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When performance shortfall arises, contract or trust?

A multi-method study of the impact of contractual and relational governances on performance in Public – Private Partnerships

PROEFSCHRIFT

ter verkrijging van de graad van doctor

aan Tilburg University

op gezag van de rector magnificus,

prof. dr. K. Sijtsma,

in het openbaar te verdedigen ten overstaan van een

doors het college voor promoties aangewezen

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“The best way to find out if you can trust somebody is to trust them.”

-- Ernest Hemingway
Chapter 1 Introduction

This research investigates how two different governances (contractual and relational) and performance affect each other in a public – private partnership (PPP). The aim is to contribute to the governance literature by providing an integrated view of the dynamic process, not only of how these two governances affect project performance, but also how project performance affects the use of the two mechanisms in a PPP.

This chapter will also demonstrate why this research topic was chosen and how the research question has been formulated. The research context, which is the Dutch infrastructure sector, an important part of the Dutch economy, is introduced in Section 1.1. The aging infrastructure needs to be renovated and maintained on a frequent basis in order to function properly. Moreover, there is demand for innovation so that facilities and installations operate in a cost-effective way and also fulfil environmental and safety regulations. Due to their own limited capacity for internal innovation, public organizations (in most cases, owners of the infrastructure) began to form PPPs and to outsource renovation and maintenance projects to private companies in order to access external innovation capabilities. Furthermore, performance-based contracts are being used increasingly in this context (Hooper, 2008; Hypko, Tilebein, & Gleich, 2010; Selviaridis & Wynstra, 2015; Wu, Braaksma, & Dongen, 2019). The combination of innovation and performance-based contracts has significantly contributed to the complexity of the projects, often resulting in disappointing outcomes. Section 1.2 points out that worldwide, many infrastructure projects being delivered by PPPs have failed to achieve their initial performance targets. This is true also in the specific context of this research, Dutch water authorities responsible for water management and wastewater treatment in the Netherlands. After describing engagement with managers from Dutch water authorities, the dissertation will focus on the following research topic: “how does a PPP deliver success or result in failure in infrastructure innovation projects outsourced by Dutch water authorities?” In Section 1.3, two governance mechanisms
are discussed since each plays an important role in determining the performance dynamics of the projects. Many discussions (e.g. van der Valk, Sumo, Dul, & Schroeder, 2016) have focused on what the correct governance might be for innovation projects. However, there has been limited research investigating how the choice of governance mechanisms influences the performance dynamics, in particular when there is a performance shortfall. This research aims to fill this gap by addressing the following research question: “how do two governance strategies for dealing with performance shortfall and performance affect each other over time in an outsourced infrastructure innovation project that is a PPP?” In Section 1.4, the structure of the dissertation is outlined.

1.1 Research context

1.1.1 The infrastructure sector

1.1.1.1 Importance of the infrastructure sector

The infrastructure sector consisting of such vital elements as water supply, electricity supply, gas supply, sanitation, telecommunication, railway and road transport, is of critical importance for our civilized society. This infrastructure is the backbone of reliable, affordable and qualified services that ensure a livable, accessible and safe society. As Finger et al. (2005) point out, an infrastructure consists of complex technical, economic, and political systems provides essential services to the whole of society.

1.1.1.2 Characteristics of infrastructure systems

Infrastructure is characterized by five key features (Markard, 2009). First of all, infrastructure is often classified as capital intensive. High capital costs are typically related to physical assets such as transmission networks, pipelines, power plants, treatment plants and etc. A second key characteristic of infrastructure is the high durability of its physical assets. In electricity supply, for example, nuclear power plants have a useful life of around 30 years, while hydropower stations can often be operated
for almost 80 years without major re-investment. Power lines last for about 40-60 years and sewers can reach a useful life of 80 years before they have to be replaced. The third feature is the dominance of public organizations in the infrastructure sector. These organizations may be corporations with public shareholders, but also organizations that are directly controlled by public organizations. The fourth feature relates to the high degree of regulation, that for example includes price regulation, service quality norms, rules for network access and environmental regulations. Finally, the fifth feature of infrastructure is the high degree of “systemness”, implying that there are strong complementarities among system components, which in turn means that overall system performance is highly dependent on how well the various components are coordinated (Künneke, 1999). This strong interdependency is especially present in infrastructure like electricity supply, railway transport and telecommunication. In other network sectors, such as road transportation, these interdependencies are less prominent.

1.1.1.3 The Dutch infrastructure sector

In the Netherlands, the infrastructure sector also plays an important role in economic and social activities. It has a value of approximately 4.5 billion Euros per year (Department of Infrastructure and Water Management, 2017) and is dominated by public organizations. For example, the Dutch Ministry of Infrastructure and the Environment is responsible for the national highway and waterway network. The Department of Public Works and Water Management (in Dutch: Rijkswaterstaat), is the executive agency of the Ministry of Infrastructure and Water Management, responsible for the development and maintenance of the national road infrastructure network. The railways infrastructure in the Netherlands is managed by ProRail, a 100% state-owned organization (Wu et al., 2019). Together they manage 139,294 km of road and 3055 km of rail road (Central Bureau of Statistics, 2017). Water authorities form another vital type of public organization in the Netherlands: in total there are 21. They are responsible for water safety, water quantity and water quality, including groundwater
and waste-water purification. They manage more than 3,400 pumping stations, 230,000 km of drainage ditches and around 350 sewage treatment plants. They also manage around 3,450 km of primary flood defense structures and 14,000 km of secondary flood defense structures (Havekes et al., 2017). All these examples of infrastructure are important in safeguarding a livable, accessible and safe Netherlands.

1.1.1.4 Demand for cost efficiency and innovation

In the past, many types of infrastructure were not maintained or renewed adequately, which led to increasing failures and an accumulation of investment needs (Gil & Beckman, 2009). While public organizations are under pressure to achieve cost efficiency, the infrastructure sector is highly regulated. Public organizations have to manage assets governed by many rules and regulations, with increasing attention being paid to environmental issues. For example, in the case of electricity or gas supply, depletion of fossil fuel resources, air pollution or nuclear waste are examples of negative effects associated with energy consumption. In the case of waste-water treatment, reduction of phosphate and nitrate burdens on surface waters is one of the key objectives of water authorities. Innovation is needed to deal with these environmental issues. In conclusion, the challenge for many public organizations is to build and operate infrastructure more cost efficiently while at the same time becoming more innovative.

1.1.2 Public – private partnerships (PPPs)

In recent decades, many governments worldwide have sought to apply public private partnerships (PPPs) to address the challenge of combining cost efficiency and innovation. There are three key elements of a PPP contract in the infrastructure sector (Van Den Hurk & Verhoest, 2016): a long term contract between a public organization and a private sector company, the transfer of certain project risks to the private sector (notably with regard to designing, building, operating, maintaining, and/or financing
the project), and a payment structure which is influenced to some degree by service volumes and/or service quality.

1.1.2.1 Benefits of PPPs
According to Verweij (2015), a PPP has many benefits in infrastructure development: long-term benefits, such as “value-for-money” (Grimsey & Lewis, 2004; Kwak, Chih, & Ibbs, 2009), and short-term benefits, including a reduction in cost and time taken to deliver infrastructure services, higher quality service delivery, lower administrative costs, and the transfer of risks to the private sector (Flyvbjerg, Skamris, & Buhl, 2003; Hodge & Greve, 2007; Kwak et al., 2009). To elaborate more, there are three main advantages of PPPs (Klijn, Koppenjan, & De Boer, 2014). First, a PPP helps to secure the same outcomes for lower costs through cooperation (efficiency). Second, it brings greater outcomes for the same cost (added value). Public and private actors can add value to each other’s performance because their efforts enhance the value of the product or service that is being delivered. Third, it results in innovative solutions, or solutions that have not been achieved before, by harnessing each other’s knowledge and expertise (Borys and Jemison, 1989; Hodge and Greve, 2005).

