

Flexibility in PPP contracts

Dealing with potential change in the pre-contract phase of a construction project

Demirel, Hatice Çiğdem; Leendertse, Wim; Volker, Leentje; Hertogh, Marcel

DOI

[10.1080/01446193.2016.1241414](https://doi.org/10.1080/01446193.2016.1241414)

Publication date

2016

Document Version

Final published version

Published in

Construction Management and Economics

Citation (APA)

Demirel, H. Ç., Leendertse, W., Volker, L., & Hertogh, M. (2016). Flexibility in PPP contracts: Dealing with potential change in the pre-contract phase of a construction project. *Construction Management and Economics*, 35(4), 196-206. <https://doi.org/10.1080/01446193.2016.1241414>

Important note

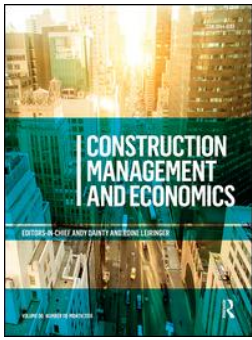
To cite this publication, please use the final published version (if applicable). Please check the document version above.

Copyright

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy

Please contact us and provide details if you believe this document breaches copyrights. We will remove access to the work immediately and investigate your claim.



Flexibility in PPP contracts – Dealing with potential change in the pre-contract phase of a construction project

Hatice Çiğdem Demirel, Wim Leendertse, Leentje Volker & Marcel Hertogh

To cite this article: Hatice Çiğdem Demirel, Wim Leendertse, Leentje Volker & Marcel Hertogh (2017) Flexibility in PPP contracts – Dealing with potential change in the pre-contract phase of a construction project, *Construction Management and Economics*, 35:4, 196-206, DOI: [10.1080/01446193.2016.1241414](https://doi.org/10.1080/01446193.2016.1241414)

To link to this article: <http://dx.doi.org/10.1080/01446193.2016.1241414>



© 2016 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 06 Oct 2016.



[Submit your article to this journal](#)



Article views: 1047



[View related articles](#)



[View Crossmark data](#)



Citing articles: 4 [View citing articles](#)

Flexibility in PPP contracts – Dealing with potential change in the pre-contract phase of a construction project

Hatice Çiğdem Demirel^a, Wim Leendertse^{b,c}, Leentje Volker^d and Marcel Hertogh^a

^aFaculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, Netherlands; ^bMinistry of Infrastructure and Environment, Rotterdam, Netherlands; ^cFaculty of Spatial Sciences, University of Groningen, Groningen, Netherlands; ^dFaculty of Architecture and Built Environment, Delft University of Technology, Delft, Netherlands

ABSTRACT

Public Private Partnerships (PPPs) cover a range of possible relationships between public and private parties. PPP contracts are typically used in contexts of great uncertainty, such as large construction and infrastructure projects that are realized over a longer period of time. Hence, a major challenge in PPPs is to keep construction progress cost-efficient and on schedule, under continuously changing circumstances. One way to achieve this is through clever contracting, by proactively anticipating potential change in the planning phase and providing flexible contract mechanisms that enable an effective response. The purpose of this article is to discuss potential changes and the subsequent requirement of flexibility in PPP contracts. By flexibility, we mean the ability of the contract to deal with changing circumstances. We set out to do so by studying the available literature on the subject and by analysing the case study of the Blankenburgverbinding in the Netherlands, a Design, Build, Finance and Maintain (DBFM) project that is currently in its planning phase based on 32 interviews. Our main findings are that the timely and accurate recognition of potential changes, combined with the availability of flexible coping mechanisms, provide the stakeholders with a better understanding of the challenges they face in realizing their aims in the pre-contract phase of projects. This understanding helps to better prepare a PPP contract for potential changes.

ARTICLE HISTORY

Received 12 December 2015
Accepted 21 September 2016

KEYWORDS

Project; complexity; change; DBFM; flexibility; public private partnerships

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

CONTACT Hatice Çiğdem Demirel  hcigdemdemirel@gmail.com, h.c.demirel@tudelft.nl

as intended (Hertogh and 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 and Chapman 2008, Hertogh and 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 within 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 and 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 and Chahal 2006, Sun and Meng 2009, Hwang and 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 2010) – 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 and 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 and 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 article 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 changes.

