project environment and the contractual network, play an important role in dealing with variations. Their expert skills and social competences can lead to adequate solutions being found when unforeseen events occur. Professional knowledge, especially experience from previous projects (e.g., understanding the contract from legal, technical, and environmental perspectives), is a valuable mechanism. Knowledge development and continuous learning increase the capacity to deal with variations. Although some learning across projects was observed, project learning could be made more explicit in public and private organizations that are involved in PPPs.

Transparent digitalized information-exchange tools that structure information can support decision making when dealing with variations. Using a shared cloud system makes it easier to exchange ideas, reduces knowledge asymmetry, increases transparency, and creates trust in the project, which in turn strengthens the relationships between partners. Investing in a good information-exchange structure that supports the competences of the project team is not only important for complex PPP projects but for any infrastructure project.

The predefined organizational structure of PPP projects is also important in building relationships during the initial phase of a project, but should be flexible and able to evolve over time. Counterparts changed roles during the project implementation due to personal preferences and different competences. Relational dynamism complements contractual mechanisms and provides ex-post flexibility.

Like every study, this research has its limitations. Firstly, it was carried out on one specific type of PPP, contracted as a DBFM in the construction industry. Secondly, the study occurred in the Netherlands, within a specific culture and law. Thirdly, we deliberately chose to study a Single Case in depth, which has to be considered when generalizing the conclusions. Nevertheless, we believe that the results are valuable also for parties dealing with variation in projects outside the Dutch context, but they need to be carefully translated to the specific contexts of the reader. Future research could focus on other contracts (such as common term agreements) to understand the relationships between SPVs and financers during variations, an aspect that was not addressed in this study. Furthermore, the study could be elaborated to a comparative multicase study.

Equivalent cases might be found in other sectors, such as telecommunications, health, or energy, where similar or different mechanisms might be observed.

CHAPTER 5

THE ROLE OF FINANCIERS IN DEALING WITH UNCERTAINTY IN INFRASTRUCTURE PPPS

This Chapter is based on: Demirel, H. C., Leendertse, W., Volker, L. (2022). Mechanisms for protecting returns on private investments in public infrastructure projects**.** *International Journal of Project Management, 40*(3), 155-166.

This Chapter focuses on the relationship between financiers and project companies by studying control mechanisms applied to ensure return on investment in infrastructure projects (Figure 5.1). In this Chapter, first of all, infrastructure is recognized as an asset class that can form part of the portfolio strategy of private capital investors, alongside other assets such as stocks and bonds, and real assets like commodities or real estate. Infrastructure investments have a low volatility and are less vulnerable than other assets to economic changes and inflation. Understanding the financier's approach to risk and uncertainty is important because financiers can moderate the relationships between public clients and project companies. Therefore, this Chapter focuses on financier's uncertainty perspectives and investigates and discusses the mechanisms applied by private financiers of infrastructure projects to protect their returns on investment. This Chapter addresses 'how' questions by focusing on how financiers approach risks and uncertainty when investing in infrastructure projects and how they protect their returns on these investments. Using semi-structured interviews, the qualitative viewpoints of infrastructure financiers and their consultants on infrastructure investment are examined. It is found that, investors are predominantly risk-oriented which means that they are mainly concerned with risks that might affect their financial returns and do not feel responsible for dealing with uncertainties associated with the public infrastructure itself. Uncertainties are if possible, approached as calculable risks and uncertainties as far as possible transferred to the public authority or the project company.

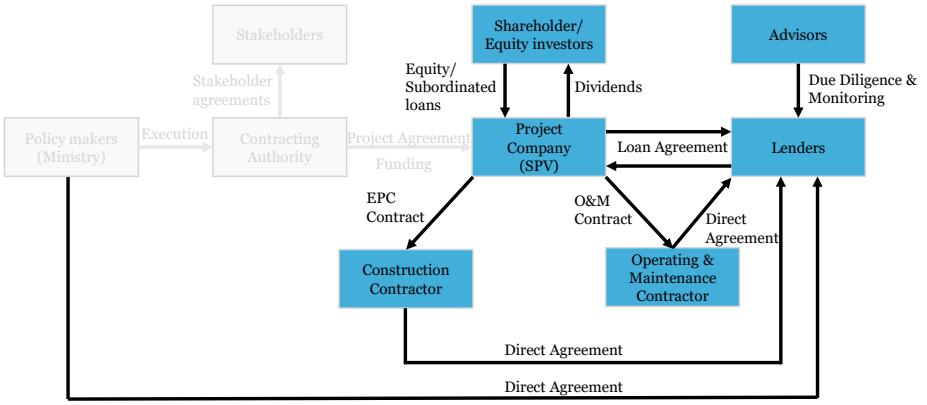

Figure 5.1: Relationships between financiers and SPV

5.1. INTRODUCTION

The term infrastructure generally covers all physical assets, equipment, and facilities of interrelated transport and energy systems and the necessary service providers, together with the underlying structures, and accompanying organizations and business models, rules, and regulations, which are used to offer certain specific commodities and services (Weber et al., 2011; Leendertse & Arts, 2020). Traditionally, most infrastructure investments have been financed by public funds (Sclar, 2015; OECD, 2015). Since the 1980's, New Public Management has gained popularity as a public governance model and stimulated private involvement in public services, for example through public-private partnerships (PPPs), resulting in a trend of increasing private financing of public infrastructure projects (see for example Verhoest et al., 2004; Cui et al., 2018; Gamble, 2019; Opara & Rausa, 2019). Under this governance model, the role of the private sector has been extended to the provision of what were generally considered public services such as the design, financing, building, maintaining, and operating of infrastructure assets, and the delivery of associated services including the associated risk management (Van den Hurk & Hueskes, 2017; Agyenim-Boetang et al., 2017).

Alongside this trend, the need for new infrastructure continues to grow, for example due to investments related to sustainability and the growth of the world population (Hueskes, 2017). It is predicted that, by 2040, there will be a $94 trillion need for infrastructure investment globally (Global Infrastructure Hub, 2020). The G20 promote, in cooperation with major international organizations, worldwide infrastructure investments (Ougaard, 2018; OECD, 2018). All these initiatives are expected to substantially stimulate private financing of public infrastructure. It is, however, uncertain how the afore mentioned initiatives will be operationalized, especially given the effects of the current conflicts between countries and pandemic.

It is reasonable to expect that private financing of public and non-public infrastructure will continue under neo-liberal economics and globalization (Mackintosh, 2017; Gamble, 2019). It is also to be expected that this financing will have a significant impact on the infrastructure market in the provision of equity and debt from providers, such as private equity, insurance companies, endowments, and private and public pension funds. Notably, infrastructure projects proved highly resilient during the recent Global Financial Crisis (GFC) in terms of risk-adjusted returns for investors (Gatti, 2018). Particularly in the aftermath of the GFC, many governments introduced policies and financial instruments to mitigate financial risks associated with infrastructure development, to continue to attract private finance to the infrastructure sector (Li et al., 2017; Vecchi et al., 2017; Hussain & Siemiatycki, 2018). Nevertheless, although

this suggests that infrastructure is an attractive asset class for private investors, it does not automatically guarantee return on investment. Infrastructure projects are complex endeavours and include specific uncertainties and interdependencies among a large number of stakeholders (Verweij 2015; Benitez-Avila et al., 2018). Scholars such as Vecchi et al. (2017), Benitez-Avila et al. (2018) and Denicol et al. (2020) increasingly stress that project complexity and inappropriate risk transfer may lead to deleterious consequences, such as significant disputes, the termination of contracts or even the bailout of private operators. Despite this debate, governments around the world continue to embrace private infrastructure finance (see, for example, Liu et al., 2017; Osei-Kyei & Chan, 2017), because, public funds in most countries do not seem to meet the government's ambition for infrastructure development (Hodge et al., 2017).

There is a burgeoning body of literature in the project management field on financing PPP approaches for the delivery of infrastructure. Moreover, aspects related to public governance, private investment, and the related risk allocations in PPPs have received growing academic attention over recent decades (see for example Keers & Fenema, 2018; Wang et al., 2019). Cui et al. (2018) and Hodge and Greve (2018) even claim that governance and project finance should be fundamental topics in infrastructure PPP research. This links to the recognition that in PPPs, a project's cash flow must ensure a return on investment and debt coverage over a long period of time. Although the protection of project cash flows against risk and uncertainties is a central issue for financiers in PPPs (Wang et al., 2019; Owolabi et al., 2019), the actual mechanisms that financiers apply to protect their return on investments and/or to control cash flow in practice have not yet been well assessed.

Only a few researchers have discussed financiers' securitization strategies in relation to risk allocation and project complexity. Most of this literature on risk allocation only identifies success criteria for PPPs. A few researchers have, however, discussed how financiers approach project complexity and uncertainty to avoid loss of revenue. Wang et al. (2019), for example, addressed the relationship between risk allocation and private investment in complex PPPs and indicated that less risk can attract more private investment and that a high level of governance reduces the negative influence of risk assumed by private partners. Further, much of the literature focuses on how risks should be allocated and transferred to the private parties but fails to elaborate on the management of uncertainty after allocation. In this context, Demirel et al. (2019), for example, showed that to deal with uncertainty during the post-contract phase in a transport-related PPP project that it was necessary to complement the formal contract rules with social mechanisms. This shows the need for research on the relation between project financing and risk allocation in infrastructure projects.

Despite many studies having focus on the governance or relationships between public clients and project companies in the management of risks, few scholars have questioned the role of financiers in risk and uncertainty control, or the interactions between parties involved. This is of importance since financiers can truly moderate the relationships between public clients and project companies. For instance, Owolabi et al. (2019) showed how risks can be packaged in a bankable form to secure the confidence of project financiers in PPP projects. Other studies have focused on the evaluation of project returns and equity optimization but ignore the interaction between project governance and private investment control. For example, Feng et al. (2017) developed an optimized equity model for the financial viability of infrastructure projects with host governments offering public funds for Special Purpose Vehicles (SPVs). Lu et al. (2019) proposed a PPP Asset Based Security as an alternative infrastructure financing model to acquire funding from institutional investors, while Li et al. (2017) elaborated the use of project bonds and a credit default swap in infrastructure financing under public-private partnerships.

In addressing the above-mentioned gaps in literature, the aim of this paper is to investigate and discuss the mechanisms that are applied by private financiers of infrastructure projects to protect their returns. It focuses on the following three research questions: 1) How do financiers approach risks and uncertainty when investing in infrastructure projects? 2) How do financiers protect their returns on investment? and 3) In what way does project governance influence the protection of financiers' returns? Answering these questions from a financial and transaction cost economics perspective will contribute to the debate on governance and financing in infrastructure projects in the context of public-private partnerships. This article proceeds as follows. First, the theoretical perspectives related to infrastructure financing are discussed in relation to project governance, including, risk and uncertainty concepts as used in investment decision making and the PPP capital structure and determinants of investment return protection for infrastructure projects. This is followed by a methodological section explaining our empirical approach, after which the results are presented relating to nine return protection mechanisms adopted by financiers in response to the uncertainties in infrastructure investment. The findings are then discussed in relation to the research questions. Finally, conclusions are formulated for how both researchers and practitioners could benefit from this research.

5.2. THEORETICAL INSIGHTS INTO INFRASTRUCTURE PROJECT INVESTMENT

PPP projects as economic transactions

Transaction Cost Economics (TCE) implies that economic institutions adapt their governance structures to achieve the lowest possible transaction costs and maximize profits (Biesenthal & Wilden, 2014; North, 1992). Williamson (1985) conceptualized the characteristics of transaction by focusing in particular on the behavioral assumptions of transactions (e.g. bounded rationality, opportunism) and the critical dimensions such as the role of uncertainty, the asset specificity, and the frequency of transacting for distinguishing among transactions. TCE is widely used in infrastructure projects (e.g. Sainati et. al., 2020; You et al., 2018; Chang, 2015), also because mechanisms protecting return on infrastructure investments are directly related to "costs of running the economic system" (Arrow, 1969, p. 48). Hence, it can be concluded that any issue that arises in the projects can be recasted as a matter of contracting and usefully examined from a TCE perspective (see also Williamson, 1985). You et al. (2018), for example, elaborated how the contract governs the relationship between uncertainty and opportunistic behavior in the construction industry and Chang (2015) identified a risk-bearing capacity approach by using project lifecycle data (costs, risks and financial protections) employing TCE analysis.

Infrastructure projects are idiosyncratic, sunk investments. Joskow (1985) showed that in infrastructure projects, transactions costs can include costs of negotiating and writing contingent contracts; costs of monitoring contractual performance; costs of enforcing contractual promises; and costs associated with breaches of contractual promises. In order to minimize transactions cost, risk and uncertainty should therefore be taken into account when entering an infrastructure deal. TCE is particularly relevant for studying the governance of infrastructure PPP investments because control on the uncertainty can minimize transaction costs through contractual agreements and risk sharing mechanisms. According to Jin and Zhang (2011) risk allocation can be formulated as a contract problem; if a risk is improperly allocated and possible transaction costs may include extra costs for clients, contractors and investors due to uncertainty. A TCE perspective implicates that "increasing the degree of uncertainty makes it more imperative that the parties devise a machinery to "work things out" since contractual gaps will be larger and the occasions for sequential adaptations will increase in number and importance as the degree of uncertainty increases" (Williamson, 1979, p. 254). More and more scholars and practitioners have become aware of the fact that PPP contracts are generally incomplete and a heavy investment in assets and complex projects (Hart, 2003; Jin & Doloi, 2008), mainly due to the impossibility of specifying

every element ex ante in the context of a long-term partnership (Demirel et al., 2019). Contractual incompleteness sets the stage for ex post performance problems and imperfections (Joskow, 1985). This can lead to opportunism between the parties in the transaction that can increase costs or reduce revenues that will be obtained by the other party (You et al., 2018; Joskow, 1985). According to Williamson (1985), additional transaction-specific savings are adapted to unfolding events and periodic contract renewal agreement are reached. This poses a serious contracting dilemma and opens up the debate on the role of formal (contractual) and informal (relational) governance between public and private partners in infrastructure projects. Hence, to contribute to this debate we first explain how infrastructure can be considered as an asset investment class from a financial perspective and how financers according to literature protect their return on investment.