1.1.2.2 PPPs in the Netherlands
In the Netherlands, PPP has been one of the approaches deployed by the Dutch government for public procurement of large infrastructure and housing projects for over a decade. For these PPP projects, Design, Build, Operate and Maintain (DBOM) contracts are often used. These contracts differ from traditional public procurement in the following respects: their focus on the specification of project outputs rather than on detailed project designs, a greater risk transferred to the private sector, long-term contracts, and the integration of different functions into one single contract (Grimsey and Lewis, 2004; Hodge et al., 2010). DBOM contracts provide governments with a steering mechanism to ensure that the private parties perform well by linking performance to payment. Payment depends on performance, pre-defined in the
contracts, with non-performance or underperformance resulting in no payment or the application of penalties. This performance-related payment is also one of most important characteristics of Performance Based Contracts (PBCs) (Selviaridis & Wynstra, 2015), which focus on specification and evaluation of outputs/outcomes rather than required inputs, activities or processes (Martin, 2007). During the contracting process, performance is determined by a monitoring system designed by the private party. In 2016, 37 national infrastructure projects were realized using DBOM contracts in the Netherlands, with a total value of 13 billion euros (Koppenjan & de Jong, 2017). The government has implemented PPP contracts on the presupposition that it would, on one hand, be able access more innovative solutions and, on the other, to complete large infrastructure projects faster and more efficiently (Van Valkenburg & Nagelkerke, 2017).

1.2 Research problem: performance shortfalls

Though PPPs are expected to bring many benefits, time and cost overruns in the construction of infrastructure projects (Flyvbjerg, Holm, & Buhl, 2002) illustrate government’s difficulties in dealing with the increasing project complexity (Lenferink, Tillema, & Arts, 2013). Among the most spectacular examples of cost underestimates is the Sydney Opera House. Construction of this landmark building started in 1959, originally scheduled to be completed in four years, with a budget of AUS $7 million. It ended up taking 14 years to be completed, with the total cost adding up to AUS $102 million, so approximately 15 times higher than the initial budget. Moreover, Vecchi et al. (2017) provide evidence that many PPP transactions and projects experience performance shortfalls (i.e. actual project performance being lower than contractually required performance). Private parties have failed to bring the expected performance, and the authorities involved often found they were required to renegotiate contracts, bail out concessionaires, or even buy back the infrastructure in question.
Such undesirable PPP experiences have also been found in the Netherlands. Koppenjan and de Jong (2017) signal that many DBOM projects have transformed into so-called “fight projects”. For instance, in the project to construct the second Coen Tunnel, conflicts emerged between government and private partners due to the different interpretation of the contracts in relation to the allocation of unforeseen costs (Reynaers, 2014). Moreover, during the realization of the complex A15 project, cost overruns almost resulted in the bankruptcy of Ballast Nedam, the contractor. Another problem in the A15 project was the disagreement among partners concerning the quality of the solution selected. A consortium was responsible for stakeholders’ involvement in this case. As the consortium had milestones for realizing performance targets, it had incentives to economize and to select cheaper solutions, and this was not in line with the preferences of stakeholders (Verweij, 2015). Although many DBOM infrastructure projects became problematic projects, others, such as the A12 Lunetten-Veenendaal, were widely seen as clear successes (Koppenjan and de Jong, 2017). Hence, the question is: given the inherent complexity of DBOM projects, how does a PPP deliver success or result in failure in an outsourced infrastructure project? I have investigated this phenomenon within Dutch water authorities, the research context of this study (see Section 1.1). I carried out nine interviews with middle management, who pointed out that they also had problems with performance shortfalls. Together with middle management from Dutch water authorities, I decided to focus this research on investigating the root causes of the success or failure of selected projects that were being carried by participating water authorities. Some of the managers involved in the research have conducted or witnessed successful DBOM projects with Performance-based contracts (PBCs) in PPPs. They were curious to learn, also from each other, which factors have contributed to success, and more importantly how they did so. On the other hand, some water authority managers have experienced unsatisfactory performance in outsourcing projects. They were eager to discover how these factors had resulted in unfavourable results.
1.3 Research question

Koppenjan and de Jong (2017) show that infrastructure projects under a PPP with DBOM contracts and PBCs can be governed by two different practices. One emphasizes the “hard” side of contracting, such as formal procedures, standardized tools, meeting performance targets, and strict contract management. While the other focuses on the “soft” side of contracting, such as dialogue, good relationships, flexibility and adaptive management. Existing literature (e.g. Cao and Lumineau, 2015) labels these hard and soft sides of contracting as contractual and relational governance. In addition, these two governance mechanisms have joint impact on project performance. Some scholars assert that the joint use of the two governance mechanisms is negatively co-related to performance (Antia & Frazier, 2001; Cao & Lumineau, 2015; Ghoshal & Moran, 1996; Lee & Cavusgil, 2006; L. Wang, Yeung, & Zhang, 2011). On the contrary, other scholars have argued the joint use of the two governance mechanisms increases performance (Poppo and Zenger, 2002; Yang et al., 2012; Nooteboom, 1999; Weick, 2001). In addition to these conflicting views on the impacts of governances on performance, many scholars (Faems, Janssens, Madhok, & Van Looy, 2008; Roehrich & Lewis, 2014; Zheng, Roehrich, & Lewis, 2008) have called upon researchers to apply process models in their research to better understand the dynamic interplay of contractual and relational governance and their impact on performance over time, as most quantitative studies on the interplay between the two governances modes are based on cross-sectional survey data rather than longitudinal data (see Malhotra & Lumineau, 2011 and Palmatier et al., 2007 for exceptions). In a dynamic or process perspective, performance has impact on the use of these two modes of governance. As a result, there might be a feedback loop between the two governances and performance. And this dynamic feedback loop gives us a more holistic view on the relationship between governances and performance. To the best of my knowledge, there has been very little research into this dynamic process. To fill this gap, this research
aims to investigate how different governance mechanisms (i.e. contractual and relational governance mechanisms) and performance affect each other over time in a public–private partnership (PPP).

As the study unfolded, I discovered that in all cases the two parties in a PPP encountered a performance shortfall. When it occurs, the business relationship is slightly changed, it deteriorates and its outcome is uncertain (Vidal, Fenneteau, & Paché, 2016). It can give rise to dissolution or cause reactions that lead to the restoration of relationships. The two parties’ different strategies for dealing with a performance shortfall are highly relevant in determining project performance and the relationship between partners over time, and in turn project performance and relationship also affect how different strategies are used. Thus, I extended the literature review into the domain of conflict management, subject to the theoretical framework of governance mechanisms. I discovered that many existing endeavors have been devoted to studying conflict development and escalation (Bijlsma-Frankema, Sitkin, & Weibel, 2015; Coleman, Vallacher, Nowak, & Bui-Wrzosinska, 2007; Perlow & Repenning, 2009), however, seldom has the theoretical lens of governance mechanisms been applied to the domain of conflict research (Lumineau and Henderson, 2012 and Malhotra and Lumineau, 2011 are two exceptions). To fill this gap, I further refined the research question as “how do two governance strategies for dealing with performance shortfall and performance affect each other over time in an outsourced infrastructure innovation project that is a PPP?”

1.4 Structure of the dissertation

The structure of the dissertation is visualized in Figure 1.1. Chapter 1 introduces the research context, the research strategy and the research question of this scholarship journey. Chapter 2 explains the methodology, which in this case is a process research design. Next, Chapter 3 reviews relevant theories, namely governance mechanisms and
conflict resolving strategies, which relate to the research problem. After that the research question is refined, the subsequent four chapters (Chapter 4-7), present narratives of the four cases, namely those of Riverboard – Mouse, Brookboard – Elephant, Creekboard – Giraffe and Lakeboard – Panda, and reflect on narratives from static and dynamic perspectives. Chapter 8 shows the findings from cross-case analysis under a static perspective, while Chapter 9 demonstrates findings under a dynamic perspective. Subsequently, Chapter 10 uses a system dynamic simulation model to explain and support the theoretical propositions. Finally, Chapter 11 concludes the dissertation with the main findings, theoretical contributions, managerial applications, limitations and directions of future research.

Figure 1.1 Structure of the dissertation
Chapter 2 Research Methodology

This chapter presents Engaged Scholarship (ES) as the main research strategy. Section 2.1 introduces the motivation for using ES as the research strategy and explains what ES is. Section 2.2 describes the research process, which gives more detailed information on how the engaged scholarship strategy was applied to this research. Section 2.3 discusses the problem formulation, which explains the context of this research (i.e. Dutch water sector) and the challenges that public organizations (i.e. Dutch water authorities) face while engaging in PPPs. Section 2.4 presents a multi-method research design including a multiple-case study and a simulation. Section 2.5 discusses the research credibility consisting of the validity and reliability of this research.