Theoretical background

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 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.* (2001) 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 (organizational) 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 neighbourhood 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 1. It recognizes nine main categories of potential changes based on particular features: changes in project environment, legislation, requirements organization, politics and financial, climate, 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.

Research approach

This research is based on a case study of Blankenburgverbinding DBFM project. The case of the Blankenburgverbinding – a project currently in its pre-contract phase – 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. Future case studies will focus on investigating dealing mechanisms with changes in post contract phase of DBFM projects. In this study, data collection encompasses 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).

Table 1. Change categorization based on reviewed literature

Change categorization	Themes	Sources
Changes in project environment	Influence of projects in surrounding networks Environmental conditions	Wu <i>et al.</i> (2004), Van Gils <i>et al.</i> (2009) De Weck <i>et al.</i> (2007), Sun and Meng (2009)
Financial changes	Effects of economic crisis Bank regularity requirements Market changes Internationalization, globalization	Henckel and McKibbin (2010), HM Treasury (2012) HM Treasury (2012) De Weck <i>et al.</i> (2007), Sun and Meng (2009), Koppinen and Rosqvist (2010) Koppinen and Lahdenperä (2004), Henckel and McKibbin (2010)
Changes of legislation	Specifications and law	Love <i>et al.</i> (2001), Van Gils <i>et al.</i> (2009), Sun and Meng (2009)
Change in politics	Fluctuating policies	Wu <i>et al.</i> (2004), De Weck <i>et al.</i> (2007), Sun and Meng (2009)
Change in organizations	Change of decision-making authority (external) Organizational culture changes Social changes Decision-makers' alterations (internal), institutional influences	Hsieh <i>et al.</i> (2004) Van Marrewijk <i>et al.</i> (2008), Sun and Meng (2009) Love <i>et al.</i> (2001), Koppinen and Rosqvist (2010) Love <i>et al.</i> (2001), Hsieh <i>et al.</i> (2004)
Changes of requirements	Safety requirements Environmental requirements Governmental requirements	Hsieh <i>et al.</i> (2004), Wu <i>et al.</i> (2004) Van Gils <i>et al.</i> (2009) Love <i>et al.</i> (2001)
Climate changes	Global warming	Rahman <i>et al.</i> (2008), Sun and Meng (2009)
Technological changes	Use of new materials Automated systems	Love <i>et al.</i> (2001), Wu <i>et al.</i> (2004) Bock and Linner (2015)
Technical changes	Physical conditions	Love <i>et al.</i> (2001), Wu <i>et al.</i> (2004), Hsieh <i>et al.</i> (2004), Van Gils <i>et al.</i> (2009)

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 RWS (Rijkswaterstaat 2014), the executive department of the Dutch Ministry of Infrastructure & Environment, 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 Service 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 shown in Figure 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, as illustrated in Figure 1.

Interviews

In this study interviews 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 & Environment (M,I&E), Rijkswaterstaat (RWS), 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. Table 2 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 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.