Infrastructure as an asset investment class

Williamson (1979) recognizes uncertainty as one type of transaction characteristics in the governance of contractual relations. This indicates that any investment decision is based on risk and uncertainty and a contract is aimed at protecting the return on investment. Hirshleifer (1965) defines an investment as the purchase of assets to generate future incomes through financial opportunities. Risk estimation and uncertainty are generally recognized as key elements in investment decision-making. In this context, Broadbent et al. (2008) argue that where there is *no* possibility of placing a numerical probability on something occurring, the unclear future state is referred to as an 'uncertainty' rather than a 'risk'. That is, a risk involves the possibility of placing some 'calculable probability' on a future event occurring. Both risks and uncertainties might result in the poor performance of infrastructure projects and reduced returns on investment (Biais et al., 2016; Denicol et al., 2020) and may thus prevent the achievement of the primary objectives of the partnerships established to deliver these projects (Keers & Fenema, 2018).

Investors always take actions to protect their equity, for example by spreading their investment in portfolios. Stewart et al. (2019) describe that diversification and rebalancing of positions help to avoid disproportionate exposure to particular systematic and idiosyncratic risks. Figure 5.2 schematizes the standard process for investing in assets. This indicates that infrastructure as an asset class can form part of the allocation strategy of private capital investors, alongside other assets such as stocks and bonds, and real assets like commodities or real estate. From within these groups, projects are chosen which reflect an envisioned return on investment given the expected performance of the assets and the associated risks and uncertainties.

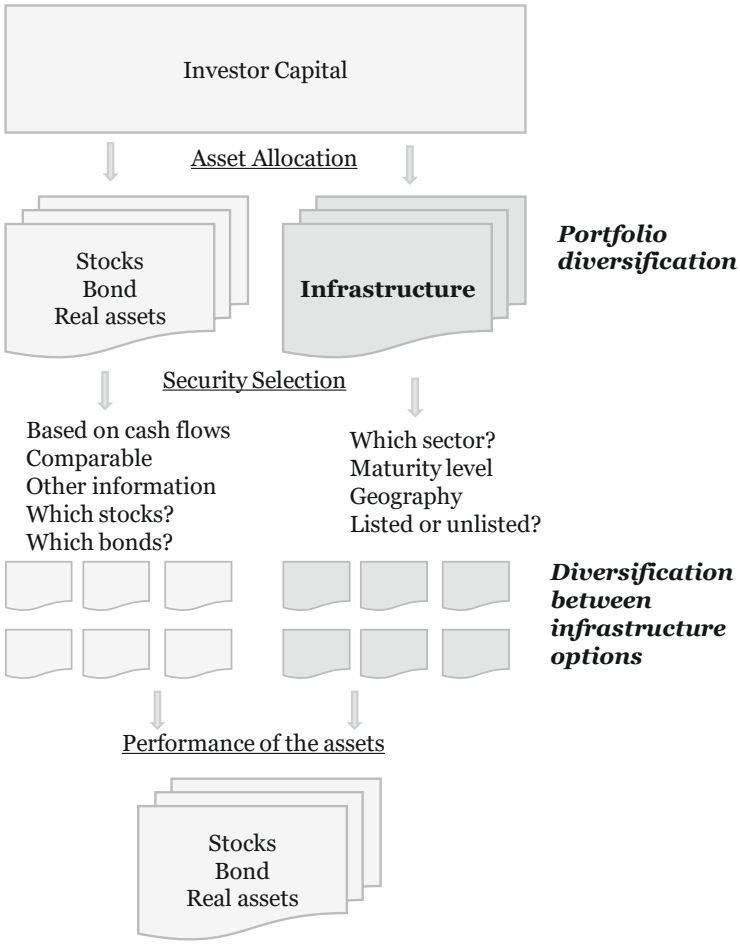

Figure 5.2: Standard investment process adapted from Anderson (2006) and Panayiotou & Medda (2016)

Infrastructure investments can be characterized by high start-up costs, a long-term investment horizon, a slow rate of recovery, and a high degree of asset specificity (Wibovo & Alfen, 2013). Furthermore, Gatti (2018) relates the typical characteristics of infrastructure to typical goals of private investors: long-term assets with a long economic life cycle, low technological risk, provision of key public services, strongly inelastic demand, natural monopoly or quasi-monopoly market contexts, high entry barriers, regulated assets, frequently a natural hedge against inflation and stable, and predictable operating cash flows. Based on these characteristics, infrastructure can provide significant diversification benefits to the portfolios of investors. Portfolio diversification can thus be considered as an important control mechanism to protect investor returns (Oyedele et al., 2014; Bianchi et al., 2014; Thierie & De Moor, 2016).

Additionally, infrastructure allows for further diversification between different infrastructure options such as sectors (transportation, telecom, utilities), regions (e.g., Europe, Africa), maturity (greenfield or brownfield), and investment vehicle (listed or unlisted) (Weber et al., 2011; Thierie & De Moor, 2016; Panayiotou & Medda, 2016).

Infrastructure financing models

Two main models for the private sector financing of infrastructure have emerged in practice: the Regulatory Asset Base (RAB) model and the Project Finance Model in Public Private Partnerships (PPP). In the RAB model, private or corporatized state-owned companies act as the infrastructure manager: they own, invest in, and operate infrastructure assets. The infrastructure manager receives revenue from users and/or subsidies to fund its operations and recoup the investment costs (Makovšek & Veryard, 2016).

In the PPP model, the government tenders a contract for a single infrastructure project or sometimes a bundle of projects under a single contract. The contract gives the private consortium responsibility for all aspects of a project financing, delivery, maintenance, and operation for a longer period often spanning decades. The contract sets out how the consortium receives revenue: either from the government in the form of a periodic 'availability payments', and/or direct from users (Makovšek & Veryard, 2016; Liu et al., 2017). PPPs are usually financed through a project finance scheme, where a large portion of the investment is financed with debt in the form of syndicated loans or bonds. In a mix of debt and equity, debt is provided by lenders/banks and equity is provided by private sponsors, pure financial investors and industrial investors (Vecchi et al., 2021).

In terms of project finance, the future cash flows of the project must be sufficient to fund delivery, maintenance and operating costs, and debt service, and to yield shareholder returns (Garcia-Bernabeu et al., 2015; Sarmento & Renneboog, 2015). Gatti (2018) explained that project finance is basically a function of a project's ability to repay the debt contracted and remunerate the capital invested at a rate consistent with the degree of risk inherent to the venture concerned (see also de-Biasio & Murray, 2017). Sectors vary from each other on risk return. JP Morgan (2015) calculated that the average expected return on investment for social infrastructure PFIs is 5-8%; for contracted power generation 6-8%; for regulated utilities 8-10%; for toll roads 8-12%; for airports 10-15%; for seaports 11-16%; for freight rail 12-16%; for telecommunication infrastructure 12-18% and for merchant power generation 14-20%.

Protecting the return on investments in infrastructure projects

To protect future returns in infrastructure projects, evaluation of potential risks and uncertainties is key. This can, for example, been done through a due diligence process provided by advisory experts (e.g. technical, legal, financial) as these are wholly engaged in transacting (North, 1992); the more complex the infrastructure process is, the more advisors will be engaged in coordinating and operating the system. Due diligence does not aim to eliminate risks and uncertainty, but to evaluate and set up control measures for the investor (Flybjerg, 2013; Yescombe & Farquharson, 2018). According to Yescombe and Farquharson (2018), typical aspects covered in an evaluation are: Can the project be completed on time and on budget? Do major subcontractors have the experience and financial capacity to support their obligations? Can revenues and operational expenditure (opex) be predicted with reasonable certainty? Will there be enough net cash flow from the project's operation be sufficient to adequately cover debt service adequately, and are the project economics robust enough to cover any temporary problems that may arise?

Risks can lead to undesired outcomes including in the provision of the services (because the facility is not completed on time) or the financial viability of the project (loss of revenue or increased costs) (Yescombe & Farquharson, 2018). Therefore, an appropriate proper allocation of risks is another key factor in the decision-making process to invest in an infrastructure PPP project (Garcia-Bernabeu et al., 2015; Mishra et al., 2015; Peda & Vinnari, 2020). Standardized project agreements have been developed to identify and allocate the main risks in infrastructure projects: generally classified as political, construction, operation, and financing risks (see, for example, the standard Rijkswaterstaat DBFM model in the Netherlands and UK HM Treasury PFI model). In line with the prospect theory (Kahneman & Tversky, 1979), Burke and Demirag, (2017) found that infrastructure financiers generally are risk averse and in favor of risk transfer to sub parties in PPP projects. This asymmetric attitude in PPP infrastructure projects of investors behaving as risk seeking agents in the domain of losses and as risk averse agents in the domain of gains was also described by Wibowo and Alfen (2013) and Espinoza et al. (2020).

Governing risk and uncertainty in PPP projects

Special Purpose Vehicles (SPV) are commonly used to support specific transactions in infrastructure projects, including public-private partnerships (Sainati et al., 2020). The SPV is usually a shell company that sub-contracts a project's tasks to related companies of the consortium members (Demirag et al., 2015; De-Biasio & Murray, 2017; Sainati et al., 2020). The capital drawn down by the SPV to pay transaction costs and construction is provided as a combination of equity from the SPV members and

incurred debt from banks or bondholders (Hellowell & Vecchi, 2012). The SPV serves to mitigate risk for sponsors and for lenders (Garcia-Bernabeu et al., 2015; Sarmento & Renneboog, 2015) by delegating and managing risks on behalf of the financiers (Zwikael & Smyrk 2015; Wang et al., 2019). Risks can be passed through a network of contracts from the SPV to subcontractors and so do not revert to the financiers (Gatti 2018; Sainati et al., 2020).

For both the equity investors and the lenders, the overall aim is to ensure that risk and uncertainty is retained by the contracting authority or passed on a back-to-back basis to subcontractors (Yescombe & Farquharson, 2018). The credit or loan agreement is the project finance artery and this controls the entire financing transaction and its security package for lenders (Gatti, 2018). It is the protection provided by this system which is activated if the project or financing does not function as expected.

According to Madykov (2015), direct agreement provisions with the contracting authority are an important mechanism to protect lender's rights by enabling the senior debt provider to step-in and take control of any project experiences difficulties (Demirag et al. 2012). Such a provision is usually for a limited timeframe the aim of giving the lenders the opportunity to rectify the default and avoid termination of the contract (World Bank, 2019). Despite all such measures, in the end, it is effective public governance and favorable institutional settings established by public authorities that are generally seen as an unconditional factor for successful completion of projects (see for example Keers & Fenema, 2018; Benitez-Avila et al., 2018; Wang et al., 2019). Wang et al. (2019) found that higher level of public governance in the form of government effectiveness, regulatory quality, rule of law, and control of corruption, attracts more private investment. Griffith-Jones and Cozzi (2016) go as far as to state that private investment would not be at adequate levels without complementary public investment and measures to mitigate risk such as grants and subsidies, credit enhancement tools, and direct provision of debt and equity. In line with Vecchi et al. (2017) and Wang et al. (2019), this would mean that a favorable institutional setting for PPP projects includes dedicated institutions and procedures and a clear regulatory framework.

According to Wu et al. (2017) investors generally safeguard their investments through two types of governance mechanisms: formal contracts and relationships. The formal governance focuses on contracting which, includes legal relationships between the project's stakeholders. A collaborative type of governance between public and private partners can also provide a secure environment to financiers to receive returns and loan coverage. Demirel et al. (2019), for example, showed the importance of information flows between partners in dealing with uncertainty in the

implementation of infrastructure projects since imperfect data can result in failure and an ineffectively financed infrastructure. Mandri-Perrot (2009) found that good quality data management will highlight any financial deviation from the original assumptions and is a key to controlling return on investment.

Last, but not least, building and operating infrastructure needs specific knowledge and expertise. According to Almarri and Boussabaine, (2020), risk holders must have the necessary skills, knowledge and capacity to influence risk outcomes in a way that benefits the partnership. This suggests that mechanisms applied by private financiers of infrastructure projects to protect their returns probably consist of a diverse range of formal and relational structures. This study aims to empirically investigate the mechanisms that are applied by private financiers of infrastructure projects to protect their returns.

5.3. RESEARCH APPROACH

Data collection

To qualitatively obtain a deeper understanding of the practices associated with infrastructure investment, the viewpoints of infrastructure financiers and their consultants were gathered using 25 semi-structured interviews (Patton, 2005). A diverse group of actors in infrastructure investment was purposefully selected for our interviews (Brinkman & Kvale, 2015). The "IJ Global Investor" (IJ Global, 2019) database was used to select people to interview. This database contains infrastructure transactions from around the world and details of infrastructure projects by their investment. Access was granted to the first author to deals closed between 2017 and 2019.

The researchers initially selected representatives (heads of infrastructure divisions, directors, investment managers, CEOs, CFOs, and transaction advisors) of top global investors in infrastructure projects and advisors who were frequently involved in the closed deals. For practical reasons, the total number of interviews was restricted to 25 and interviewees were selected in such a way that all the above-mentioned categories were equally represented (Brinkman & Kvale, 2015). The selection (see Appendix 5) was based on the investor categories of the SPV structure: equity investors (referred to as 'E': private equity, institutional investors, construction companies); debt lenders (referred to as 'D': commercial banks, investment banks, development banks), and advisors (financial (FA), technical (TA), and legal advisors (LA)). Additionally, based on suggestions from the interviewees, expert financial analysts (A) were included in the sample.