2.1 Research strategy: Engaged Scholarship

2.1.1 Motivation

This research arose out of the project PURGATIO (Prestatiecontract- Uitvoerbaarheid voor ReiniGing Afvalwater Techniek In Outsourcingscontext), which involved multiple stakeholders, namely Tilburg University, World Class Maintenance, and four Dutch water authorities. The objective was to gain more understanding of how to successfully apply Performance-Based Contracts (PBCs) in outsourced renovation projects involving waste-water treatment plants in PPPs (see Section 2.3.1). For many reasons, this was a complex research setting, for example the involvement of multiple stakeholders, complex contracts, innovative processes, and long-term relationships. The intended research outcome from industrial side was to provide them with relevant practical knowledge for addressing real-world problems. The purpose was also to advance theoretical knowledge in the discipline in a rigorous way.

To achieve this dual goal of rigor and relevance in such a complex research setting, this research adopts ES because of its fit with the research context. ES is defined by Van de
Ven (2007) as a participative form of research for obtaining the advice and perspectives of key stakeholders (e.g. researchers and practitioners) with a view to understanding complex problems or phenomena. As Shepherd & Suddaby (2017) point out, ES is likely to be most useful when associated projects involve complex real-world problems, a collaborative learning environment, an extended duration and multiple frames of reference. The problem-driven research, like this research, requires researchers to be engaged with the practitioners performing their activities, to be open to new experiences, and to be self-reflective on their engaged scholarship role (Van de Ven & Johnson, 2006). By doing this, researchers get a step closer to the challenge of bridging the gap between practice and theory (Hodgkinson, Herriot, & Anderson, 2001). This gap is further discussed in Section 2.1.2. Collaborating with practitioners throughout the process, researchers are able to formulate problems grounded in the experiences of those engaged a real-world problem, whose solution can contribute to both academic and practitioner knowledge (Van de Ven, 2007).

2.1.2 Gap between practice and theory

Academics are often criticized for not adequately putting their research into practice, whereas professional knowledge workers are criticized for not being aware of relevant research and not doing enough to turn their practice into theory (Van de Ven & Johnson, 2006). Van de Ven (2007) argues that essentially there are two problems underpinning the so-called gap between theory and practice, namely a knowledge production problem and a knowledge transfer problem. The problem of knowledge transfer is one of translating and diffusing research knowledge into practice. In other words, scientific knowledge and practical knowledge are viewed as distinct kinds of knowing. As Aram and Salipante (2003) state, knowledge of practice in a professional domain is typically customized, connected to experience, and directed to the structure and dynamics of the particular situation. Conversely, science is committed to building generalizations and
theories that often take the form of formal logical principles or rules involving causal relationships. In this line of reasoning, it is assumed that the relationship between knowledge of theory and practice entails a literal transfer or translation of one into the other.

### 2.1.3 Bridging the gap

Van de Ven (2007) takes a pluralist view of science and practice as representing distinct kinds of knowledge that are not opposites nor alternatives, but rather provide complementary insights for understanding reality. Van de Ven (2007) suggests that each form of knowledge is partial. The strengths of one form of knowledge tend to be the weaknesses of the other. Different perspectives and kinds of knowledge are incomplete and involve bias with respect to any complex problem. For that reason, a pluralist approach to knowledge co-production is needed. Van de Ven (2007) also argues that many social researches tend to reflect an unengaged process of inquiry, meaning that researchers study a research question by themselves, without interacting with other stakeholders who could actually help to shed insightful light on the problem domain under investigation.

To produce knowledge that can get over the dual hurdles of relevance and rigor, a deeper form of research that engages both academics and practitioners is needed (Hodgkinson et al., 2001). In other words, a mode of inquiry is needed that converts the information obtained by scholars in interaction with practitioners (and other stakeholders) into actions relevant for a given professional domain Van de Ven (2007).

### 2.1.4 Engaged scholarship

The engaged scholarship strategy is proposed by Van de Ven (2007) for studying complex social problems that exceed our limited individual capacity when we study on our own, and for creating the kind of knowledge that advances both theory and practice.
This strategy emphasizes that the advice and perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) are required for the study of a complex social phenomenon, because the research problem can only be studied thoroughly by exploiting the pooled knowledge of scholars and other stakeholders. Engaged scholarship has the explicit intention of knowledge ‘co-production’ (Gibbons et al., 1994), as the knowledge produced in the study is more penetrating and insightful than that gained by either scholars or practitioners working alone on the problem (Van de Ven, 2007). Scholarship means not only engaging in original research but also looking for connections, building bridges between theory and practice, and communicating one’s knowledge effectively (Boyer, 1990: 16). Engagement implies that, while performing each step of the research process, scholars step outside of themselves to obtain and be informed by the interpretations of others: problem formulation, theory building, research design, and problem solving (Figure 2.1).

In the problem formulation stage, researchers need to investigate the research problem by determining who, what, where, when, why and how the problem exists, both up close and from afar. Answering these questions requires meeting and talking with people who...
experience and understand the problem, as well as reviewing the literature on the prevalence and boundary conditions of the problem.

In the *theory building stage*, researchers need to create, elaborate and justify a theory by abductive, deductive and inductive reasoning. Developing this theory and its plausible alternatives requires conversations with knowledge experts from the relevant disciplines and functions that have addressed the problem, as well as a review of relevant literature.

Moreover, researchers need to develop a variance or process model for empirically examining the alternative theories in the *research design*. Doing this well typically requires getting advice from technical experts in research methodology and the people who can provide access to data, and of course, the respondents or informants of information.

In the *problem-solving stage*, researchers need to communicate, interpret and apply the empirical findings to find out which alternative model fits best in terms of answering the research question(s). It starts with written reports and presentations for knowledge transfer, proceeds with conversations to interpret different meanings of the report, and then involves pragmatic and political negotiations to reconcile conflicting interests.

The ES research process is an iterative process. Researchers can start from any step in the model. In this research, the problem formulation formed the starting point, since addressing real world problems experienced by water authorities was the initial motivation for this research. Section 2.2 discusses in detail how the ES research strategy has been applied in this research.
2.2 Research process

Problem formulation began in September 2013. Initial meetings were arranged in each of the public organizations (i.e. Dutch water authorities) between researchers from the university and managers from public organizations. I also joined many guided site tours to learn the business context of these public organizations. During the first year of research, several problem formulation sessions were conducted, followed up by group meetings, in order to identify a research problem that combines both parties’ interests.

A literature review was carried out in parallel with problem formulation. This helped to identify theories relevant to the research problem and was useful in refining the research question. The literature review was mostly done between 2013 and 2015, and theory development between 2016 and 2018.

After this, data was collected and analyzed from December 2013 until December 2018. Empirical data were collected via interviews, field observation, and archive documents. The data was continuously analyzed while new data was collected, and this helped refine research questions and the direction of theory building, which in turn helped decision making regarding new data collection.

Finally, in the problem solving step, data verification and reflection was conducted through seminars, conferences and quarterly meetings with managers from public organizations. After that, a conclusion was reached, reflected upon and communicated to managers through group meetings in the final years of the research, 2017 and 2018. Knowledge gained from this research was disseminated through the platforms that were suggested by the managers. During group meetings, the results were presented to managers who were challenged to reflect and give their opinions on how the results should be interpreted in the specific domain of the public organizations. The rest of this chapter further explains the problem formulation and the research design.
review that helped to develop and refine the research question is discussed in Chapter 3, the theory development is discussed in Chapter 10, and knowledge gained from this research is discussed in Chapter 11.

2.3 Problem formulation

This section introduces the Dutch water authorities (DWAs) and the challenges that they face while engaging in public private relationships. It concludes with the research problem which was discovered after the engagement with managers from DWAs.

2.3.1 Dutch water authorities

The water authorities are the oldest form of democratic government in the Netherlands. Their very first existence traces back to the 13th century and they have been vested in the Dutch constitution since 1848. They have three fundamental attributes:

- Their top management is chosen via public election every four years.
- They are empowered to levy their own taxes, meaning that they represent a separate public governance level, alongside the Dutch national government, province, and municipality administrations (Van den Oever, 2017). For example, the total expenditure of the water authorities was 2.9 billion euros in 2016, while a household that owned its own home had to pay an average of 805 euros in rates and taxes (Havekes et al., 2017).
- Though they are public organizations, they are not considered to be general government authorities, but rather as functional bodies whose remit is limited to public water management. Their governance is quite similar to that of business firms. Each has a board of directors of around 25 individuals who meet approximately every two months. Of these directors, five typically also make
up the top management team which meets approximately every two weeks (Van den Oever, 2017).