Findings

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

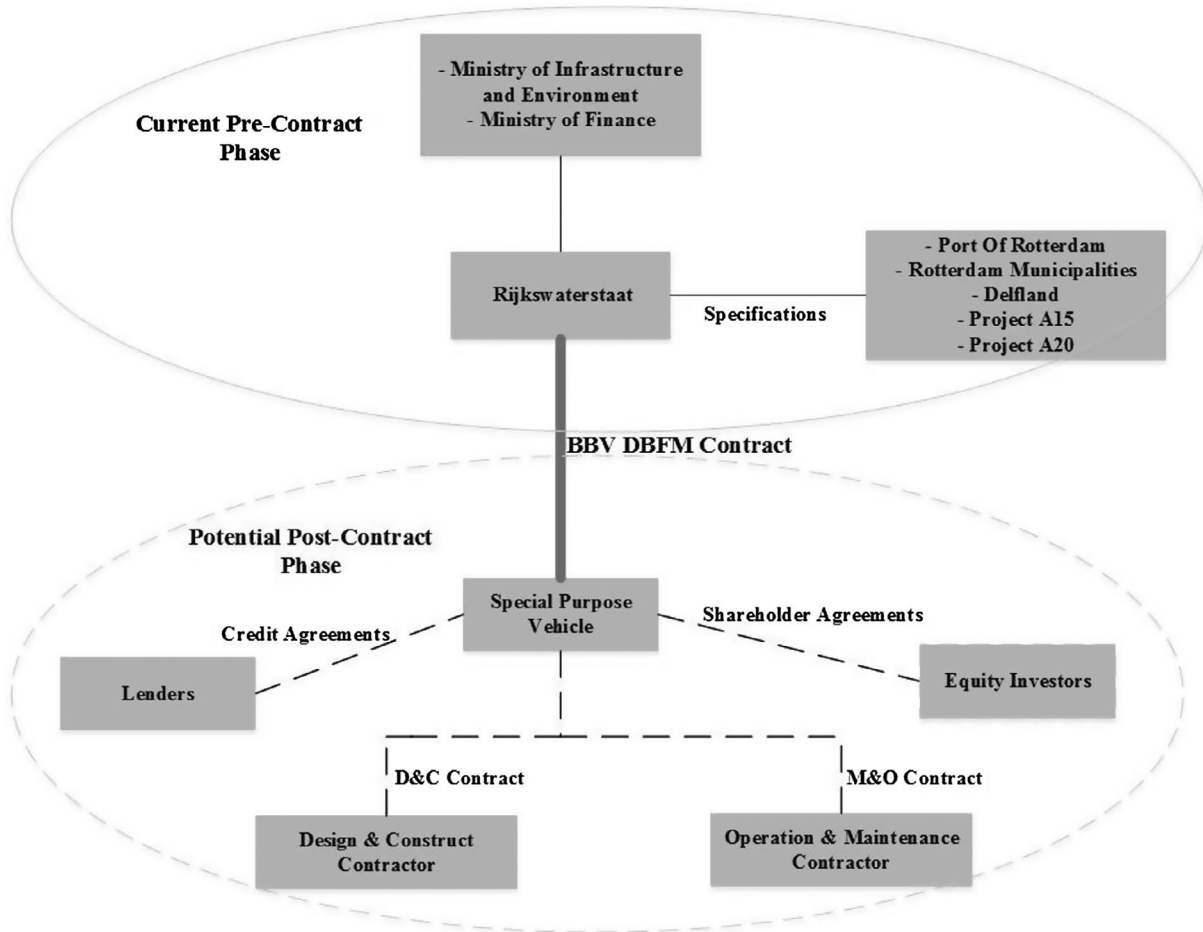


Figure 1. BBV DBFM project pre-contract and post-contract overview, possible related agreements and actors

Table 2. Profile of interviewees

Organization	Number of interviews	Functions
Ministry of infrastructure and environment	2	Director
	1	Policy advisor
Rijkswaterstaat	2	Project manager
	1	Asset manager
	3	Advisor
Project A13/A16	1	Network manager
	2	Contract manager
	2	Contract manager
	1	Contract manager
	1	Contract manager
	1	Contract manager
	2	Project manager
	1	Contract manager
	1	Stakeholder manager
	1	Technical manager
Project Blankenburg-verbinding	1	Risk manager
	1	Finance manager
	1	Planning manager
	3	Project manager
	1	Project manager
Port of Rotterdam	3	Project manager
Water authority of Delfland	1	Project manager
UK Highways Agency	3	Contract manager

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 RWS 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 & Environment 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 & Environment 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 Coen Tunnel, of which he suspect 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, the change categorization from Table 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.

Flexibility

Stakeholders’ understanding of flexibility differs from person to person. In general, interviewees assess the flexibility

Table 3. Findings of the BBV case related to the categorization of changes as given in Table 1

Change categorization	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 New dykes
Financial changes	Environmental conditions Effects of economic crisis Bank accounting systems Fluctuations in budgets Market changes Internationalization, globalization	Toll prices Loans Toll cuts
Changes of legislation	Specifications and law	Tunnel safety standards EU laws
Change in politics	Fluctuating policies Change of decision-making authority (external)	Ministerial decisions changes Mayor changes
Change in organisations	Organizational culture changes Social changes Level of competition Decision-maker alterations (internal), institutional influences	Internal changes in management Roles of parties
Changes of requirements	Safety requirements Environmental requirements Governmental requirements	Safety system Mobility, performance, quality levels (noise and air)
Climate changes	Global warming	Sea level
Technological changes	Use of new materials Automated systems	New type of products Robotics in construction Car technology Smart highways Traffic information system
Technical changes	Physical conditions	Geological survey, tunnel installations

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.