The interviews were conducted in a semi-structured way (Patton, 2005). The first author conducted the interviews in the UK, Germany and in the Benelux in the period between 2017 and 2019. All the interviews were recorded and transcribed verbatim. The interviews were conducted in face-to-face meetings and telephone calls of about 1.5–2 hours and divided into three parts. First, basic information about the interviewee was asked, i.e., their investment scheme and in which way they were involved in infrastructure investment. In the second part, their approach to risk and uncertainty and the actions they take to protect their return on investments were explored. This also included questions about 'How do you evaluate the risks?' and 'Can you please give an example how you ensure return on investment from an infrastructure investment?'. In the third part, the questions focused on how public governance, institutional settings and social factors influenced their investment decisions. This led to a rich dataset on how financiers invest in infrastructure projects.

Data Analysis

The analysis of all the data was done by way of coding initially based on the research questions and insights from the literature (deductive) and then further developed in iterative steps of analysis of the interview data (inductive). Analyzing the data from the semi-structured interviews, going back and forth while applying concepts from literature, distinctive categories of return protection mechanisms emerged. In our analysis, the first step comprised the identification of investment decision making under uncertainty. The resulting codes included several TCE elements, for example, 'attractive asset class', 'low volatility', 'hedge against market uncertainty', and 'diversification benefits'. From this first step, two types of control mechanism emerged from both literature and interviews: 1) asset portfolio diversification and 2) diversification between different infrastructure options. Then we looked further into the investment process and aimed to identify actions applied by financiers to ensure return on investment from infrastructure projects, for example, a PPP type. Codes in this step again included elements derived from our theoretical framework, such as 'risk transfer', 'due diligence', 'back-to-back principle', 'free SPV from risks', 'uncontrollable', 'standard contracts', 'direct contracts', 'cash flow control', 'lenders step-in right' etc. From this second step of the analysis emerged five types of control mechanisms from both literature and interviews: 3) risk and uncertainty evaluation, 4) risk allocation, 5) investment manager's financial knowledge and preference, 6) project experience and 7) data management. In the final step, we focused on exploring mechanisms in relation to governance. This step included the following codes: 'collaboration between partners', 'relationships', 'subsidies' 'formal contracts'. From this step two types of mechanisms emerged: 8) public governance and institutional setting and 9) relational governance, leading to a total constellation of nine mechanisms that are used by private investors

to ensure a return on infrastructure investment. Each of these mechanisms is listed in the next section on the findings.

5.4 RESULTS

Asset portfolio diversification

A dominant aspect in the data was that returns are best hedged against market uncertainty through the diversification of the investment portfolio by investing in multiple asset classes. "Uncertainty in financial markets has shifted our portfolio decisions to move our corporate financing to infrastructure financing. This is very important for us because by investing in infra we are not affected by the volatility of the stock markets" (E1). Infrastructure was considered an attractive class because it provides good performance for investors with a long term focus"infrastructure presents a low risk investment and a better performance in the long run compared to other asset classes" (E4). Infrastructure investments are typically tied to public goods, and so their revenues are less vulnerable to economic cycles or changes in monetary policy. Moreover, their revenues are often inflation linked, protecting the real returns on the investment.

Interviewees noted that especially after the 2008 GFC and 2009 Eurozone turmoil, equity investors embraced infrastructure when private debt became provident. They also regularly mentioned the influence of the Basel committee, a global standard setter for the prudential regulation of banks (BIS, 2011). As D2 explained: "After Basel III, the capital requirements for the banking sector changed, the basis points for private borrowing have decreased and the exposure of banks' lending has also been questioned under leverage and liquidity ratios. Since then, the escalation began for equity such as pension funds due to their long term investment strategies". This shift in investors character aligns with the long life character of infrastructure. Compared to other assets infrastructure is characterized as 'illiquid', thereby attracting investors who "have a long-term mind set and take decisions based on the long-term stable returns on an asset, and who are paying more attention to long-term contracts which are regulated and indexed to inflation" (E2).

The above shows how investors are increasingly looking at infrastructure as investment because it seems an attractive diversifier in their investment portfolio among other asset classes to control market volatility.

Diversification between different infrastructure options

All the interviewees mentioned the large capital needed to realize infrastructure projects. "Up-front costs are high and there are only a few parties that can invest in infrastructure projects directly" (D3). As a consequence, most of the time, it is the same infrastructure investment companies taking part in infrastructure deals. One of the investors emphasized that "they are investing globally in sectors ranging from utilities to telecommunications. They especially look at the size of the investment" (E3).

In general, the interviews showed that investor decisions are based on the sector, region, maturity, investment type, and project conditions of the infrastructure, as well as the personal preferences of the investment managers. One of the interviewed investment managers listed their criteria for infrastructure investment as follows: "The infrastructure project needs to align with our business plan we set every year for the next three years: where do we want to invest, which sectors etc. Second, we look at the size of the investment, we won't invest under 20 million euros. Third, we look at the returns per sector and per geographical location, against minimum returns which we need to meet. Finally, we look at the risk profile and the network of the contracts. What risk profile does this individual project resemble?" (E5).

Geography came across in the data as a significant variable when deciding to inject private capital into infrastructure projects. In this, an important consideration is the country that investors are targeting for their investment. E3 commented that "we do comprehensive research on the projects and at the place they are located. We evaluate and line up the locations from high credit rating to low credit rating. Our philosophy is to invest in high credit rating, triple AAA, countries such as the Netherlands. Political stability, local regulations and the [country]'s extensive knowledge of and experience in infrastructure contributes to our engagements". One of the private equity investment managers argued that "their investment target is to invest in low credit rating countries where they have already invested in a lot of greenfield projects in emerging countries. Our expected return targets in emerging economies are higher than in the developed ones, due to political uncertainties and uncontrollable Forex (Foreign exchange) risk" (E5).

Another investment characteristic mentioned is the sector that investment managers prefer certain sectors. One of the investment managers stated that "the only way you can deal with black swans is to carefully diversify your infrastructure portfolio across sectors and in different regions. You cannot protect individual deals, but what you can do is protect your portfolio by making sure you are not filling it with similar types of deals in similar countries" (E6). Several investment managers mentioned that

they have different risk return criteria for different infrastructure sectors: "Toll based transportation projects, such as roads, and demand-driven fiber projects can be riskier than a regulated wastewater collection plant, due to their cash flow volatility" (E4). "The EU target to decrease CO_2 levels, increases our interest in investing in renewable energy. Investing in Hydrogen infrastructure can be riskier; however, it can provide higher annual returns than regular airport infrastructure" (E6).

Interviewees regularly suggested that they took the phase of projects into account in their diversification strategy. E5, for example, explained that "The risk profile in the construction phase is higher than the operational phase in infrastructure projects. In the early stage of infrastructure development, they expect 15-20% return. For brownfield assets 8-15% would be acceptable".

This indicates that investors ensure a diversification of several characteristics of the infrastructure investments, such as the phase at which they become involved in an infrastructure, the location, the sector and the size of the investment, makes quite a difference for investors.

Risk and uncertainty evaluation

From a financier's perspective, it appears important to be able to predict possible changes in the global market while allocating capital. It seems, however, impossible to include all events in a statistical analysis of financial possibilities since "it is very difficult to value uncontrollable events in the financial models" (A2). According to most interviewees, uncertainty is both "unknown and uncontrollable": for example, "uncertainty has an impact wider than individual projects you are investing in" (E1). Although participants recognized that uncertainty has an effect, their approach to uncertainty and risk management is mostly project based and correlated with project returns. "If any unforeseen event occurs during the project (which it always does), the project agreement has to be on board to calculate compensation" (E7). "A project has to come with a certain return level, and that return level should be robust enough for unforeseen circumstances" (D5). Uncertainty is generally approached from a risk perspective and characterized as an exposure to loss. D4 gave the example of the uncertainty of delay due to unknown ground conditions that can be specified, quantified, priced and buffered as a risk in the financial model. FA1 mentioned that "in the financial model, for unexpected events an overall contingency is added to the project of around 10% of the capital expenditure".

When it comes to project financing, and particularly PPPs, rating agencies tend to provide ratings that result from calculating a range of qualitative and quantitative risk

characteristics likely to affect the project outcomes. As A1 stated: "the risk models of our agency focus on expected losses, where a rating reflects the expected loss associated with contractually promised payments". According to some interviewees, these risk-quantification models used by rating agencies are very useful for the valuation of a project during their decision-making process. D1 explained that they "considered risk measures and ratings when investing in different geographies that we are not familiar with".

All the investment managers stated that they are in favor of having a proper due diligence process in order to understand projects better and to better assess risks during their investment decision process, hence, to guarantee returns on investment. It is common in the infrastructure sector to use third party independent advisors to carry out feasibility studies. Many investment managers (E1 to E9 and D1 to D5) mentioned that a variety of advisors - financial, technical, legal, insurance, tax etc. - had been assigned to infrastructure transactions. These advisors help financiers assess potential associated risks and can suggest mitigation measures related to the specific infrastructure project. Such assessments indicate whether a project is bankable or not and, based on this, financiers can decide whether to invest in a specific project. Here, E9 commented that "when a project is complex or highly uncertain, the advisor's role, especially the role of the technical advisor, is crucial and dominant. They are the ones influencing our decisions by identifying technical risks in areas where our knowledge is very limited". TA1 indicated that they "combine the technical and environmental knowledge of the specialists with operational, commercial and financial expertise to assess risks and opportunities in our clients' deals. This integrated approach allows us to diagnose and evaluate interrelated issues in the context of an overall transaction, mitigating risks, identifying opportunities, and realizing investment value".

According to TA2, advisor based assessments should at least include: 1) a technical assessment of the physical assets, their technical performance, operations and maintenance regimes, an organization review, a review of ICT systems, and an assessment of the threats to the operation of the business; 2) a business assessment of investment planning, historic capex, suitability of a capex forecast and a business plan assessment; and 3) an environmental and health & safety assessment including a review of environmental management, potential risks, liabilities and issues and the safety record and procedures. Generally, a 'transaction team' will include financial, technical, legal, insurance, and tax advisors, and be led by a "mandated lead arranger". E9 said that "once a deal has been financially closed, some consultants -mainly technical advisors- stay on their role during the execution phase of the project. They monitor ongoing issues in order to protect the investments and returns of the financier". Monitoring

was often mentioned in the interviews as mechanism to control risks and to follow the SPV's services during the construction and operation phases of infrastructure projects.

These results indicate that financiers approach risk as quantifiable and apply control mechanisms based on this quantification. Uncertainty is mostly approached as uncontrollable and avoided or neglected. Third party advisors seem often used by investors to support in their investment decisions by providing due dilegence. In addition, advisors provide consultancy during the project implementation.

Risk allocation

Generally, interviewees concurred that risks should be allocated to the party that can best manage them. Investors typically transfer risks to a SPV that then transfers them to subcontractors through a network of contracts. According to D3, "the idea behind the whole finance structure is to hedge all risks. We aim to transfer important risks from the SPV to EPC and O&M contractors on a back-to-back basis... it is to keep the SPV risk neutral. In the event of non-performing, we can wait till the long stop date and use the option of termination. In this way, we can shield SPVs from any type of risk and guarantee future returns". Consequently, contractors employed for execution, maintenance, and operation "are accepting all the most important risks in the project agreement, such as agreeing high percentages of liquidated damages, in order to be in the deal" (TA3).

As Figure 5.1 shows, a private partner signs a contract with the contracting authority to provide services through a project agreement and, at the same time, also enters into a separate Credit Agreement with Lenders. This Credit Agreement is "a loan agreement with the banks to raise a senior debt leveraged as 90:10 or 80:20" (E8). The loan agreement includes several security agreements as a control mechanism. Further D2 stressed that, in infrastructure projects, "the first priority is payment of debt". A financial advisor (FA1) mentioned that "a loan agreement's key covenants are the mechanism used to protect debt return: such as, the borrower shall not prepay without the bank's authorization, the borrower shall not pay dividends unless the project presents risks in a period; the borrower shall maintain a reserve account at specific levels". To give an idea of the complexity of agreement networks E9 mentioned that they "are entering into more than 70 security agreements with the lenders- hedge documents and swap contracts which guarantee the pay back to the lenders, in a big infrastructure project". E9 also said that "our lenders (banks) have rights to restrict the dividend payments if contractual variations have an implication on their cover ratios [...]. Banks control the accounts". One of the debt providers from a commercial bank mentioned that "shock events can impact cash flows from the project, inevitably

we might get paid from the Debt Service Reserve Account" (D3). Direct agreements give specific rights to the banks. They offer third-party consent to the assignment of receivables, and a safeguard that a third party cannot terminate the contract without notice to the banks. The most important safeguard is that "it gives step in rights in the event of a contractor's default" (D4).

This means that if an unexpected event occurs and contractors fail their obligations under the project agreement, negotiation might be finalized with the lenders stepping in. Step in rights give lenders the right to replace a SPV and/or contractors. In summary, our findings show that investors in PPP projects use the SPV to separate themselves from risks.

Investment manager's financial knowledge and preference

The financial knowledge of investment managers also appeared to be an important investment control mechanism. As one commented: "The complex nature of infrastructure financing creates a need for understanding the current developments, trending sectors, and best regions to invest in. Only experienced investment managers can deal with the complex decision-making process of investments" (E1). A remarkable observation from the interviews was that investment managers' preferences also affected the decision to invest: "An infrastructure manager's key responsibility is to manage, keep safe and maximize the profit of the investor's portfolio. Investment managers are often incentivized to drive the best deal possible. Sometimes investment managers make decisions based on their own career goals and drag investors into uncertain revenue streams" (A4).

This illustrates that the investment's managers knowledge is important to deal with the complex nature of infrastructure projects, but that personal preferences can also highly influence choices.