2.3.1.1 Responsibilities and the importance of Dutch water authorities

The water authorities are responsible for water management on a regional and local level. The term ‘water management’ can be described as the part of public welfare that relates to flood protection, water management (surface water and groundwater in terms of both quantity and quality, including waste-water management) and the waterways. It also focuses on the habitability and usability of the soil and on the protection and improvement of the living environment (Havekes et al., 2017). There are 21 water authorities in the Netherlands by 2017. The infrastructure, such as flood defenses, pumping stations, flood barriers, canals and ditches (see Figure 2.2 for facts and figures) that they build and manage are vital in safeguarding a liveable, accessible and safe Netherlands. Given the special geographic situation in the Netherlands, without proper and continual maintenance of this infrastructure the safety of ten million Dutch citizens would be in immediate danger, as more than fifty percent of the Netherlands would be under water if the water management was not up to standard (Havekes et al., 2017).

<table>
<thead>
<tr>
<th>Number of water authorities</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of employees</td>
<td>11,250</td>
</tr>
<tr>
<td>Length of primary flood defenses being managed</td>
<td>3,600 kilometers</td>
</tr>
<tr>
<td>Length of other flood defenses</td>
<td>14,100 kilometers</td>
</tr>
<tr>
<td>Length of managed watercourses</td>
<td>230,000 kilometers</td>
</tr>
<tr>
<td>Number of pumping stations</td>
<td>3,550</td>
</tr>
<tr>
<td>Length of managed roads</td>
<td>7,500 kilometers</td>
</tr>
<tr>
<td>Number of wastewater treatment plants</td>
<td>335</td>
</tr>
<tr>
<td>Volume of wastewater treated</td>
<td>2 billion m$^3$</td>
</tr>
</tbody>
</table>

*Figure 2.2 Key facts and figures about Dutch water authorities in 2017*
2.3.1.2 Waste-water treatment
This research focuses on the Dutch water authorities’ responsibilities for waste-water treatment. A major part of their task is the construction, operation and maintenance of waste-water treatment plants where households and industrial wastewater is purified. Each year DWAs invest approximately 300 million euros in total in the field of waste-water management (Groot, Afrian, Suiskind, & Vrolijk, 2013). The waste-water treatment is a complex process involving two main processes, namely water purification and sludge treatment. The water purification process consists of screening, pre-sedimentation, aeration and final sedimentation. After the water purification process the water is free from harmful substances and chemicals and is therefore allowed to be released to rivers or the sea. The sludge (the residue of the water purification process) is handled in the sludge treatment process, which is composed of pre-dewatering, digestion and final dewatering. The byproduct of sludge treatment is biogas, which is used to produce electricity and heat. The final product of dewatered sludge (disposal sludge) is transported to the incineration plant for final treatment (see more details in Appendix 1).

2.3.1.3 PPPs in Dutch water sector
DWAs have outsourced their infrastructural renovation project to external contractors using PBCs that focus on specifying outcomes (what to achieve) rather than processes (how to achieve) (Selviaridis & Wynstra, 2015). The waste-water treatment process requires advanced technological equipment that needs to be built and maintained (this includes both ongoing maintenance and overhauls). While the DWAs used to outsource only the actual construction of plants (in other words: design, engineering, maintenance and operations were kept in-house), nowadays the PPPs between public sector authorities (Dutch water authorities) and private suppliers (i.e., construction and engineering companies) are established to develop and implement technologically advanced solutions for treating waste-water. The outsourced projects normally involve
the design, build, operate and maintain (DBOM) of the installations that meet pre-set functional specifications.

2.3.2 Challenges

The abovementioned capital-intensive infrastructural installation characteristically has a long-life cycle, and this creates challenges for the DWAs in terms of coming up with appropriate PBCs for outsourcing, in particular for projects that include design, building, operation and maintenance. The contracts typically have a time horizon of 5-15 years (see more characteristics in Appendix 2), while the life cycles of installations encompass several decades. The challenge, then, is to build into the contract incentives that will lead contractors to perform well, not only in the short term but also in the long run. An intensively used installation is very unlikely to stand still without good maintenance. In that case, DWAs have to pay a huge bill due to extra cost.

Moreover, one of the purposes of outsourcing renovation projects for waste-water treatment plant is to get access to the external technological capability in the market. Using PBCs that specify only what to achieve not how to achieve it gives more freedom to contractors in deciding and controlling the process of achieving target performance. This is likely to promote greater innovation. However, innovative solutions implies high complexity, which certainly brings risks, one of which is the problem of unknown performance. On the one hand, DWAs do not know for certain what performance they can expect at the end of the project. It is therefore difficult for them to specify appropriate performance requirements. On the other hand, the lack of knowledge on possible performance also brings challenges for the contractors. Due to the high competitiveness in the infrastructure construction market, contractors tend to submit tenders offering high performance, and these later turn out impossible for them to achieve under a scheduled time period.
In addition, due to the public function of DWAs, the outsourcing is also characterized by political aspects, such as European procurement rules and environmental rules. Given these challenges as a result of complexity in technology, contract and environment, DWAs are required to find a new way of managing contract and public–private relationships. However, experience to date with these performance-based contracts is still rather limited, causing unsatisfied outsourcing performance, either financially, technologically or relationally.

2.3.3 Research problems

In the problem formulation stage, I conducted nine interviews with managers from DWAs, aiming to identify a research problem that is interesting from both a practical and academic perspective. After the engagement, three main problems that middle management have encountered or witnessed emerged.

- The first one related to contract management, which was “how to properly manage contracts in general?” In particular, how to adapt to changing environments and cope with unexpected problems, given that the contracts with contractors have been signed.
- The second problem concerned relationship management, which was mainly about mutual understanding and trust between partners. The following questions were raised by managers: How to build mutual trust with a contractor during the whole contracting process? Why do people not understand each other and how can this be improved?
- The third problem concerned the understanding of the root causes of the success or the failure of a project. For managers who have conducted or witnessed successful projects with PBCs, they were curious about what has contributed to the success. While for other managers who have encountered unsatisfied
outcome of outsourcing projects, they were eager to discover what has caused the unfavorable results.

After two group feedback sessions with managers, all stakeholders (the author and managers from Dutch water authorities) realized that there was a link between the third problem and the first & second problems, since contract management and relationship management might serve individually or jointly as underlying mechanisms for the success or the failure of an outsourcing project in a PPP. We therefore decided to investigate the third problem, while taking the perspectives of contract and relational management. Thus, the research focuses on finding out the root causes of the success or the failure of an outsourced renovation project in Dutch water authorities.

2.4 Research design

This section first presents two basic approaches that are commonly applied in empirical studies, variance and process research design. Then it explains why the process research design was chosen and how it was designed, including data collection and data analysis.

2.4.1 Variance and process research design

The objective of conducting an empirical research study is to develop or test a theory that addresses a research problem or question. For this purpose, there are two commonly used models or research designs, namely variance model and process model (Van de Ven, 2007). They are applied to examine two different kinds of research questions: the first is “what are the antecedents or consequences of the issue?” This demands a variance model or outcome-driven explanation of the input factors or independent variables that statistically explain variations in some outcome criteria or dependent variables (Aldrich, 2001; Mohr, 1982). The other type of question is “how does the issue emerge, develop, grow or terminate over time?” and this requires a process model
or event-driven explanation of the temporal order and sequence in which a set of events occur based on a story or narrative (Bruner, 1991).

With regard to causality, “what” questions entail evidence of co-variation, temporal precedence, and absence of spurious associations between the independent and dependent variables (Blalock, 1972), while “how” questions require narratives that indicate an observed sequence of events with an underlying generative mechanism explaining the causes of real life events or contingencies (Bruner, 1991; Tsoukas, 1989). As a conclusion (Figure 2.3), in general terms, a variance theory explains change in terms of relationships among independent variables and dependent variables, whilst a process theory explains how a sequence of events leads to some outcome (Mohr, 1982).

To elaborate more on process theory, it explains development in terms of the order in which things occur and the stage in the process at which they occur. In narrative methods the plot in the story itself is the generative mechanism. Process models strive to build theory that depends on versatility, defined as “the degree to which it can encompass a broad domain of developmental patterns without modification of its essential character” (Poole et al., 2000: 43). A versatile process explanation can stretch or shrink to fit specific cases that may differ in their tempo and time span (Van de Ven, 2007).