Reflection 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.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

- Barton, T.D., 2015. Flexibility in contracting: introduction. In: S.H. Nystén Haarala, T.D. Barton and K. Jaakko, eds. *Flexibility in contracting. A special issue of Lapland Law Review*, (2). Finland: University of Lapland, University Rovaniemi.
- Bock, T. and Linner, T., 2015. *Robot-oriented design*. Cambridge: Cambridge University Press.
- Bourne, L., 2005. *Project relationship management and the stakeholder circle™*. Melbourne: RMIT University.
- Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative research in psychology*, 3 (2), 77–101.
- Bryman, A., 2012. *Social research methods*. 4th ed. Oxford: Oxford University Press.
- Cantarelli, C.C., 2011. *Cost overruns in large-scale transport infrastructure projects: a theoretical and empirical exploration for the Netherlands and worldwide*. Delft: Technical University of Delft.

- Cantarelli, C.C., et al., 2012. Characteristics of cost overruns for Dutch transport infrastructure projects and the importance of the decision to build and project phases. *Transport policy*, 22, 49–56.
- Court of Audit, Algemene Rekenkamer, 2013. Contractmanagement bij DBFMO-projecten. Tweede Kamer, vergaderjaar 2012–2013, nr. 33 639, nrs 1–2.
- Cruz, C.O. and Marques, R.C., 2013. Flexible contracts to cope with uncertainty in public–private partnerships. *International journal of project management*, 31 (3), 473–483.
- De Neufville, R. and Scholtes, S., 2011. *Flexibility in engineering design*. Cambridge: MIT Press.
- De Weck, O., Eckert, C., and Clarkson, J., 2007. A classification of uncertainty for early product design and system design. In: *International conference on engineering design*, 28–31 August 2007. Paris, France: Cite Des Sciences Et De L'Industrie.
- Domingues, S., Zlatkovic, D. and Rouboutsos, A., 2014. Contractual Flexibility in Transport Infrastructure PPP. In: *European transport conference 29 September 2014*. Frankfurt, Germany.
- Flyvbjerg, B., 2011. Case study. In: Norman K. Denzin and Yvonna S. Lincoln, eds. *The sage handbook of qualitative research*. 4th ed. Thousand Oaks, CA: Sage, Chapter 17, 301–316.
- Flyvbjerg, B., Bruzelius, N., and Rothengatter, W., 2003. *Megaprojects and risk*. Cambridge: Cambridge University Press.
- Hagan, G., Bower, D., and Smith, N., 2012. Delivery of complex construction multi projects in contractor-led procurement. In: *Twenty-eight Annual Conference ARCOM 3–5 September 2012*. Edinburg, UK.
- Henckel, T. and McKibbin, W., 2010. *The economics of infrastructure in a globalized world: issues, lessons and future challenges*. Washington, DC: The Brookings Institution.
- Hertogh, M. and Westerveld, E., 2010. *Playing with complexity. Management and organisation of large infrastructure projects: public Administration*. Rotterdam: Erasmus University.
- Highways Agency, 2011. *M25 design, build, finance and operate contract*. House of Commons United Kingdom.
- Hoezen, M.E.L., 2012. *The competitive dialogue procedure: negotiations and commitment in inter-organisational construction projects*. Enschede: University of Twente.
- Hsieh, T.Y., Lu, S.T., and Wu, C.H., 2004. Statistical analysis of causes for change orders in metropolitan public works. *International journal of project management*, 22 (8), 679–686.
- Hwang, B.G. and Low, L.K., 2012. Construction project change management in Singapore: status, importance and impact. *International journal of project management*, 30 (7), 817–826.
- Iossa, E., Spagnolo, G., and Vellez, M., 2013. *The Risks and Tricks in Public-Private Partnerships (No. 64)*. Milano, Italy: IEFÉ, Center for Research on Energy and Environmental Economics and Policy, Università Bocconi.
- Kodwo, A.A. and Allotey, S., 2014. Cost overruns in building construction projects: a case study of a government of Ghana project in Accra. *International knowledge sharing platform*, 4 (24), 54–64.
- Komonen, K., et al., 2005. *Käyttöomaisuuden hallinta [Asset management]*. Espoo: VTT Tutkimusraportti.
- Koppinen, T. and Lahdenperä, P., 2004. *The current and future performance of road project delivery methods (No. 549)*. Espoo: Technical Research Centre of Finland.