Project experience

Most interviewees believed that it is very important that financiers are supported by a highly skilled and knowledgeable joint venture that will successfully bid and implement the project thus ensure a return on investments. Consequently, they "look for the relevant experience in the companies that are going to undertake the design, construction, operation, and maintenance of the facilities in large infrastructure projects" (E5). In this, according to TA3, "the EPC holder experience is the most important, because most of the risks appear in the construction phase", and "there are only a few contractors that can deliver these types of intense and large infrastructure projects. It is essential to choose them" (D3). E1 mentioned the importance of

the clients' competence and experience, adding "Managing the uncertainty and dependencies in the contracts is very important [...]. We know that Rijkswaterstaat has professional knowledge to manage DBFM type of contracts and network of relations".

The above indicate that investors are keen to see experienced partners who can deal with difficulties, conflicts and other aspects that could danger their investments. Hence, explicit experience with projects can be considered as another mechanism to protect private investments.

Data management

A final aspect that, interviewees mentioned as an important mechanism to keep track of their return over the life cycle of a protect was data collection and management related to physical infrastructure and registration of contractual and financial documents. A legal advisor (LA2) commented that "it is very important to keep original and updated versions of contract variations and project documents to keep track of revenues. Those documents are especially valuable during the hand back of the project where investors will receive a large proportion of their return". A project portfolio dashboard, in addition to the regular performance-payment data sheet provided by the SPV, appears to be a useful instrument to keep investors informed of risk conditions: "Investment managers need to keep track of the performance of their assets and need to understand the conditions of their assets under risk" (TA3).

Public governance and institutional setting

Governments provide fiscal incentives, guarantees, insurances, credit enhancements, currency risk protection, and other instruments to attract investors in public infrastructure investments and mitigate the risks investors can be exposed to. In this context LA1 commented that "to stimulate private project finance, the government's strong political support, a standard contract, a sound contract management approach, and legislation without legal ambiguities are needed. Governments should assure commercial viability, clear project requirements, a clear level of demanded services, proactive management, and a clear allocation of risks". From the interviews it seemed that especially a country's legal system was an important mechanism in the protection of financiers' returns. Some countries have specific laws for private participation in infrastructure projects. For example, Turkey has - Law nr 3996 - realization of certain infrastructure and public services with the BOT model, while some others use standard agreements complementing civil codes with specific contract clauses. For example, in The Netherlands, Rijkswaterstaat has a Standard DBFM Model Agreement that it employs.

These results indicate that investors are more likely to invest in an infrastructure project which has a steady environment and confirm that the standard model agreements play a moderator role in investment decision making.

Relational governance

All the investment managers agreed that their returns must be protected by a sound contract management mechanism: "Not every risk can be quantified and hedged, the SPV has to deal with issues through sound contract management" (D5). FA2 mentioned that "the higher the level of governance, the greater the chances of guaranteeing investors returns". In this sense, the relationship between the contracting authority and the SPVs was especially mentioned. E3 remarked that "the [country] way of integrated project management used by [public client organisation] leads to more collaboration between parties and consequently variations are dealt with more smoothly both in the construction and maintenance processes". According to D3, "we all learned how complicated the actual contract management and implementation of a PPP contract really is. At the end of the day the important underlying principle is a feeling of partnership in a long-term relationship. Day-to-day contract management in a relational environment is more important than the contract rules". Collaboration was frequently mentioned in the interviews as a necessary basis for sound contract management. A judgement by the UK Royal Courts of Justice on 22 February 2018 was often referred to. This states that "a PFI contract intended to run for 25 years may be classified as a relational contract [....]. Both parties should adopt a reasonable approach in accordance with what is obviously the long-term purpose of the contract. They should not be latching onto the infelicities and oddities, in order to disrupt the project and only maximize their own gain".

The relational governance aspect of investment decisions was mentioned very frequently during the interviews. This stresses the need for a relational mechanism to ensure return on investment in addition to the formal contracts.

5.5 DISCUSSION

This paper investigated a constellation of nine mechanisms that are used by private investors to ensure a return on infrastructure investment. From a TCE perspective any issue that arises can be recasted as a matter of contracting. In line with Chang (2015) and Jin and Zhang (2011), our study adds a further discussion on interpretation of the mechanisms underlying the decision making process in the risk allocation process. It was found that in the infrastructure transactions investors appear to combine TCE related mechanisms which include asset portfolio and infrastructure options diversification,

evaluation and allocation of risks and uncertainties, financial knowledge, relational governance, project experience, and data management. Hence, this study enhances the transaction cost theory by considering that including these protection mechanisms are transaction costs for investors, seeking for compensation which can be emphasized by the need of equilibrium (see also Williamson, 1985). Additionally, by approaching infrastructure as an investment class as part of economical transaction, the PPP project governance debate in project management literature has been enriched in several ways.

Firstly, in line with the findings of Gatti (2018), the results show that infrastructure investments have low volatility and are less vulnerable to economic changes and inflation than other assets. Our study indicates that infrastucture investments demonstrate an ability to bounce back from economic shocks. Therefore, the inclusion of infrastructure assets into investors' portfolios may reduce the effects of uncertain market movements. Equity investors have therefore been diversifying their portfolios among a wider spectrum of investments, and, especially since the GFC, include infrastructure assets to protect their returns (Thierie & De Moor, 2016; Blanc-Brude et al., 2017). Our findings revealed that investors further diversify their infrastructure assets between different infrastructure options or investment vehicles such as listed or unlisted infrastructure, sectors (e.g., transportation, telecommunication), regions (e.g., Europe, Africa) and maturity level (e.g., greenfield, brownfield). This extended diversification was perceived to be very important, as a way to avoid having too many smilar types of deals in one's portfolio.

Secondly, the study contributes to the debate on risk and uncertainty management by providing an extended critique on risk allocation through formal contracts in infrastructure projects (Burke & Demirag, 2017; Keers & Fenema, 2018; Cui et al., 2018; Sainati et al., 2020). Previous project management studies argue that risks should be allocated appropriately between contracting authority and project sponsors (Cruz & Marquez, 2013; Wang et al., 2018; Keers & Fenema, 2018). Risks are generally predicted and specified, then quantified, priced and buffered into financial models. As a consequence, unquantifiable uncertainties are as far as possible either not accepted or contracted away to others as externalities. In this context, the results are quite consistent with the principles of TCE. Hence, TCE provides a useful framework to explain that infrastructure financiers emerge to minimize their costs by externalization of uncertainty and safeguard their return on investment (Williamson, 1985; Joskow 1985). Investors seem predominantly concerned with risks that might affect their returns, and do not feel it is their responsibility to deal with uncertainties in the public infrastructure itself. The Dutch standard DBFM model contract used by their national highway agency Rijkswaterstaat, for example, states that *"with respect to the occurrence of*

unforeseen circumstances, parties agree that they have willingly and wittingly entered into this long-term agreement and that the mechanisms that are included in this agreement are already intended to deal with the consequences of any possible unforeseen circumstances that may arise". The interviews, however, showed no evidence that investors want to agree with the premise that they should willingly and wittingly accept any responsibility in dealing with the consequences of uncertainty. Although risks are a factor in the viability of projects (Owolabi et al., 2019), our findings indicate that financiers are in favor of uncertainty being backed up by government support. The interviewees appear to consider uncertainty as uncontrollable which should remain with the public sector. By considering financier's mechanisms to protect return on infrastructure investment this study explicates the underlying interplay between uncertainty and incompleteness of the long term contract (such as standard DBFM agreements) by indicating that financiers behave rather opportunisticly by taking actions that increase the costs that will be obtained by the other party (see also Williamson, 1985). This behavior does not maximize the joint gains when a particular contengincy arises. Therefore, it is no surprise that the consequent costs end up being borne by the tax payers in PPP projects. Ex-post emerged opportunism can give financiers monopoly power when contengies arise and they seek for their own-stakes. The findings confirm that when contengencies arise that are not covered by formal contractual provisions, one party has a strong incentive to behave badly, which increases other party's costs as also indicated by Joskow (1985). Financiers generally close their eyes to uncertainties until the results will come back with additional transaction-specific costs to unfold events and contract adaptation will be reached as previously described by Williamson (1985). The findings of this study could provide a guidence for future contract designers to take financier's return protection mechanisms into account while drafting incomplete contracts.

Thirdly, infrastructure development PPPs are considered beneficial to the public sector because certain risks are transferred to the private sector which is a basic part of the PPP definition. Here it is worth emphasizing that the SPV structure used to deliver PPPs facilitates equity and debt holders in protecting their investor returns by passing the important risks from SPV to the contractors through back-to-back type contracts. In line with Sainati at al. (2020), we see that to avoid being burdened with the ownership of risks, investors isolate the SPV from the risks to protect themselves. To this end, financiers force contractors to accept the most important risks in order to become part of the deal. Given that the risks and uncertainties can be relatively high in public infrastructure and that contractors accepting these risks are increasingly facing collapse, the costs to the public sector will increase. The use of key covenants, pledges on the company shares, and security on receivables show the dominancy of the debt provider over the service providers. If an unexpected event

occurs resulting in the contractor defaulting, negotiation might be finalized with the lenders stepping in. The initial direct agreements made between the lenders and the public contracting authority provide the lender with this one-sided step-in right. In a PPP, this is an important mechanism to protect the debt provider's investment and gives them right to replace contractors to protect future returns. Our study shows how investors aim to be risk free by transferring risks through a network of contracts to the contractors. Using the back-to-back contract principle leads to risks being allocated between the contracting authority and the contractors, rather than between the contracting authority and the SPV. This does not follow the basic logic of allocating risks appropriately. Moreover, the term 'contract' in TCE is equivalent to a complex of contracts in large infrastructure PPP projects resulting in less capacity to deal with uncertainty and increased transaction costs when an uncertain event emerges. Consequently, there is a growing reluctance among western governments to procure public infrastructure through a PPP or PFI. With financiers aiming for a risk free SPV, our findings also uncovered differences in return protection measures between equity investors and lenders. The debt providers bear less risk than equity investors because they have priority into receiving government payments. In addition, lenders have directly agreed step-in rights to protect their future returns if things go wrong. Our results indicate that key covenants seem to provide the authorization for lenders to block dividend payments. This immediately shows PPPs are based on a formal contractual governance mechanism. If things go wrong, parties' defect from the verbal promises and refer to the letter of the contract.

Fourthly, third party advisors are often used by investors to help in their investment decisions. The complex character of infrastructure investment requires specialist input from legal, financial, technical and tax advisors. As Flyvbjerg (2013) observed, an outside view provided by advisors about the bankability of a project helps investors assess risks and uncertainties in deciding whether they will go ahead or not. Advisors not only help in assessing potential associated risks but can also suggest mitigation measures during the project implementation and operation. In line with Demirag et al. (2012), our findings indicate that the due diligence performed by financiers is aimed purely at protecting the investment. In addition, investors use rating agencies and risk quantification models for the valuation of a project in their decision-making process. One may pose the question as to whether such an approach is appropriate when there is real uncertainty as in the complex environment of modern public infrastructure investment. As a result of the adopted risk-based approach, investors are predominantly concerned with risks that might affect their returns and do not feel responsible for the public infrastructure itself. As a result, the role of investors in, for example, public-

private partnerships, which are notionally based on the idea of aligning of interests by sharing responsibilities, is not that of a true partner but merely a resource provider.

In addition, this study indicates in line with the findings of Vecchi et al. (2017) and Wang et al. (2019), that government actions form an important mechanism in protecting the returns of investor in public infrastructure. To attract sufficient private capital, it seems that public grants and/or subsidies are necessary to convince investors of an adequate return. This creates a paradox since the reality seems to be that investors require public grants and/or subsidies to invest in public infrastructure. Since most governments need private capital to finance their infrastructure ambitions, they are forced to deliver those grants. However, this contradicts the widely used PPP model for the procurement of public infrastructure that is based on the sharing of risks among all the partners involved in the PPP.

The study revealed that risks can be managed by contractual governance mechanisms and these safeguards return on investment. However, results also indicates that the contractual governance is not sufficient by itself to safeguard return on investment. In line with theoretical insights from previous studies on PPP governance, our findings suggest that next to formal governance (contracting), relational governance has a purpose to provide a protection mechanism for infrastructure financiers. This relational aspect complimentary to formal governance is relevant to understand financiers' return on investment associated from a TCE perspective assuming to "work things out" when the investment is idiosyncratic (Williamson, 1979). The investors return has to be protected through a sound contract management mechanism where day-to-day contract management in a relational environment is crucial. In line with Benitez-Avila et al. (2018) and Demirel et al. (2019), this study, however, also shows that relational partnering mechanisms are an important way to deal with changes and thus risks and especially uncertainties in the total lifespan of a long partnership. As such, the collaboration between parties can be seen as a necessary and flexible complement to the contractual agreements. In this light, the way investors define their involvement in an infrastructure project partnership, raises the question if their choice of control mechanisms isn't actually too limited and shortsighted.

Finally, the study highlights that information and data gathering, adequate information exchange, and documentation form another control mechanism that is employed by financiers of infrastructure projects. This eases the flow of information and provides investors with an instrument to keep track of returns over the entire life cycle of a project. This data is very often confidential, yet excessive confidentiality within projects and between projects creates a huge barrier to transparency and learning.

Here it could be possible for public authorities to play a role by requesting, recording and disclosing data, for example in return for providing guarantees and/or subsidies. Moreover, increasing transparency about risks and risk measures will enhance learning and may boost the attractiveness of investing in public infrastructure. Government officials should, however, concern better non-confidenality in the financing structure of infrastructure transactions.