![Figure 2.3 Variance theory versus process theory, adapted from Mohr (1982)](image-url)

23
2.4.2 Process research design

The process model is adopted in this research, because the goal is to investigate a “how” question (i.e. how do two governance mechanism and performance affect each other over time?). The process perspective focuses on actors, temporal orders and the sequence of critical events that explain how things change over time (Langley, 1999; Langley, Smallman, Tsoukas, & Van de Ven, 2013; Pettigrew, 1997; Van de Ven, 1992). Studying governance and performance as processes through the analysis of actors (i.e. public organizations and private companies) and critical events, could allow us to gain an enhanced understanding of how these two – governance and performance – interact with each other.

Following Chandrasekaran et al. (2016) and Gray, Esenduran, Rungtusanatham, & Skowronski (2017), I applied a multi-method research approach (i.e. a combination of a multiple case study and a system dynamics simulation method) to explore such a complex phenomenon as Public – Private Partnerships (see Figure 2.4 ).

This research design consist of four cases, with many observed events per case. Following Poole et al. (2000), a comparative analysis of qualitative case studies using the design of Yin (2014) is conducted. In the rest of this section, the multi-method study design is discussed in more detail, including multiple case design, case selection, data collection, data analysis and simulation method.

Case Analyses: Within and cross-case analyses showed contractual and relational strategies in managing performance shortfalls resulted in different project outcomes.

Theory Development: A cross-case comparison identifies a general mechanism of how contractual and relational strategies affect performance dynamics.

Method 1: Multiple Case Studies

Method 2: System Dynamics Simulation

Theory Refinement: Develop a contingency approach on the effectiveness of contractual strategies and relational strategies.

Simulation Analyses: A system dynamics model is able to replicate performance outcomes under different strategies in real cases and helps identify boundary conditions of strategies in dealing with performance shortfalls.

Theory Augmentation: Iterating between case analysis and the literature gives rise to relational strategies, rather than contractual strategies, in dealing with performance shortfall in complex projects.

Figure 2.4 A multi-method study design adapted from Chandrasekaran et al. (2016)

2.4.3 Multiple case study

The benefits of multiple case study are twofold (Yin, 2014). Firstly, it provides possibility of direct replication. The analytic conclusions independently derived from two or more cases are more powerful than those from a single case study. Secondly, it allows the selection of cases with contrasting situations, called theoretical replication. It helps strength findings compared to those from a single case study, if the findings support the hypothesized contrast. There are four Dutch water authorities involved in this research project. Each of them agreed to provide one case for study. As the research focuses on the context of long-term public – private partnerships, the first criterion was that the renovation projects should involve a long term contract. Furthermore, the replication logic was applied to select cases (see case characteristics in Appendix 2). As cases, two relatively small projects were selected and two relatively big projects. To achieve contrast, for the first two cases, one was in a relatively good situation while the
other was in a relatively bad situation. The same applies to the other two cases. The case from Riverboard (see Chapter 4) was a relatively successful case at the time we started this research, as the two parties were able to find the technical solution to the unexpected technical problems. While in the case of Creekboard (Chapter 6) the two parties were already engaged in contractual discussions, in the case of Brookboard, the two parties were fighting in court when case was selected, and in the case of Lakeboard, the two parties were in a good relationship at that point in time.

The unit of analysis refers to the entities (individuals, collectives, or objects) being studied, which can be identified as who or what is to be described or analyzed in a study (Van de Ven, 2007). In other words, it defines what the case is and how it is related to the way the research questions have been defined (Yin, 2014). The main unit of analysis in this research is a dyadic relationship between public organizations (Dutch water authorities) and their contractors (engineering and construction companies) in Public–Private Partnerships (PPPs) in the Netherlands. In view of the objective of this research, this unit of analysis enables an investigation into the dynamic interaction process between two types of governance and performance in a PPP.

2.4.4 Data collection

In this study, data were collected through the following four procedures: periodic interviews with key managers from both public organizations and private companies, direct observations of regularly scheduled meetings between two partners; a diary recording informal discussions with participants; and documents & reports from news media and organizational archives. In the rest of this section, I present the time horizon of data collection and elaborate more on each source of data.
2.4.4.1 *Time horizon*

The research started in September 2013 and lasted for more than four years. As the case projects had started prior to data collection, some of the data is retrospective in nature, while the majority is collected in real time. Data collection took place between December 2013 and June 2018. Data collection in the case of Riverboard – Mouse and the case of Creekboard – Giraffe was stopped in June 2016, as both cases were already at the operation and maintenance stage and in both cases the two parties had been able to overcome the performance shortfall and improve their relationship. The development of relationship tended to fall in the positive direction and stay stable. Data collection was stopped in the case of Brookboard – Elephant in January 2017, as both parties terminated the contract in December 2016. Although the case of Lakeboard – Panda is ongoing and still at the construction stage, data collection was stopped in June 2018, mainly because the end of the research period was approaching.

2.4.4.2 *Semi-structured interviews*

Data collection included multiple rounds of semi-structured interviews (see interview protocols in the Appendix 3) with representatives including senior management (e.g. departmental directors) and middle management (e.g. operation managers and maintenance managers). Senior management at the water authorities helped to identify relevant informants at the strategic and the project levels of both water authorities and the suppliers. The interviews with directors focused on strategic issues (e.g. project escalations, communication), while middle management were the key source of information about projects and the interviews with project leaders and project team members focused specifically on what went on in the projects (e.g. performance, project-related communication, trust). Unfortunately, due to an arbitration process that was ongoing at the start of the data collection process, it turned out to be impossible to interview representatives from one of the suppliers. Insights on the perspective of this supplier were instead obtained by attending or by studying minutes of inter-
organizational project team meetings. The data collection process eventually resulted in total of 74 interviews with average duration of approximate one hour per interview. The interviews were later transcribed and yielded 633 pages of transcription. Appendix 4 shows more information about interviewees and when the interviews have been conducted. Table 2.1 presents an overview of the collected data. Cross-validation of interviews (Gioia & Thomas, 1996) took place by summarizing the results from the previous interview at the beginning of each new interview. The transcriptions were also sent back to interviewees for verification.

Table 2.1 Overview of data

<table>
<thead>
<tr>
<th>Cases</th>
<th>Contract</th>
<th>Interview</th>
<th>Minutes</th>
<th>Contract supplement</th>
<th>Performance</th>
<th>Others</th>
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<td>NO.</td>
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</table>

2.4.4.3 Observation and other documents

Besides interviews, there were other sources of information: observations at the water authorities, wastewater treatment installations and construction sites; attendance at intra- and inter-organizational project meetings as “a fly on the wall” (Van Oorschot,
Akkermans, Sengupta, & Wassenhove, 2013), and the study of other relevant data sources including the seven contracts (200 pages), 40 contract supplements (1489 pages), 139 minutes of meetings (950 pages), 58 performance documents (393 pages) and 66 other documents (e.g. website announcements, newspaper articles; 625 pages). In total 384 documents (4290 pages) were collected. This approach allows perceptual data from interviews to complement objective data from other sources, and helps to reduce retrospective bias (Langley, 1999) as well as informant bias (Ketokivi & Schroeder, 2004).

2.4.5 Data analysis

2.4.5.1 Data analysis process

The qualitative data was analyzed at both within case and across case levels. The process of data analysis is visualized in Figure 2.6. As Miles et al. (2014) suggest, data analysis consists of three iterative steps: data condensation, data display and drawing & verifying conclusions. Data collection and data analysis can be considered as interconnected and overlapping processes rather than independent and separate ones. The three steps of data analysis will be further explained in the sub-sections on within case analysis and cross case analysis.

![Interactive model of data analysis](adapted from Miles & Huberman (1994))
2.4.5.2 Within case analysis

Data condensation refers to the process of selecting, focusing, simplifying, abstracting and transforming the data that appear in the full body of written up field notes, interview transcripts, documents and other empirical materials (Miles et al., 2014). Coding is primarily used to condense data by categorizing similar data chunks so that a researcher can quickly find, pull out and cluster the segments that relate to a particular construct or theme (Miles et al., 2014). Following the general guidelines of coding suggested by Miles et al. (2014), first and then second cycle coding (pattern coding) was applied. First cycle coding is a way of initially summarizing segments of data, while pattern coding, as a second cycle method, is a way of grouping those summaries into a smaller number of categories, themes or constructs.