- Koppinen, T. and Rosqvist, T., 2010. Dynamic project portfolio selection in infrastructure sector. In: J.E.A. Echendu, K. Brown, R. Willett and J. Mathew, eds. *Definitions, concepts and scope of engineering asset management (1)*. London: Springer, 311–326.
- Kwak, Y.H., Chih, Y., and Ibbs, C.W., 2009. Towards a comprehensive understanding of public private partnerships for infrastructure development. *California management review*, 51 (2), 51–78.
- Lenferink, S., Tillema, T., and Arts, J., 2013. Towards sustainable infrastructure development through integrated contracts: experiences with inclusiveness in Dutch infrastructure projects. *International journal of project management*, 31 (4), 615–627.
- Love, P.E.D., et al., 2001. Using systems dynamics to better understand change and rework in construction project management systems. *International journal of project management*, 20 (6), 425–436.
- Moura, H.M.P. and Teixeira, J.M.C., 2010. *Managing stakeholder's conflicts, Construction stakeholder management*. Ames, Iowa: Wiley Blackwell.
- National Audit Office, 2008. *Making Changes in Operational PFI Contracts*. UK: Report by the Comptroller and Auditor General.
- Nystén-Haarala, S., Lee, N., and Lehto, J., 2010. Flexibility in contract terms and contracting processes. *International journal of managing projects in business*, 3 (3), 462–478.
- Price, A.D. and Chahal, K., 2006. A strategic framework for change management. *Construction management and economics*, 24 (3), 237–251.
- Rahman, S.A., Walker, W.E., and Marchau, V.A.W.J., 2008. *Coping with uncertainties about climate change in infrastructure planning: an adaptive policymaking approach*. Delft, The Netherlands: Ecorys and Delft University of Technology.
- Rijkswaterstaat, 2014. *Design, Build, Finance and Maintenance Contract, Version 4.1*. The Netherlands: Rijkswaterstaat.
- Rotterdam Vooruit, 2009. *Masterplan Rotterdam Vooruit*. The Netherlands: Ministerie van Verkeer en Waterstaat.
- Saleh, J.H., Mark, G., and Jordan, N.C., 2009. Flexibility: a multi-disciplinary literature review and a research agenda for designing flexible engineering systems. *Journal of engineering design*, 20 (3), 307–323.
- Shaoul, J., Stafford, A., and Stapleton, P., 2006. Highway robbery? A financial analysis of design, build, finance and operate (DBFO) in UK roads. *Transport Reviews*, 26 (3), 257–274.
- Stahl, C.H. and Cimorelli, A.J., 2005. How much uncertainty is too much and how do we know? A case example of the assessment of ozone monitor network options. *Risk analysis*, 25 (5), 1109–1120.
- Sun, M. and Meng, X., 2009. Taxonomy for change causes and effects in construction projects. *International journal of project management*, 27 (6), 560–572.
- Taleb, N.N., 2010. *The black swan: the impact of the highly improbable fragility*. New York, NY: Random House.
- Treasury, H.M., 2012. *A new approach to public private partnerships*. London: The Stationery Office.
- Van Gils, M.K.A., Gerrits, L.M., and Teisman, G.R., 2009. *Non-linear dynamics in port systems: change events at work. Managing complex governance systems: dynamics, self organization and coevolution in public investments*. New York, NY: Routledge, 76–96.
- van Marrewijk, A., et al., 2008. Managing public–private megaprojects: paradoxes, complexity, and project design. *International journal of project management*, 26 (6), 591–600.
- Verweij, S., van Meerkerk, I., and Korthagen, I.A., 2015. Reasons for contract changes in implementing Dutch transportation infrastructure projects: an empirical exploration. *Transport policy*, 37, 195–202.

Ward, S. and Chapman, C., 2008. Stakeholders and uncertainty management in projects. *Construction management and economics*, 26 (6), 563–577.

Wu, C.H., Hsieh, T.Y., and Cheng, W.L., 2004. Grey relation analysis of causes for change orders in highway construction. *Construction management and economics*, 22 (5), 509–520.

Wu, C.H., Hsieh, T.Y., and Cheng, W.L., 2005. Statistical analysis of causes for design change in highway construction on Taiwan. *International journal of project management*, 23 (7), 554–563.