5.6. CONCLUSIONS

This study aimed to provide an understanding of how financiers in infrastructure PPP projects protect their returns on investment through control mechanisms. For this purpose, data on the investment practices of finance actors, collected through a set of interviews were critically reflected upon in relation to existing literature on this topic. Based on this reflection, it can be concluded that:

- Infrastructure investments have a low volatility and are less vulnerable than other assets to economic changes and inflation. As such, investing in infrastructure makes a valuable contribution to investment portfolio diversification as a way to protect investors' returns against shocks and uncertainties in the market;

- Nine main control mechanisms could be identified to ensure returns on investment in (public) infrastructure development projects in which transaction costs economics and project governance play an important role: asset portfolio allocation, diversification among different infrastructure options, evaluation of risks and uncertainties, allocation of risks, financial knowledge, public governance and institutional setting, relational governance, project experience and data management;

- Investors in infrastructure projects seem predominantly risk-oriented and approach uncertainty as uncontrollable. Investors are mainly concerned with risks that might affect their financial returns and do not feel responsible for dealing with uncertainties associated with the public infrastructure itself. They aim to be risk and uncertainty free by transferring risks and uncertainties through a network of contracts to subcontractors. This goes against the basic logic of allocating risks to those who can best manage them, nor with the basic assumptions of PPP in general;

- To ensure an adequate return on investments, public grants and/or subsidies seem to be essential in infrastructure projects. Since most governments need private capital to finance their infrastructure ambitions, they are forced to provide such

grants. This contradicts the general procurement models for public infrastructure that are based on the sharing of risks among all the project partners involved;

- In addition to 'classical' transaction cost theory a combination of formal contractual and relational governance mechanisms is considered as favorable and vital for the protecting return on investment.

Will public infrastructure projects continue to be attractive to private investors? Will governments enhance investments in infrastructure to stimulate their economies and addresses the challenges of future days? And if so, will infrastructure projects be substantially financed by debt or will business models change? We simply do not know. However, based on findings of this study one may expect private investment in public infrastructure to continue. This study has shown that infrastructure is essentially seen as as just another asset class, albeit one that has certain unique attractions. It is, however, still approached in line with traditional financial market expectations: i.e., building a finance structure that hedges against all risks and guarantees shareholder value. In this basis, it is maybe time that infrastructure should be no longer considered as a single asset but seen as a socio-economic collective development by private investment. Hence, a recommendation for extending this study would be to also take into account the associated public challenges into mechanisms that protect the returns of private investors.

Further research could investigate if the growing appetite for investing private equity in the infrastructure sector may force private investors to shift from pure profit-driven investment to more socially responsible financing. Due to the growing investment interest, there is now a broad range of new funds available, which also might trigger alternative financing strategies. When availability exceeds demand, the relative power of public infrastructure may increase providers to combine private investment with societal ambitions such as sustainability or livability. This would not only benefit private investors but also the society as a whole.

CHAPTER 6

CONCLUSION

The aim of this study is to gain insights into the mechanisms that are applied by parties involved in PPP infrastructure projects to deal with uncertainty. The study focuses on understanding how risk and uncertainty are managed in practice by the parties involved through contractual and non-contractual mechanisms and how this effects flexibility in infrastructure PPP projects. This Chapter summarizes the answers to the three research questions 1, 2, and 3 as formulated in Chapter 1, thereby providing a basis for then answering the main research question. The three sub-questions all focus on different subsets of the relationships present in the PPP scheme as outlined in Figure 1.1 and reflect theory and practice from diverse perspectives and are based on the interactions between the relevant actors in the set of relationships under consideration. This Chapter pulls it all together and elaborates on the main research question and formulates overall conclusions and recommendations for infrastructure managers.

6.1 ANSWERING THE RESEARCH QUESTIONS

This section answers the sub-questions as formulated in Chapter 1 and by doing so offers a basis for answering the main research question.

The first research question was formulated as followed:

What potential changes typically occur in infrastructure PPP projects? How to deal with these potential changes? What is meant by flexibility in infrastructure PPP projects?

Chapter 3 explains that the dynamic and complex environment of PPP infrastructure projects provide a direct challenge to the effective and efficient provision of services due to issues that arise as a result of unforeseen events. The literature provided a basis for the classification of changes. Combining the various classifications of changes identified in the literature with the findings from the case resulted in the following general categories of potential changes in large PPP projects: changes in the project environment, financial changes, changes in legislation, change in politics, change in organizations, changes in requirements, climate changes, technological changes, and technical changes. In general, most changes appear to be related to the external environment of a project and are not fully controllable by the project itself. Therefore, flexibility, i.e., the possibility of the project to adapt to changing circumstances, in its internal relationships (in PPP projects these are the contracts) is needed. Flexibility can be divided into social flexibility (i.e., flexibility through cooperation and interaction), legal flexibility (i.e., the provision of flexibility arrangements in the contracts), and managerial flexibility (i.e., process management that enables interaction and involvement of relevant stakeholders). All three perspectives should be taken into account in developing an adequate contract strategy to provide flexibility in PPP infrastructure projects.

Chapter 3 shows that the unpreparedness for change is not so much based on ignorance, as is often claimed in the literature, but rather on unawareness. The difference between unawareness and ignorance is related to the willingness to actively deal with change. When the actors are unconscious of an uncertainty, they are unaware of its existence, but can still willingly and wittingly accept uncertainty and deal with it when it occurs. However, if an uncertainty is consciously neglected, this constitutes ignorance. As a result, change management is then mainly reactive with all the inherent consequences. Flexibility also requires a more proactive way of dealing with uncertainty in which partners willingly accept the possibility of changes, some of which are unknown and cannot be foreseen.

To anticipate potential change and provide flexible mechanisms that enable an effective response, traditional risk management methods can be used. These are based on identifying potential risks, calculating probabilities and potential effects, and mitigating these risks by including appropriate measures. However, PPP projects are vulnerable to change and, due to the internal contractual structure and environment, PPP infrastructure projects will always have to deal with uncertainty. Risk management will never offer a complete picture of what might happen, so flexibility to deal with (deep) uncertainty is a prerequisite in PPP infrastructure projects.

This study shows that effective and continuous engagement of stakeholders early in the development phase of an infrastructure project, and throughout the life of a PPP, is an effective dealing mechanism. Continuous interaction with external stakeholders provides insight into what is really at stake and what issues are relevant. Early engagement creates flexibility to manage arising issues which may well happen ex-post. Due to the complex contract arrangements of PPP infrastructure projects any change will affect several relationships in it. This is what makes PPP infrastructure projects particularly vulnerable to change. A critical finding is that using only formal contract rules does not offer sufficient flexibility to deal with changes effectively.

The study in Chapter 3 also showed that an effective dealing mechanism is to add social and managerial flexibility to the formal contractual arrangements. This is further elaborated in the following question:

What mechanisms, additional to the formal contract rules, are used in practice to deal with variations in infrastructure projects, and how are these mechanisms operationalized?

Changes are inevitable in large infrastructure public–private partnerships, due to the lengthy duration of the contracts and the dynamic environment in which these PPPs are usually implemented. Changes may lead to variations in the contract and, consequently, to adverse reactions from partners. Chapter 4 presented the results of an in-depth case study into the modus operandi of a large PPP infrastructure project with regard to changes in the realization phase. It was found that the variations that arose could not be dealt with solely through the formal contract rules, and that additional social mechanisms between the public commissioners and the contracted companies were needed to deal effectively with the uncertainty.

In PPP projects, contracts are the vital component of the relationships between the public and the private partners. Both in practice and in the literature there is a

strong focus on the legally enforceable written contracts for dealing with unexpected events. However, contracts are always incomplete since they cannot foresee every possible future event. Chapter 4 shows, in addition to underpinning contract, social mechanisms are needed to coordinate the partnership under changing circumstances. That is, there is a need for a constellation of elements and/or activities that can be used by partners to adapt an initial agreement undergoing variation. Such social mechanisms facilitate the contracting authority and the project company acting together to solve the challenge resulting from of an unexpected event. In Chapter 4, several social mechanisms were identified to deal with unforeseen variations:

- *Contract provisions:* The process of dealing with variations takes place within the boundaries set by the contractual agreement. As such, the agreement can be seen as a foundation for this process. The provisions in the standard PPP/DBFM agreement specify features and characteristics of variation, information exchange, and each party's responsibility during the renegotiation process.

- *Human relationships:* These appear to be a strong addition to the contract provisions. The complementary character of relational mechanisms allows partners to become more engaged and act according to the spirit rather than the letter of a contract. Through human relationships, partners develop a common approach to achieve a certain degree of cooperation.

- *Relational governance:* The standard, internally integrated, project management approach (the IPM model, based on the integration of important project management roles) adopted by many authorities provides the opportunity for all relevant project disciplines to align their views and deal with variations in an integrated way. In practice, contractors normally shadow this model in their organizational structure. This creates a relational governance structure enabling balanced everyday communications between counterparts.

- *Digitalized tools:* Digitalized cloud-based tools enable an easy flow of information between partners and encourages openness and transparency. Using a shared cloud system makes it easier to exchange ideas, reduces knowledge asymmetry, increases transparency, and creates trust in the project which, in turn, strengthens the relationships between partners.

- *Professional knowledge:* Professionalism and experience enable an understanding of the contract and the project with its environment. This is important in recognizing

and managing the network of dependencies in the contract arrangement and between the project and its environment.

- *Actor competences*: It was found that managers with good communication and coordination skills, and who are well aware of the project environment and the contractual network, play an important role in dealing with variations.

When an uncertain event occurs, actors may need to renegotiate the contract clauses due to the incompleteness of contracts. Through renegotiation, an initial imbalance in risk allocation can be partly restored, in essence providing reactive flexibility. However, effective renegotiation will only take place if social aspects, additional to the contract's provisions, make it possible to negotiate within the intentions of the contract rather than according to its letter. The study shows, in infrastructure PPP projects, that most tensions and conflicts arise during negotiations over major events related to funding and financial discussions since this component is the backbone of the PPP arrangement. The competences of the contract managers, on both the public and the private sides, appeared to be especially important in handling these tensions by using their leadership skills and promoting openness in discussions. If a situation arises, the first approach should be to solve the problem jointly before going back to the 'letter of the contract'. A strongly interactive, open, and cooperative relationship thus provides a mechanism to deal with issues that arise. Some interviewees went as far as to state that these relationships were the foundation of the PPP process.

In the Dutch infrastructure sector, the establishment of social arrangements has been strongly supported by the so-called 'Market Vision' strategy, a sector-wide agreement that, aims to change public-private relationships in the infrastructure sector. It aims to create a better atmosphere between contracting partners and to create greater societal value while maintaining a healthy financial base for the project's sponsors. However, because investors are not part of this agreement, it does not cover all the relevant partners in PPP arrangements for large infrastructure projects. This issue is further elaborated in Section 6.4.

Chapter 4 also revealed the significant role of the legal system in which a project and its contract is situated. The Dutch PPP/DBFM model agreement complements certain sections of the Dutch civil code with specific contract clauses. Dutch law is based on the principle of reasonability and fairness, and this creates room to establish the abovementioned social mechanisms. Nevertheless, the study shows that social mechanisms are always necessary for project success, including and maybe especially in countries, that rely more on common law. This relates to the third research question:

How do financiers approach risks and uncertainty when investing in infrastructure projects? How do financiers protect their returns on investment? In what way does project governance influence the protection of financiers' returns?

Regardless of the importance of relationships between the contracting authority and the project company, issues cannot be resolved without involving a PPP's financiers. Financiers partly or fully fund an infrastructure project in order to receive a return on their investment. The literature positions infrastructure as an attractive asset class. Infrastructure is recognized as an asset class that can form part of the portfolio strategy of private capital investors, alongside other assets such as stocks and bonds, and real assets such as commodities or real estate. Investing in infrastructure has a low volatility and is less vulnerable to economic changes and inflation than other assets. As such, investing in infrastructure can make a valuable contribution to investment portfolio diversification and serve as a way to protect investors' returns against market shocks and uncertainties. Chapter 5 shows that the most important criterion for investors investing in an asset is the concept of risk and uncertainty. Risks and uncertainties are commonly approached by financiers as calculable entities, including when they consider investing in infrastructure. The result is that financiers are mainly concerned with risks that might affect their financial returns and do not feel a responsibility to deal with uncertainties which, as discussed above, are inherent to (public) infrastructure. To maximize returns, they transfer risks and uncertainties to the (public) contracting authority and subcontractors through a network of contracts. Through the establishment of an SPV, as a shell company, risks are transferred using the back-to-back principle to the subcontractors. As a result, risks and uncertainties are unevenly distributed and positioned in a contact arrangement. Consequently, in practice, services are delivered through a comprehensive network of contracts leading to rigidity and few possibilities for flexibility if required.

Chapter 5 identifies mechanisms that financiers consider for protecting their return on investment:

- *Asset portfolio diversification*: Diversifying the investment portfolio by investing in multiple asset classes. The inclusion of infrastructure assets in an investor's portfolio can reduce the effects of uncertainties such as, market dynamics.

- *Diversification between different infrastructure options:* Within infrastructure, there is the possibility to further diversify among various infrastructure options such as sectors (transportation, telecom, utilities), regions (such as Europe, Africa), maturity levels (greenfield or brownfield), or investment vehicle (listed or unlisted).

- *Risk and uncertainty evaluation:* Financiers explicitly evaluate risks and uncertainties that might impact on the return on investment and on controllability. Investors are risk-oriented and mostly approach uncertainty as uncontrollable. Viewing uncertainty as uncontrollable, they consider that it should predominantly remain with the public sector.

- *Risk allocation:* Investors typically transfer risks through a network of contracts to protect their return on investment.

- *Investment manager's financial knowledge and preferences:* The complex nature of infrastructure financing creates a need to understand current developments, sector trends, and the best regions to invest in. Only experienced investment managers can deal with the complex decision-making process involved in determining investments.

- *Public governance and institutional setting:* Governments provide fiscal incentives, guarantees, insurance, credit enhancements, currency risk protection, and other instruments to attract investors to public infrastructure investments and mitigate the risks to which investors could be exposed.

- *Relational governance:* The investor's return has to be protected through sound contract management.