More specifically, the principal investigator first coded the data using NVIVO (see example of coding in figure 2.7), condensing data through an open coding process by using the interviewees’ vocabulary, such as “contract,” “relationship,” “project,” and “contracting process.” These codes also had several “sub codes” (e.g. “trust” being a sub code of “relationship”) and associated “dimensions” (e.g. “competence trust” and “goodwill trust”). The initial coding list is shown in Appendix 5.

Figure 2.6 An example of coding
Subsequently, pattern coding, i.e., coding the data in new ways by grouping conceptually similar codes (i.e., grouping codes that refer to the same theoretical concept), was applied. At this point, and using the resulting code list, two other researchers independently coded ten pages of a randomly selected interview transcript, following Miles et al. (2014), who argue that about five to ten pages of one set of transcribed field notes is sufficient for checking inter-coder reliability. The initial inter-coder reliability was found to be 57.3%. Follow up discussions then took place with the aim of reconciling as many coding discrepancies as possible. In some cases, this led one of the coders to code certain parts of the text differently (bringing inter-coder agreement to 69.3%). More importantly, however, these discussions led to adaptations to the codes list. Subsequently, the dual coding exercise was repeated using the adapted codes list (See Appendix 5). This time, an inter-coder reliability of 81.8% was achieved, which was within the norm of 80 to 90 percent as recommended by Miles et al. (2014).

Together these steps resulted in the identification of a small number of “core categories” (see the final coding list in Appendix 5), that serve to integrate all theoretical concepts into a narrative story (Langley, 1999). The narrative is written in a chronological order, based on the order of critical events (see Figure 4.1, 5.1, 6.1 and 7.1). Critical events were coded under the general code of “Contracting process” which includes codes of “Tender & selection”, “Design & construction” and “Operation & maintenance”. Other codes such as trust and performance were also recorded chronologically. Trust was evaluated based on quotes from periodic interviews. All dates of interviews were noted and attached to the codes, so that a map showing the dynamic behaviors of trust can be developed (see Appendix 9). Performance is mainly judged based on data from archive documents, such as minutes of meetings, which shows date as well. It allows the development of a figure that shows dynamics of performance (see Appendix 8).

Within-case analysis results in four narratives that explain what has happened within each PPP and why it happened. To be more specific, it explains when and why a
performance shortfall happened, how the two parties in the PPP responded to it and how this interaction affected the project performance and relational outcome. At the end of each narrative, the narrative is reflected upon and explicit connections made to the key concepts, namely project complexity, performance shortfall, strategies, project performance, and relational outcome (see their definitions in Appendix 6), under a static perspective. Subsequently, a dynamic perspective is provided by displaying an underlying causal mechanism in a causal chain (Figure 4.2, 5.2, 6.2 and 7.2). This is a researcher-constructed linear display of events, action and/ states that suggests a plausible sequence of causes and effects. Such a chain helps a researcher to lay out explicitly what may be causing certain phenomena Miles et al. (2014).

2.4.5.3 Cross-case analysis

Just as in the within-case analysis, the four cases are analyzed from a static and a dynamic perspective in the cross-case analysis. In the static perspective (see Chapter 8), the commonalities and differences between four cases are compared on five key concepts, namely project complexity, performance shortfall, strategies, project performance, and relational outcome. The aim is to investigate when and why a performance shortfall occurs and what the relationships are between contractual and relational strategies in dealing with a performance shortfall and project outcomes. In the dynamic perspective (Chapter 9), the four cases are compared on the dynamic processes between contractual/relational strategies and project outcomes. The objective is to identify a general mechanism of how strategies affect performance dynamics. Specifically, a causal loop diagram that depicts hypothesized causal structure of a PPP under investigation will be developed.

Causal loop diagrams are among the main representation tools used to describe a theory of how different parts of the system are causally related for the system to generate behaviors of interests (Sterman, 2000). A CLD is a diagram mapping the
interrelatedness between different variables in a system, in this case a public – private relationship. It shows the causal links among variables with arrows from a cause to an effect. The important feedback loops are also identified in the diagram. A positive link indicates a positive relation and a negative one indicates a negative relation. A positive causal link means a decrease/increase in a variable resulting in a decrease/increase in the other variable. In other words, two variables change in the same direction. While a negative causal link means the two variables change in opposite directions, i.e. if one variable starts increases, the other variable decreases and vice versa. A feedback loop is one of the important features in a causal loop diagram, which is either defined as a positive or negative loop. In positive causal loops, the feedback is self-reinforcing and amplifying, while in a negative causal loop, the feedback is dampening (Sterman, 2000).

As a conclusion, by comparing four cases, a general causal loop diagram is developed, and has the ability to explain why and how two governance mechanism led to different performance dynamics. Examples of how causal relationships between variables is collected, and how a causal network is constructed using a causal loop diagram can be found in Appendix 7.

2.4.6 Simulation

In this research, a simulation model was built based on the general causal loop diagram discussed above. As Davis et al. (2007) point out, simulation has become an increasingly significant methodology in theory building in management literature. The purpose of using a simulation model is to refine the theory that developed after the cross-case analysis. The rest of this section explains why a simulation approach is used and why the system dynamics simulation modelling is chosen.

*Usefulness of simulation*
It is particularly useful to apply simulation after the theory-creating researches using methods such as inductive multiple case studies (Eisenhardt, 1989). This is also the case in this research, since simulation enables the elaboration of rough, basic or simple theory that is derived from inductive cases into logically precise and comprehensive theory. Simple theory is an undeveloped theory that has only a few constructs and related propositions with modest empirical or analytic grounding such that the propositions are in all likelihood correct but are currently limited by weak conceptualization of constructs, few propositions linking these constructs together, and/or rough underlying theoretical logic. Thus the theory developed through simulation can then be effectively examined further by using deductive logic and empirical evidence. To be more specific, through computational experimentation simulation allows the enhancement of a theoretical precision and related internal validity, and enables theoretical elaboration and exploration. In particular, simulation relies on some theoretical understanding of the focal phenomena in order to construct a computational representation. And simulation also depends on an incomplete theoretical understanding such that fresh theoretical insights are possible from the precision that simulation enforces and the experimentation that simulation enables. Furthermore, simulation is particularly useful when the theoretical focus is longitudinal, nonlinear, or processual (Davis et al., 2007), as is the case in this research, since in these situations, simulation is likely to reveal non-intuitive elaborations of simple theory that are difficult to uncover using other methods.

*System Dynamics as simulation approach*

Davis et al., (2007) suggest that to choose an appropriate simulation approach, one needs to consider the fit of the research question, assumptions and the theoretical logic of the simple theory with those of the simulation approach. The structure-behavior relationship that a causal loop diagram is able to show is called structural theory in a system dynamics approach (Größler, Thun, & Milling, 2008). The system dynamics
approach focuses on how causal relationships among constructs can influence the behavior of a system (Forrester, 1961; Sastry, 1997; Sterman, Repenning, & Kofman, 1997). It typically models a system (e.g. a public – private relationship) as a series of simple processes with circular causality, in a form of feedback loops discussed above. While each process may be well-understood, their interactions are often difficult to predict. The system typically includes stocks, acting as buffers (i.e. constructs with values that accumulate and dissipate over time, and so introduce time delays, e.g. Trust and performance) and flows (i.e. constructs specifying temporal rates in the system, e.g. trust gain rate/erosion rate and performance change rate). System dynamics models also capture information feedback and time delays to simulate complex and dynamic behavior (Senge, 1990; Sterman, 2001), so that they can model complex conflict resolution decisions with real-world characteristics (Forrester, 1961; Senge, 1990; Sterman, Oliva, Linderman, & Bendoly, 2015). Research questions are often framed in terms of how specific conditions affect the stability of the system. That is, researchers are usually interested in finding the initial conditions that lead to abrupt, nonlinear changes, such as tipping points, catastrophes, and the emergence of vicious or virtuous cycles (Davis et al., 2007). That is the aim of this research, to investigate how different governance mechanisms affect performance over time and how performance affects use of governance mechanisms in a complex infrastructure outsourcing project delivered through PPP. Moreover, the study also strives to discover how specific conditions (different strategies – relational or contractual – for dealing with performance shortfalls) would affect the stability of a PPP’s system. The simulation model is presented in chapter 10.
2.5 Research credibility: validity and reliability

Yin (2014) suggested four criteria to assess the credibility of a qualitative case research design: construct validity, internal validity, external validity, and reliability.