- *Project experience:* Financiers recognize the need to be supported by a highly skilled and knowledgeable joint venture that will successfully bid and implement a project to ensure a return on investments. They look for relevant experience in the companies that are going to undertake the design, construction, operation, and maintenance of the facilities in large infrastructure projects.

- *Data management:* Keeping track of returns over the life cycle of a project through data collection and management related to an asset's contractual and financial documents.

Findings show that investors tend to unbalance risks to their own advantage: shifting most of the risks to the client and the executing contractors. As a result, much of the risk and uncertainty is held by the contractors in a PPP arrangement and by the client. This means that PPP arrangements tend to be initially based on an unbalanced risk allocation rather than the application of the common risk allocation paradigm that posits that risks should be distributed to those best able to manage them. This contract-

based imbalance makes dealing with uncertainty effectively in practice difficult. Rather than issues that arise being managed by a strong governance mechanism, such as a working-together approach, one party is responsible for managing and the other party monitors or controls this. Contrary to common partnership principles, investors feel little responsibility for dealing with uncertainties, seeing this as a client's or the contractors' responsibility. Based on the basic PPP principle, clients also tend to transfer risks to private partners, resulting in an even more uneven risk and uncertainty burden for the executing contractors. When margins are low this leaves little room for contractors when dealing with uncertainty, resulting in inflexibility in interaction and disputes.

6.2 REFLECTION

This thesis set out to gain a deeper understanding of mechanisms that are applied by parties involved in PPP infrastructure projects to respond to changing circumstances, i.e. flexibility. Having answered the research questions above, this section reflects on the outcomes of this research that add to the discussions and conclusions of Chapters 3, 4, and 5 by offering a more overarching perspective. In this reflection, the following issues that came out of the findings, financiers' focus on return on investment, inappropriate risk distribution and the need for social arrangements in PPP infrastructure projects were discussed.

PPPs comprise a network of actors and mutual relationships regulated by contracts. These contracts arrange the division of tasks and responsibilities between contracting parties and they specify the allocation of risks and uncertainties. Through PPPs, risks can be transferred from the public to the private sector and distributed between private partners. Following on from the contractual allocation, each actor defines their own mechanisms to deal with the risks and uncertainty allocated. While governments want to shift risks and uncertainties to the private sector, PPP financiers are concerned that accepting these will have a negative effect on the predicted return on investment. The basic principle of project finance is that a project's future cash flows must be sufficient to fund delivery, maintenance, operating costs (including risks and uncertainties), and debt service, and to yield shareholder returns (Gatti, 2018).

Risks are generally predicted and specified, then quantified, priced, and buffered into financial models. In line with the literature, our study found that PPPs are usually financed through a project finance scheme, where a large proportion of the investment is financed with debt in the form of syndicated loans or bonds with the first priority of an investor being the debt payment (see Chapter 5), thereby making lenders important stakeholders. Their risk mitigation strategies have to be accepted

to make the project bankable (see Yescombe & Farquharson, 2018; Owolabi et al., 2019). If their requirements are not met, the project will not be bankable. However, this process is confidential and makes the financial basis of infrastructure projects untransparent (see Chapter 5). The basis of finance is that risks and uncertainties need to be quantified. Quantified risks are considered in the financial models as possible losses, and buffers are estimated. As a consequence of this approach, unquantifiable uncertainties are, as far as possible, either not accepted and returned to the government or contracted away to others (the project contractors) as externalities. For example, if an SPV defaults, financiers may have established the right to step out (specified in the direct agreement with the contracting public authority), with the contracted public party paying the remaining debt. Since the PPP concept involves transferring risks to the market, the public authority will strive for private partners to accept risk responsibility. The consequence of all this is that, in practice, the responsibility for most risks and uncertainties lies with the contractors. This contrasts with what most PPP studies argue: that risks should be appropriately allocated among the PPP partners (see, for example, Cruz & Marquez, 2013; Wang et al., 2018; Keers & Fenema, 2018). Some even argue that appropriately dealing with risks and uncertainty is the key determinant of project efficiency and success (Demirag et al., 2012; Liu et al., 2014; Zou et al., 2014). Contractors are placed in a difficult position. Not accepting risks will likely mean they are unable to participate in the PPP, which may result in losing their market position and may even endanger the continuity of the firm. However, accepting much of the risk and uncertainty (given that these are always present in large PPP projects) may lead to consequences such as having to seek a bail out. In today's climate, contractors in the infrastructure sector have limited reserves, and margins are low. Contractors are thus forced to seek cost reductions in order to build up reserves to handle setbacks and, wherever possible, to pass the consequences of change back to the customer/client. As a result, tension may arise in the realization phase.

A PPP arrangement does not remove uncertainties, but only transfers them. The above outlined the distribution of risks and uncertainties runs contrary to the basic risk management logic of allocating risks to those who can best manage them and have the resources to bear the consequences. As such, there is an apparent inconsistency in transferring risks to an SPV with extremely limited risk bearing capacity and, subsequently, through back-to-back contracts to contractors. In a typical PPP arrangement, the SPV serves to mitigate risk for sponsors and for lenders (Garcia-Bernabeu et al., 2015; Sarmento & Renneboog, 2015) by delegating and managing risks on behalf of the financiers (Zwikael & Smyrk, 2015; Wang et al., 2019). These scholars revealed that SPVs are usually shell companies that subcontract a project's delivery, maintenance, and operation tasks to related companies of consortium members. In

our study, financiers indicated that, to not to be burdened with the ownership of risks, they isolate the SPV from a substantial part of the risks, in order to protect themselves, alongside a direct agreement with the public authority for further protection (see Chapter 5). This indicates that PPP investors do not seem to feel any responsibility for dealing with the risks and uncertainties that are related to public infrastructure (see Chapter 5, Section 5). Our study is in line with the findings of Demirag et al. (2012) that returns are protected by passing risks (via the SPV) to subcontractors using back-to-back contracts. Furthermore, investors do not accept uncontrollable uncertainty, which is mainly backed-up by the government through risk limitation in the main contract and the direct agreement. From the interviews it also appeared that financiers believe that uncertainty should remain with the public sector.

A basic precondition of partnering is that partners must be aware and willingly accept the possibility of changes when they enter into a PPP contract, some of which are unknown and cannot be calculated. Interestingly, most standard PPP contracts do provide for accepting uncertainty and dealing with it. For example, the Dutch Standard DBFM contract states that *"with respect to the occurrence of unforeseen circumstances, parties agree that they have willingly and wittingly entered into this long-term agreement and that the mechanisms that are included in this agreement are already intended to deal with the consequences of any possible unforeseen circumstances that may arise"*. This clause stipulates that parties cannot ignore unforeseen changes that occur over the long lifespan of a project. It also stipulates that parties have to install mechanisms ready to deal with changes in the contract. That is, actors cannot ignore uncertainty. Chapter 3 shows that an unpreparedness for change seems to result from a lack of awareness or unconsciousness on the part of the actors, especially on how to deal with uncertainty. As a result, change management is mainly reactive with all its inefficient consequences. In contrast, however, Chapter 5 shows, that ignorance does play a role in financing. The study shows that uncontrollable, or unquantifiable, risks are either not accepted or, as much as possible, externalized by financiers. This reduces the financers' role to a resource provider, instead of a service provider, where the main PPP contract is a service and cooperation contract.

Partnering should mean that public and private parties entering a PPP arrangement intend to cooperate and share responsibilities (as per the definition of a PPP, Van Ham & Koppenjan, 2001). The study shows that the contractual arrangement seen in current PPPs, combined with financiers as important actors lead to an inappropriate risk and uncertainty distribution and consequently to project inefficiency. A financier's opportunistic behavior may increase the costs for other parties. From a transaction cost perspective, the current behavior does not maximize the joint gains when a specific

contingency arises. Consequently, an uncertainty leads to additional transaction costs when contract adaptation is required. This goes against the basic 'partnership logic' of allocating risks to those who can best manage them (Liu et al., 2017; Wang et al., 2019) and the general underpinning assumptions of a PPP (van Ham & Koppenjan (2001) and discussed in Chapter 1). Public contracting authorities should reconsider the position of the financier in infrastructure PPPs, whether this should be as a separate finance provider to the PPP, between the public authority and their contractors, or as an alliance partner based on shared responsibility. The latter would require reconsidering the direct agreement between the public authority and the financer, the position of the SPV in the arrangement, and the back-to-back agreements between the SPV and the contractors.

One of the arguments for public authorities to become involved in PPPs is that risks can be allocated to other partners (who can better manage them) and, by so doing, the public sector's balance sheet can be freed of these risks (see Chapter 1). Given the above discussion, it is pertinent to ask whether PPPs create public value. The literature suggests that a PPP approach can increase the value of infrastructure outputs because management by a private entity can bring important efficiency gains (see, for example, Liu et al., 2014; Xiong & Zhang, 2014; Iossa, 2015). However, in practice, issues related to risk and uncertainty transfer, as discussed above, may give rise to deleterious consequences such as significant renegotiation or even the termination of contracts or the need to bailout private operators. When this happens, the public authority will ultimately bear the cost of any liquidation. This is simply because when risk and uncertainty are unbalanced (allocated to partners that cannot manage them or bear the consequences if an event occurs) these will ultimately be reallocated back to the public contracting authority. Risks and uncertainties do not simply evaporate by transferring them through a network of contracts: they may come back with a delay and extra cost.

This debate debunks the rosy view of public private partnering and should spark a discussion on the role of the state and the role of financiers in public infrastructure PPPs. However, such discussion in the literature is very limited. One of the reasons may be that governments are tightly bound to the idea of the financialization of infrastructure as an off-balance source of financing. However, as the need for new infrastructure continues to grow, and as investors are increasingly looking at infrastructure as an attractive investment class, and therefore the number of infrastructure PPPs is tending to increase, a more elaborate discussion is needed regarding the roles of financiers and public authorities in public-private partnering.

As already stated, PPPs comprise a network of actors and mutual relationships regulated by contracts. Long-term contracts are always incomplete because they cannot

foresee every possible future event (Williamson, 1985; Hart, 2018) and our study shows that infrastructure PPP contract arrangements, due to their characteristics and environment, are no exception (Ling et al., 2014; Brown et al., 2016; Xiong & Zhang, 2016). Here, Brown et al. (2016) argue that rather than one all-encompassing ex-ante detailed contract, the contract's governance should be based on a more general formal contract (for baseline, see Koppenjan & de Jong, 2017) and an additional informal arrangement based on mutual relationships. Our study further indicates that social mechanisms are essential to coordinate PPPs under contract variations, ensuring that the contract adequately governs the parties' relationships over the term of the contract and that parties maintain the associated benefits. However, the literature offers little evidence as to how these mechanisms may be worked out in practice. Our study shows that relational arrangements in particular offer flexibility by allowing partners to become more engaged and act according to the spirit rather than the letter of the contract (see Chapter 4). Focusing on relationships can lead all parties to have a better understanding of each other's interests and to understand the ways in which parties perceive the contract, thereby making it easier to deal with uncertainty and provide flexibility. In practical terms, partners can proactively develop a common approach by translating the contract provisions into mutual personal relationships to achieve a certain degree of cooperation. This could decrease the level of formality and ease dealing with unforeseen events, for example by creating a favorable environment of trust and transparency in the renegotiation process.

The development of such a joint and cooperative approach will be heavily influenced by the prevailing contract culture and nature. Whereas Anglo-Saxon contract practices emphasize the tough side of contracting - such as competition, formal procedures, standardized tools, meeting performance targets, and strict contract management – the Rhenish model is based more on the softer side of contracting - dialogue, behavior, good relationships, flexibility, and adaptive management (Eversdijk, 2013; Koppenjan & de Jong, 2017; Ruijter, 2019). As a result, adopting the Anglo-Saxon approach to contracting may cause pressure during the execution of infrastructure projects within a Rhineland context. Chapter 4 shows that on the upper level of the contract, the reasonability and fairness basis of Dutch Civic Law (a Rhenish law culture) can help to solve problems in a more relational way. Knowing that they are able to rely on the legal guarantee of fairness, parties want to act reasonably when dealing with variations during the implementation period that go beyond the ex-ante allocated risks. Furthermore, reasonability and fairness can also be arranged on the sector level. For example, an overarching 'Market Vision' agreed between public authorities and contractors, as for example in the Netherlands, can help achieve a more balanced allocation of risks and uncertainties and create a basis for social arrangements.

Nevertheless, incorporating such arrangements in a project will still depend on the willingness of the project participants. Further, adopting this approach would not affect all the relevant partners in large infrastructure PPP arrangements since investors are not sectorally involved in this 'Market Vision'.

6.3 GENERAL CONCLUSIONS

Based on the reflection in the previous subsection, the following overarching conclusions can be formulated in relation to the main research question of this study:

How to deal with uncertainty in infrastructure PPP projects?

1. Dealing with risks is not the same as dealing with uncertainties. Risks can be tackled by (traditional) risk management methods (for the 'known unknowns') combined with project management to mitigate possible negative effects. To deal with uncertainty, the management approach should be flexible to be able to respond to a dynamic environment. Flexibility can be reactive, but should preferably also be proactive.
2. The multitude of (interacting) contracts makes dealing with uncertainty in infrastructure PPPs difficult because, in the event of unforeseen change, the renegotiation of a multitude of (interacting) contracts is necessary. PPPs comprise a network of actors and mutual contractual relationships. Through these contracts, a division of tasks and responsibilities between the contracting parties is established.
3. Inappropriate distributions of risks and uncertainties lead to inefficiency in current infrastructure PPP arrangements. An inappropriate distribution goes against the basic 'partnership logic' of allocating risks to those who can best manage them and bear the consequences if an unexpected event occurs. From a transaction cost perspective, joint gains are not maximized, and an uncertainty may lead to additional transaction costs when contract adaptation is required.
4. Financiers in infrastructure PPPs do not act as partners but merely as resource providers. This risk-averse positioning of financiers in a PPP is contrary to the nature of a PPP, where responsibilities are shared.
5. A PPP arrangement does not remove uncertainties, but only transfers them. When risk and uncertainty are unbalanced and, allocated to partners that cannot manage them or afford to bear the consequences if an event occurs, these risks will ultimately be reallocated back to the public contracting authority.
6. Social settings offer flexibility by allowing partners to be more engaged and act according to the spirit of the contract rather than the letter and thus make the contract more flexible. Cooperation, joining skills and knowledge are key to

flexibility. Relational arrangements especially offer flexibility by allowing partners to become more engaged and act according to the spirit of the contract rather than the letter. To this end, cooperative arrangements should be explicitly established in advance in PPPs and remain active throughout.

7. Relational arrangements should be based on the principle of reasonability and fairness in infrastructure PPP projects. Knowing that they are able to rely on reasonability and fairness stimulates parties to themselves act reasonably when faced with variations.

6.4 SCIENTIFIC CONTRIBUTION FROM THE STUDY

Dealing with uncertainty in infrastructure PPP projects has received growing academic attention in fields such as project and program management, public governance, and private investment. This study aims to gain insight into the contractual and non-contractual mechanisms that are applied by parties involved in PPP infrastructure projects and improving the flexibility. By doing so this study contributes to the two research gaps that were identified in Section 4 of Chapter 1.

First, in order to create insight into contractual and non-contractual mechanisms that are applied in infrastructure PPP projects to deal with uncertainty was identified. This study first looked at the contractual setting of a typical PPP infrastructure project, seeing the PPP as a network of actors connected through contractual relationships. The complex setting of this contractual arrangement, together with the tendency to divide responsibilities instead of sharing responsibilities results in a rigid system with low flexibility. It was found from the research that the role of the financiers (and lenders) is crucial. Their uncertainty-averse attitude can lead to an unbalanced risk and uncertainty distribution that has the potential to harm project success. This fills a gap on the role of financiers in the PPP literature and emphasizes the need to (re)consider this role from a partnering perspective (since a PPP is a partnering arrangement) and from the perspective of efficient risk management related to project success. The study shows that, in successful PPP infrastructure projects relationships additional to the formal contract are important due to their vulnerable for change. Proactively building social arrangements throughout a project appears crucial for establishing flexibility, i.e., the potential to deal with uncertain events. This study shows that social mechanisms that evolve from practice can be used by practitioners to increase project flexibility. This study provides a fundament for the discussion on the cruciality of social mechanisms for infrastructure PPP project success in relation to the contractual setting on the one hand and effective project management on the other hand.

Second, a lack of insight was identified into the role of financiers in controlling uncertainty in infrastructure PPP projects. There is a burgeoning body of literature in the project management field on financing PPP approaches for the delivery of infrastructure. Cui et al. (2018) and Hodge and Greve (2018) go as far as to claim that project finance should be a fundamental topic in infrastructure PPP research. This research fills the gap on the role of financiers in risk and uncertainty control, or the interactions between parties involved in the PPP arrangement and shows the crucial role of financiers for project success. It indicates that, under the current infrastructure PPP arrangement, their role seems to be more that of a financial resource provider instead of a partner in the project. As a result, combined with their risk and uncertainty averse attitude, risks and uncertainties are unevenly loaded onto the client and especially the contractors. The research also clarifies the essence of contractors for the successful realization of the project and their unfavorable positioning in the PPP arrangement, due to this uneven risk and uncertainty distribution. This contributes to ongoing debate about partnering and the issue of sharing responsibility and cooperation from a perspective of reasonability and fairness, which appears to be key for flexibility of the infrastructure PPP projects. It also addresses the financiers' role perception since it was found that the current role makes real partnering difficult in practice, and drives partners away from each other and towards a contract-based setting with accompanying inertia that resists to change. It is crucial that this discussion takes place, especially since the number of infrastructure PPP projects worldwide can be expected to increase given that infrastructure is an attractive asset class for investors and that the private financing of PPP projects remains attractive for cash-strapped public authorities especially given the current enormous demand for replacement and renewal of infrastructure.

6.5 SUGGESTIONS FOR FUTURE RESEARCH

As with any research, this study has limitations. Although these limitations mean that our conclusions should be carefully considered before applying them to a specific situation, they also suggest avenues for follow-up research to broaden and deepen the findings.

First, the focus here was on infrastructure projects in a PPP contractual setting. Only a proportion of infrastructure projects worldwide are planned and executed under a PPP contract. In particular, the discussion raised about relational arrangements (social mechanisms) in addition to the contract could be relevant to other forms of contracts such as, Design & Build contracts. Therefore, further case studies are needed to study social arrangements in practice in relation to both contractual setting and to effective project management. The mechanisms found in this study may also be applicable in

other contracts than PPPs in infrastructure projects. A suggestion for future research is to broaden the study to other contract types.

Second, all the PPP cases researched were situated in the Netherlands. This potentially limits the applicability of the findings since the Netherlands has adopted the DBFM model for infrastructure PPPs, and these PPPs are realized under Dutch Civic Law that is based on reasonability and fairness above the letter of the contract. This means that researchers and practitioners should be especially cautious in applying the findings in other legal regimes. Future research focusing on mechanisms for dealing with risks and uncertainty in different legal regimes would extend the results of this research.

Third, from our study, the role of the financiers appeared crucial to project success. Our findings were based on a broad, international, set of interviews. These interviews revealed trends and these insights could be deepened with further in-depth research in international cases. In particular, the dynamics between the client, the financier and the contractors appear to strongly influence flexibility and, consequently, project results and success. We would therefore strongly advise further in-depth case research, and comparative research between cases, to deepen the findings of our study.

Fourth, our findings focus on project finance but do not capture elements of the ongoing discussions on sustainable finance. For example, the United Nations' Sustainable Development Goals (SDGs) might create new values in the investment area. Future research could look into how sustainability goals can be related to investment criteria and control mechanisms for return on investment. Here, more research is needed on how PPPs (and other infrastructure contract forms) can be used to achieve governments objectives related to a sustainability and circular economy.

Finally, our study reveals a relationship between project management and the dynamics of the partners in the PPP project. This relationship is not explicitly discussed in project management literature but this dynamic is in essence regulated by management. Since project management is directed at effectively and efficiently managing processes to ensure project success, these dynamics cannot be ignored in project management. We therefore plea for more research into these dynamics from a project management perspective.

6.6 RECOMMENDATIONS FOR PRACTICE

Based on the findings of this study, recommendations can be made for public authorities, contractors, and financiers involved in infrastructure PPP projects.

Recommendations to public (contracting) authorities

Public contracting authorities may consider to proactively establish social arrangements - jointly with the partners - in addition to the formal contracts throughout the project life cycle. The focus on relationships may lead to all the partners gain a better understanding of each other's interests and to understand the ways partners perceive the contract. This can decrease the level of formality and ease dealing with unforeseen events, for example by creating a favorable environment of trust and transparency.

Public contracting authorities should reconsider the position of project financiers to create a more equal risk and uncertainty distribution based on the guiding principles of partnering and project management. This means rethinking the contract arrangement in a way that partners (including financiers) share responsibility for the outcome of the contract arrangement and that risks and uncertainties are allocated to those partners best able to deal with them. In this, public contracting authorities could consider adopting an alliance type of partnering model for mutual cooperation. If partnering is not the main objective of the public contracting authorities, they could consider moving away from the partnership logic and instead look for a separate way of financing infrastructure projects such as direct public financing or establishing an infrastructure fund to cover multiple projects. There are various financing options available in the investment portfolios. Many institutional investors (such as pension funds) have long-term investment goals and public contracting authorities could seek direct investments from them to bypass banks (and also private equity), hence their direct agreements.

Given that financing is an essential part of infrastructure PPPs, public infrastructure managers need adequate skills and knowledge to understand the dynamics of investing and financing. Part of this is 'opening the black box' by requiring detailed information from financiers on how they deal with risks and uncertainty, and how they guard their return on investment when contracting infrastructure PPP projects.

Finally, public authorities could consider using PPPs as a vehicle to stimulate societal transitions. Given the changing landscape with new economic systems (shared economies, digitalization) and the shift in public opinion towards ESG (Environmental, Social, Governance) issues, public ambitions (for example greater sustainability) could be incorporated in PPP contracts to increase public value and force private investors in the direction of societal transition. In PPPs, public contracting authorities are in a position to incorporate sustainable finance in funding infrastructure projects.

Recommendations for contractors

The uneven allocation of risk and uncertainty in current infrastructure PPPs places contractors in a very unfavorable position. When the profit and risk margins are not balanced with the risk and uncertainty burden, project success is at stake. The rebalancing of infrastructure PPP arrangements should be discussed, including on the sectoral level, to place contractors in a more favorable negotiation position in the contracting process. To reinforce this, it is important that contractors do not take on responsibilities in their offers that they are unable to manage. Two-phase contracting, which would help gain a mutual understanding of the risks and uncertainties related to a project, prior to price setting could be a way to stimulate this.

An approach to balancing risks and uncertainties among the partners is to use the principle of fairness and reasonability as a basis for the partnership. This could be achieved by, for example, accompanying the formal contract arrangement with a social arrangement that stimulates cooperation. This cooperation could be achieved by the addition of social mechanisms (a relational charter) to the partnership both ex ante and during the partnership. This social arrangement should not only concern the public contracting authority and contractors but also financiers. A basis for this type of charter could be formulated on the sector level and the Dutch 'Market Vision' is an example of this.

Recommendations for financiers

Given the magnitude of infrastructure investment required worldwide in the next decade and the attractiveness of infrastructure as an asset class for investors, it is reasonable to assume that infrastructure investments in the form of PPPs will continue to increase. However, providing a service in infrastructure projects is supposed to concern more than just providing the financial resources. As such, infrastructure should no longer be considered as just another asset class for investors but should be seen as a potential socio-economic development of the financing business. As a consequence, financiers may need to shift from just being a financial resource provider in projects to a real partner in infrastructure development, which involves taking co-responsibility for all the risks and uncertainties associated with a project.

The United Nations Sustainable Development Goals (SDGs) and the EU Green Deal could create new values in the investment business. The finance sector can re-examine the current control mechanisms for ensuring return on invesment in relation to sustainable investments in order to shape real value not only for themselves but for society as a whole.

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APPENDICES

APPENDIX 1: GLOSSARY

Actor: Person or agents or group of actors or agents or organization that act in the infrastructure project environment.

Asset class: A group of investments that exhibit similar financial characteristics (equity, stock, real estate, infrastructure).

Compensation event: The circumstance as a result of which the Contractor is unable to comply with its obligations under the contract. Contracting authority is required to compensate the project company for its financial loss (i.e contracting authority default, contracting authority change, force majeure) (taken from Rijkswaterstaat Standard DBFM Contract 2014).

Contract: A legally binding agreement between actors for the period in which the contract is effective.

Control mechanism: A constellation of elements that are used by private investors to ensure a return on investment.

DBFM: Design, Build, Finance and Maintenance is a project delivery method where a special purpose vehicle bears responsibility for the design, build, finance and maintenance of a project.

Dealing mechanism: A constellation of elements and/or activities that can be used by partners to adapt an initial agreement under variation.

Direct Agreement: Agreement(s) between the lenders and the contracting authority or subcontractors, protecting the lenders' interests under project contracts, or similarly between the contracting authority and subcontractors (taken from Yescombe & Farquharson, 2018).

Dispute: A situation where two parties typically differ in perception of a contractual right, resulting in a decision being given under the contract to become a formal dispute (taken from Arcadis Global Construction Disputes Report, 2020).

Due Diligence: Review and evaluation of project contracts, financial projections and their related risks, carried out by both the contracting authority and the project sponsors (Yescombe & Farquharson, 2018).

EPC Contract: Engineering, Procurement and Construction Contract is a type of construction contract between the Special Purpose Vehicle and an EPC contractor that encloses services on engineering, procurement and construction of a project.

Equity: A security representing an ownership interest in an entity

Financial close: The phase in which all contracts and financing documentation have been finally arranged between SPV and lenders.

Flexibility: The ability to deal with uncertainty.

Force Majeure: Events outside the control of the contract parties which prevent one or both of the parties from performing their contractual obligations (taken from Rijkswaterstaat Standard DBFM contract).

Incomplete contract: The notion of incomplete contracts refers to the circumstance that some aspect of contractual parties' payoff-relevant future behavior or some relevant payoff in future contingencies is unspecified in the contract and/or unverifiable by third parties (taken from Rossi, 2014).

Infrastructure: The term infrastructure generally covers all physical assets, equipment and facilities of interrelated (transport and energy) systems and the necessary service providers, together with the underlying structures, and accompanying organizations and business models, rules, and regulations, which are used to offer certain specific commodities and services (taken from Weber et al., 2011; Leendertse & Arts, 2020).

Infrastructure sector: The network of actors involved in infrastructure development.

Integral Project Management (IPM): Rijkswaterstaat's standard project management model for integrated project management. The IPM model divides overall management of the project in 5 working areas who are represented by a manager, namely, project manager, project control manager, contract manager, technical manager, stakeholder manager.

Issue: Discussion item resulting from the interrelated dynamics in the construction and infrastructure environment which are specific to the project and require management action.

O&M Agreement: Operations and Maintenance Agreement as signed between the Special Purpose Vehicle and an O&M contractor that encloses services on maintenance and operation of an infrastructure project.

PFI: Private Finance Initiative, the UK's PPP Project programme.

Pre-contract: Period prior to the contract sign between contracting authority and project company.

Post-contract: Period after signing the contract between contracting authority and project company.

Project: A temporary organization that has been created with the purpose of delivering, operating and maintaining an output or asset according to a predefined business case.

Project Finance: A method of raising long-term debt financing for major infrastructure projects through 'financial engineering', based on lending against the cash flow generated by the project alone (taken from Yescombe & Farquhason, 2018).