2.5.1 Construct validity

Construct validity refers to the extent to which correct operational measures are established for constructs under study (Yin, 2014) and threatened by potential research subjectivity. To meet the requirement of construct validity, as recommended by Yin (2014), the main topics (e.g. contractual governance and relational governance) were defined in terms of specific concepts and operational measures (e.g. contractual control, self-serving response, accommodative response and information sharing) were identified to match the concepts by citing published studies that have the same matches (see Appendix 5).

To mitigate the negative effect of researchers’ subjectivity, the three methods proposed by Ellram (1996) are followed, namely multiple data sources, establishing & maintaining a chain of evidence, and having key informants review the reports.

- Three data sources of evidence were applied: periodic interviews, field observations and archive documents (e.g. contracts, minutes of meetings, and media publications), to confirm the validity of information being collected.
- A computer-assisted data base was created using qualitative data analysis software Nvivo 10 (see an example in figure 2.5), and consists of research reports, database, and citations of specific evidentiary sources, interview protocol, and research questions, to form the chain of evidence, meaning that
any evidence from initial research questions to ultimate case study conclusions, or the other way around, can be traced.

- Transcripts of the interviews were reviewed by interviewees after each interview to avoid wrong interpretation by the interviewer. Reports were presented in group meetings periodically and feedback from managers incorporated into the revised reports.

![Figure 2.7 A screenshot of Nvivo 10](image)

### 2.5.2 Internal validity

Internal validity concerns the extent to which a causal conclusion based on a study is warranted. In other words, internal validity is the extent to which a causal relationship is established, whereby certain conditions are believed to lead to other conditions, as distinct from spurious relationships (Yin, 2014). Analytic tactics such as pattern matching, explanation building, addressing rival explanation and using logic models can be applied to enhance internal validity. In this research, explanation building tactics are applied with the aim of explaining why or how a public – private relationship fails or succeeds, and involve analyzing the contractual governance and relational governance applied by both parties and the impact of these governance mechanisms on performance over time. The explanation building tactic is an iterative process. An initial theoretical statement is made, the findings of the first case compared with the initial
theoretical statement, the statement revised, and the revision compared to the findings of the second case and so on.

2.5.3 External validity

External validity is the extent to which a study’s findings can be generalized (Yin, 2014). The lack of generalizability has been a major criticism of qualitative case study, which can be improved by using replication strategy in multiple case studies. In contrast to statistical generalization in quantitative research, qualitative case study focuses on analytical generalization. More specifically, a statistical inference is based on a random sample from a certain population, and the statement obtained is in principle valid for the whole population. While analytical generalization focuses on generalizing a particular set of results to some broader theory (Yin, 2014). The aim of this research is to extend the findings from the specific setting of PPPs between Dutch water authorities and their contractors to PPPs in different sectors or industries.

2.5.4 Reliability

Reliability is defined as the extent to which the operations of a study can be repeated with the same results (Yin, 2014). In other words, the underlying issue is whether the process of the study is consistent regardless of time and researchers (Miles et al., 2014). Two tactics for enhancement of reliability are the use of the case study protocol (e.g. interview protocol) and the development of a case study database. As discussed in the section on construct validity, a qualitative analysis software NVivo 10 (see Figure 2.5) as used to assist in creating a case study database that included the case study protocol in this research.
Chapter 3 Theoretical background

This chapter shows the theoretical background for the research. Section 3.1 reviews the literature of two exchange governances, namely contractual and relational governances. After explaining the definitions, types and dimensions, and functions of the two governances, the chapter discusses the performance outcomes that these two governances might bring. The chapter then presents the debate on the interplay between these two governances, namely their mutual relationship and their joint impact on performance. Section 3.1 concludes by pointing out the theoretical gap in the existing literature about the two governances. Under the theoretical framework of the two exchange governances, section 3.2 examines the literature on strategies for dealing with performance shortfall. The aim is to further refine the research question in the specific context of this research on public – private partnerships. Section 3.3 discusses the results of the literature review and concludes with the refined research question.

3.1 Two exchange governances

Two distinct types of governance mechanisms for supporting and managing Inter-Organizational Relationships (IORs) have been studied in the literature (Griffith & Myers, 2005; Rousseau, Sitkin, Burt, & Camerer, 1998; Williamson & Ouchi, 1980; Zaheer & Venkatraman, 1995). One of these is contractual governance, emphasizing the importance of formal rules and contracts between organizations for governing the exchange. The other is relational governance, relying on relational norms and trust to coordinate the exchange relationship, mitigate hazards associated with uncertainty and transaction-specific investment, and allow adaptation to unexpected future contingencies (Cao and Lumineau, 2015).

As firms often apply both contractual and relational governance simultaneously to promote collaboration and reduce opportunistic behaviour in their relationships (Bradach, 1997; Malhotra & Lumineau, 2011) the interplay between these two
governances in IORs has been a hot topic in management literature. Nevertheless, to date there is little consensus on the relationship between these two governances and their impacts on performance. On the one hand, many scholars (Huber et al., 2013; Li et al., 2010; Lui and Ngo, 2004) argue that contractual and relational governance substitute for each other. In other words, the use of one type of governance decreases the use of or the benefits of using the other one (Cao and Lumineau, 2015). On the other hand, other scholars (Lui et al., 2009; Poppo and Zenger, 2002) contend that the two types of governance are complementary, meaning that the use of one increases the use of or the benefits of using the other one.

3.1.1 Contractual governance

3.1.1.1 Definition and dimension

Previous studies have referred to contractual governance using many different labels, namely formal institutions (Zenger, Lazzarini, & Poppo, 2002), formal contract (Li et al., 2010; Poppo and Zenger, 2002), formal control (Das & Teng, 2001), legal contract (Achrol & Gundlach, 1999), “explicit contract” (Zhou & Poppo, 2010), and legal safeguards (Lui & Ngo, 2004). Many different definitions have also been used. For instance, Abdi and Aulakh (2012) define contractual governance as the level of specification of promises, obligations, and different aspects of the relationship expressed in written agreements among firms. Ferguson et al. (2005) consider contractual governance as the degree to which the formal contract is implemented in established service exchanges. Though different titles and definitions have been attached to contractual governance, existing literature has commonly considered it as a formal, legal, and economic governance mechanism involving the use of explicit and written contracts (Vandaele, Rangarajan, Gemmel, & Lievens, 2007) that are mostly very detailed, legally binding agreements, specifying the roles and obligations of the contracting parties (Lyons & Mehta, 1997). In line with Cao & Lumineau (2015), this study refers to contractual governance as the extent to which an IOR is governed by a
formal and written contract which explicitly stipulates the responsibilities and obligations of each party (Ryall & Sampson, 2009).

Contracts, as the main type of contractual governance, are written agreements that are legally binding (Klein-Woolthuis, Hillebrand, & Nooteboom, 2005). Recently, Performance Based Contracts (PBCs) have been increasingly applied in practice, in both public (e.g. government, healthcare) and private (e.g. manufacturing and service industries) sectors (Hooper, 2008; Hypko et al., 2010). PBCs have also attracted much academic attention (Selviaridis & Wynstra, 2015). In short, PBC is considered a contractual approach that links payment to contractor’s performance. Moreover, it places emphasis on specification and evaluation of outputs or outcomes rather than required inputs, activities or processes (Martin, 2007). In other words, PBC underlines the outcomes of exchange rather than how to organise transactions or which resources to use (i.e., it allows the supplier some freedom). As such, a PBC clearly separates the client’s expectations (i.e., the performance goal) from the partner’s implementation (i.e., how it is achieved) (Kim, Cohen, & Netessine, 2007). PBCs are increasingly applied in the specific setting of this research (i.e. Dutch water authorities) and are a type of contractual governance predominantly used in the context of partnering with an organization that delivers services (Sumo, van der Valk, van Weele, & Duysters, 2016). This construct is further elaborated in the rest of this section.