Public-Private Partnership: A cooperation of some sort of durability between public and private actors in which they jointly develop products and services and share risks, costs and resources which are connected with these products. (taken from Van Ham & Koppenjan, 2001)

Relationship: The interaction between actors or groups of actors or organizations which impacts mutual behavior (taken from Leendertse and Arts, 2020).

Renegotiation: Negotiation to change originally agreed contract terms and conditions under new circumstances.

Return on investment (ROI): The expected financial gain of a project expressed as a percentage of total project investment.

Risk: A potential future event which has a 'calculable probability' and 'calculable effect' based on past experience and knowledge (taken from Froud, 2003).

Special Purpose Vehicle (SPV): A fenced organisations having limited pre-defined purposes and a legal personality (taken from Sainati, 2017).

Step-in rights: The right, under the direct agreement with the contracting authority, for the lenders to take over the management of the project company to protect their security; (taken from Yescombe & Farquhason, 2018).

Termination of the contract: Early ending of the contract prior to it being fully performed by the parties.

Uncertainty: A potential future event with *no* possibility of placing a numerical probability on occurrence or possibility of calculating the effect (taken from Broadbent, 2008).

Variation: Uncertainties that lead to changes in the contract.

APPENDIX 2: EXPLORATIVE INTERVIEWS

Nr	Type	Organization	Position
1	Public Organization	Court of Audit	Senior Auditor
2	Policy Maker	Ministry of Infrastructure and Water Management	Director
3	Policy Maker	Ministry of Infrastructure and Water Management	Director
4	Policy Maker	Ministry of Infrastructure and Water Management	Policy Advisor
5	Contracting Authority	Rijkswaterstaat	Lawyer
6	Contracting Authority	Rijkswaterstaat	Risk Manager
7	Contracting Authority	Rijkswaterstaat	Project Director
8	Contracting Authority	ProRail	Project Manager HSL-Z
9	Contracting Authority	ProRail	Project Manager
10	Public Organization	Noord Brabant Province	Contract Manager – A59
11	Contractor	EPC	Director HSL-Z
12	Contractor	EPC	Director
13	Contractor	EPC	Director
14	Contractor	EPC	Tender Manager
15	Advisor	Law Firm	Partner
16	Advisor	Law Firm	Lawyer
17	Advisor	Law Firm	Lawyer
18	Advisor	Engineering & Consultancy Firm	Transaction Director
19	Advisor	Engineering & Consultancy Firm	Finance Manager
20	Advisor	Engineering & Consultancy Firm	Economist
21	Advisor	Engineering & Consultancy Firm	Economist
22	Advisor	Engineering & Consultancy Firm	Technical Consultant
23	Advisor	Development Bank	Consultant
24	Advisor	Financial Firm	Director
25	Advisor	Consultancy	Economist
26	Advisor	Management Consultant	Director
27	Advisor	Management Consultant	Project Manager
28	Equity	Private Equity	Managing Director
29	Private Equity	Arjun Infrastructure	Managing Director
30	Debt	Investment Bank	Executive Director
31	Academician	TUDelft	Professor
32	Academician	University of Amsterdam	Professor
33	Academician	University College London, UK	Assistant Prof
34	Academician	Keele University	Professor
35	Academician	Illinois Institute of Technology, US	Professor
36	Organization	IBR – Instituut voor Bouwrecht	Professor
37	Organization	IPFA - International Project Finance Association	Director - Lawyer
38	Organization	Bouwcampus	Manager

APPENDIX 3: INTERVIEWS CONDUCTED FOR CHAPTER 3

Nr	Type	Organization	Position
1	Policy Maker	Ministry of Infrastructure and Water Management	Director
2	Policy Maker	Ministry of Infrastructure and Water Management	Project Manager
3	Policy Maker	Ministry of Infrastructure and Water Management	Policy Advisor
4	Policy Maker	Ministry of Infrastructure and Water Management	PPP Advisor
5	Public Organization	Water Board - Delfland	Project Manager
6	Contracting Authority	Rijkswaterstaat	Policy Advisor
7	Contracting Authority	Rijkswaterstaat	Project Manager
8	Contracting Authority	Rijkswaterstaat	Contract Manager
9	Contracting Authority	Rijkswaterstaat	Contract Manager A13
10	Contracting Authority	Rijkswaterstaat	Technical Manager
11	Contracting Authority	Rijkswaterstaat	Planning Manager
12	Contracting Authority	Rijkswaterstaat	Environment Manager
13	Contracting Authority	Rijkswaterstaat	Contract Manager A13
14	Contracting Authority	Rijkswaterstaat	Contract Manager
15	Contracting Authority	Rijkswaterstaat	Contract Manager
16	Advisor	Rijkswaterstaat	Contract Manager
17	Contracting Authority	Rijkswaterstaat	Risk Manager
18	Contracting Authority	Rijkswaterstaat	Contract Manager A20
19	Public Organization	Port of Rotterdam	Project Manager
20	Public Organization	Port of Rotterdam	Project Manager
21	Public Organization	Port of Rotterdam	Project Manager
22	Contracting Authority	Rijkswaterstaat	Network Manager
23	Contracting Authority	Rijkswaterstaat	Contract Manager
24	Contracting Authority	Rijkswaterstaat	Contract Manager
25	Contracting Authority	Rijkswaterstaat	Contract Manager
26	Contracting Authority	Rijkswaterstaat	Director
27	Contracting Authority	Rijkswaterstaat	Finance and Legal Manager
28	Contracting Authority	Rijkswaterstaat	Asset Manager
29	Contracting Authority	Rijkswaterstaat	DBFM Advisor
30	Contracting Authority	Highways Agency UK	Contract Manager
31	Contracting Authority	Highways Agency UK	Change Manager
32	Contracting Authority	Highways Agency UK	Change Manager

APPENDIX 4: INTERVIEWS CONDUCTED FOR CHAPTER 4

Nr	Type	Organization	Position
1	Contracting Authority	Rijkswaterstaat	Program Director
2	Contracting Authority	Rijkswaterstaat	Program Manager
3	Contracting Authority	Rijkswaterstaat	Project/Finance Manager
4	Contracting Authority	Rijkswaterstaat	Project Manager (PPP Advisor)
5	Contracting Authority	Rijkswaterstaat	Contract Manager
6	Contracting Authority	Rijkswaterstaat	Contract Manager
7	Contracting Authority	Rijkswaterstaat	Stakeholder Manager
8	Contracting Authority	Rijkswaterstaat	Stakeholder Manager (
9	Contracting Authority	Rijkswaterstaat	Technical Manager - PPPs
10	Contracting Authority	Rijkswaterstaat	Lawyer
11	Contracting Authority	Rijkswaterstaat	Technical Advisor
12	Contracting Authority	Rijkswaterstaat	Change Manager
13	SPV	SAAone	CEO
14	SPV	SAAone	CFO
15	SPV	SAAone	COO
16	SPV	SAAone	Project Manager
17	SPV	SAAone	Project Manager
18	EPC	SAAone	Contract Manager
19	EPC	SAAone	Contract Manager
20	EPC	SAAone	Technical Manager
21	Advisor	Advisor	Lender Technical Advisor

APPENDIX 5: INTERVIEWS CONDUCTED FOR CHAPTER 5

Nr	Type	Organization	Position
1	Equity (E1)	Pension Funds	Investment Manager
2	Equity (E2)	Pension Funds	Director
3	Equity (E3)	Private Equity	Asset Manager
4	Equity (E4)	Private Equity	Managing Director
5	Equity (E5)	Private Equity	Managing Director
6	Equity (E6)	Private Equity	Director
7	Equity (E7)	Insurance Company	Head of Infra Investments
8	Equity (E8)	Construction company	Director
9	Equity (E9)	Construction company	CFO
10	Debt (D1)	Commercial Bank	Director
11	Debt (D2)	Commercial Bank	Director
12	Debt (D3)	Development Bank	Head of Infra Investments
13	Debt (D4)	Development Bank	Director
14	Debt (D5)	Investment Bank	Director
15	Financial Advisor (FA1)	Investment Bank	Director
16	Financial Advisor (FA2)	Consultancy firm	Director
17	Legal Advisor (LA1)	Legal firm	Partner
18	Legal Advisor (LA2)	Legal firm	Director
19	Technical advisor (TA1)	Engineering and Technical Consultancy	Director
20	Technical advisor (TA2)	Technical Consultancy	Director
21	Technical advisor (TA3)	Technical Consultancy	Director
22	Analyst (A1)	Rating Agency	Director
23	Analyst (A2)	Economic Organization	Researcher
24	Analyst (A3)	Journal	Editor
25	Analyst (A4)	Journal	Editor

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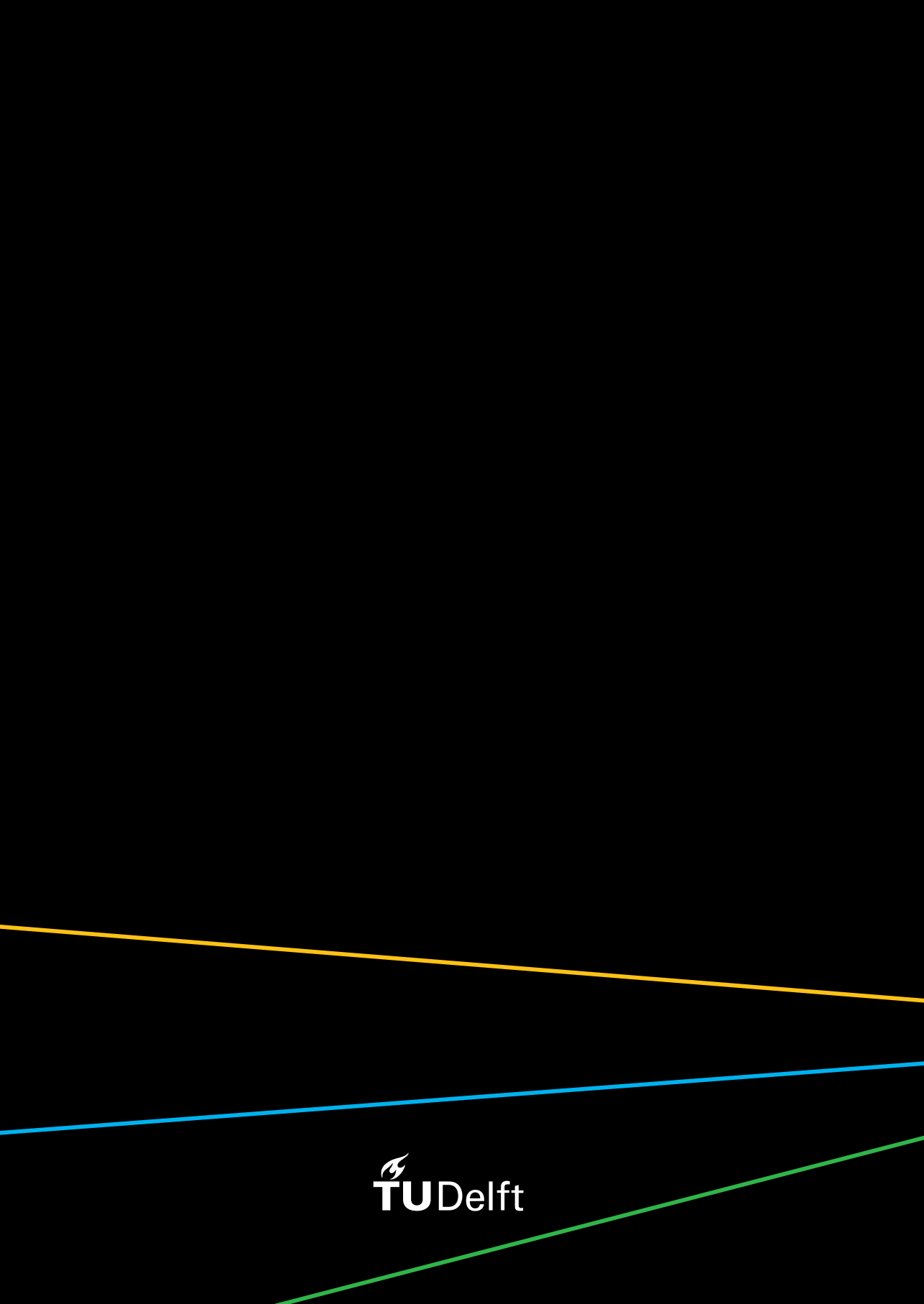
ABOUT THE AUTHOR

Hatice Çiğdem Demirel was born in Oss, the Netherlands. She obtained her BSc degree in 2006 in Civil Engineering at Suleyman Demirel University, Isparta, Turkey. In 2010, she completed her MSc degree in Structural Engineering at Suleyman Demirel University. During her MSc, she moved to the Netherlands and was admitted to the Erasmus Program at the Faculty of Civil Engineering and Geosciences of Delft University of Technology. During her Erasmus program, she completed her internship in Asset Management in DHV (currently Royal HaskoningDHV). After completing her studies, she started working at CB&I (currently McDermott) as a structural engineer.

During her PhD track, Çiğdem was part of the Integral Design and Management department at the Faculty of Civil Engineering and Geosciences of Delft University of Technology. She completed her PhD under the collaboration between Delft University of Technology, Groningen University, Twente University and Rijkswaterstaat (executive agency of Ministry of Infrastructure and Water Management in the Netherlands). She was also a visiting researcher in the contract management department of Rijkswaterstaat.

Since 2014, Çiğdem works as a Transaction Consultant for infrastructure projects in the department of Advisory Services at ARUP in London and Amsterdam. She has been involved in the establishment of the Advisory Services section in Amsterdam. She combines science and practical knowledge with the experience of managing complex projects. She advises infrastructure investors (banks, private equity, pension funds) and developers on feasibility, technical and ESG due diligence processes of infrastructure projects.

Besides her work at ARUP, Çiğdem has recently co-founded a company in the Netherlands in the energy sector.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