A recent literature review on PBCs (i.e. Selviaridis & Wynstra, 2015) suggests that they can be conceptualized along three key dimensions, namely performance, incentives, and risk. This conceptualisation emphasizes the interdependence among the specification and evaluation of supplier’s performance and the design of applicable risk and reward sharing systems to incentivize performance. To be more specific, the performance dimension is defined as the process and practices of specifying, measuring, evaluating and reporting performance. The performance design entails the specification of relevant outputs and/or outcomes and key performance indicators that should be
reported and monitored. After the evaluation of performance, payment should be effected and corrective activities should be planned (Mohammadnezhad-Shourkaei, Abiri-Jahromi, & Fotuhi-Firuzabad, 2011; Schulz, Wu, & Chow, 2010). Moreover, the incentives dimension is considered as the structure of financial & non-financial incentives and their impact on supplier behavior. It stresses that the incentives structure that is designed and its intensity influence supplier behavior in terms of incentive alignment (Huntington, Zaky, Shawky, Fattah, & El-Hadary, 2010). This refers to the process of sharing costs, risks, and benefits between partners (Simatupang & Sridharan, 2002). If the incentive is aligned, supplier effort is directed towards improving performance, otherwise it might create unintended consequences and induce supplier opportunism (Mcdonald & Roland, 2009). The risk dimension refers to the allocation of financial and operational risk. The main motivation of buyers to apply PBC is to transfer risks to suppliers by linking reward to performance (Nalli, Scanlon, & Libby, 2007). However, suppliers can be risk averse, if they sense limited control of performance that depends on outcome clarity, measurability and intensity, and perceived capacity to manage related risks (Haghifam & Abedi, 2013).

3.1.1.2 Functions

This section explains further the functions of contractual governance and serves as a theoretical background to give readers a better understanding of contractual governance. Contractual governance has been traditionally regarded in the literature as a way of safeguarding or controlling exchange hazards (e.g. Poppo and Zenger, 2002; Weber and Mayer, 2011). Recently, many authors (Cao & Lumineau, 2015; Malhotra & Lumineau, 2011; Schepker, Oh, Martynov, & Poppo, 2014) have argued that contractual governance can also function as a coordination and adaptation mechanism in governing IORs.
Safeguard mechanism

Through specifying each party’s rights and duties in the contract, contractual governance may mitigate ex ante and ex post risk of opportunism and thereby safeguard the exchange between partners (Schepker et al., 2014; Williamson, 1985). Prior literature has regarded contractual governance as an important way of controlling exchange hazards, by minimizing cost and performance losses resulting from hazards (Joskow, 1988; Laura Poppo & Zenger, 2002; Weber & Mayer, 2011).

To elaborate more, Transaction Cost Economics (TCE) theory highlights that optimal governance designs that best safeguard investments and minimize transaction costs are determined by transactional attributes, suggesting that companies should align their governance features to match known exchange attributes and hazards (Williamson, 1985). In line with the TCE, the classical contract theory suggests achieving the optimal contract which is the one resulting in the lowest transaction costs relative to outcome. Organizations should design contracts that take into account certain transaction characteristics such as frequency, asset specificity, environmental and behavioral uncertainty, and task complexity (Anderson & Dekker, 2005; Chen & Bharadwaj, 2009; Williamson, 1979). The outcome of the contract crafting process is mostly a complex contract that provides an institutional framework concerning each party’s rights, duties, and responsibilities, and the goals, policies, and strategies underlying the relationship (Zheng et al., 2008). By outlining the responsibilities of both parties, contracts serve as a blueprint for exchange, reduce opportunism and safeguard IORs (Williamson, 1985).

The underlying assumption is that complete contracts, containing all the necessary safeguards, can be drafted, and be applied to mitigate opportunistic behavior and reduce transactional ambiguity by clear specification of what is, and what is not, allowed within a relationship (Lui & Ngo, 2004; Lyons & Mehta, 1997). Moreover, contracts may reduce uncertainty and the risk of opportunism (Achrol & Gundlach, 1999) and constitute a legal safeguard against ex post performance issues (Luo, 2002).
instance, Parkhe (1993) points out that formal contracts may stipulate penalties that change the pay-off structure by increasing the cost for opportunistic behaviors.

**Coordination mechanism**

Besides the control or safeguard function, contractual governance also plays an important role in coordination between partners in exchanges. Many authors (Carson, Madhok, & Tao, 2006; Collins, 1999; Lui & Ngo, 2004) have demonstrated that contracts can be used as a planning tool to coordinate between partners, thus helping mitigate ambiguity during the exchange period. Moreover, Schepker et al. (2014) argue that organizations can use contractual governance to promote coordination by defining roles and responsibilities (Klein-Woolthuis et al., 2005; Mayer & Argyres, 2004), and outlining provisions for monitoring processes (Argyres, Bercovitz, & Mayer, 2007).

To be more specific, Klein Woolthuis et al. (2005) contend that by defining roles and responsibilities, contracts signal commitment between transacting parties. Argyres et al. (2007) and Mayer and Argyres (2004) discuss contracts as repositories of knowledge, meaning that contracts have been used for inter-firm learning and knowledge sharing. Thus, contracts are serving both as a codification tool, which codify accumulated knowledge and efficient ways of collaboration, and a communication tool, which enhances information and knowledge sharing flow, thus promoting coordination between partners. And last but not least, contractual governance can be used to enhance coordination also through contract design and application. More specifically, how a contract is written can affect the subsequent coordination between parties (Schepker et al., 2014). The results of Weber et al. (2011) and Weber and Mayer (2011) reveal that the framing of contracts may psychologically affect how partners behave and coordinate their actions. Furthermore, Lumineau and Malhotra (2011) find that when contracts emphasize coordination, partners are more likely to apply a dispute resolution approach that emphasizes collaboration. The findings stress that how contracts are framed will affect how parties examine and resolve disputes in the relationship.
Adaptation mechanism

It is also argued by Schepker et al. (2014) that contractual governance can serve an adaptation function in an uncertain environment. Providing evidence that adaptation functions of contractual governance, Argyres et al. (2007) discover that as firms contract over time, they include more contingency planning in the contracts. At the same time, Mayer and Argyres (2004) also find that contractual terms are added to future contracts as contingencies arise. The mechanism for adaptation is to define mutually agreed tolerance zones between parties for unexpected contingencies or to develop procedures to follow when changes start to appear. In other words, to function as an adaptation mechanism, a contract should contain provisions that define remedies for foreseeable contingencies, or specify processes for resolving unforeseeable outcomes (Poppo and Zenger, 2002). For instance, Crocker and Reynolds (1993) find that contracts with mutual agreed payoff schemes that depend on dynamic environmental circumstances help parties to cope with price fluctuation.

3.1.2 Relational governance

3.1.2.1 Definition and dimensions

Prior studies have assigned many labels to relational governance: informal self-enforcing governance (Dyer & Singh, 1998), non-economic, sociological factors (Zaheer & Venkatraman, 1995), informal institutions (Macneil, 1978), relational mechanisms (Jayaraman, Narayanan, Luo, & Swaminathan, 2013) and social control (Li, Xie, Teo, & Peng, 2010). Relational governance also has many definitions. It has been defined as the strength of the social norms present in an exchange situation (Ferguson et al., 2005). In the work of Abdi and Aulakh (2012), it has been referred to as a mechanism that relies on informal rules and procedures, trust, ongoing flexibility, mutual understanding and perception of equity and fairness among partners to maintain a relationship. Moreover, in the study of Ryall & Sampson (2009) it has been...
considered as an unwritten mechanism for governing exchange, such as an interest in preserving the value of ongoing relationships that prevents opportunistic behavior. Though relational governance has been associated with different titles and definitions, it has been commonly associated with being informal and social in comparison with formal contractual governance (Vandaele et al., 2007). Relational governance is based on values and shared processes in the exchange relationship and incorporates trust and commitment (Lui & Ngo, 2004), relational capital (Kale, Dyer, & Singh, 2002), information sharing routines (Poppo et al., 2008), and informal exchange (Cook & Emerson, 1978). In line with Cao and Lumineau (2015), this study defines relational governance as the extent to which an IOR is governed by informal and social relations and shared norms (Laura Poppo et al., 2008; Zhou & Xu, 2012).

Trust and relational norms are commonly considered as two of the most important components of relational governance (Griffith & Myers, 2005; Gulati, 1995), however, this study considers trust as a relational outcome rather a component of relational governance, and the reason is given in Section 3.1.3. To serve as a theoretical background, trust and relational norms are further explained in the rest of this section.

Trust concerns both parties fulfilling collaborative roles in a risky situation, and relates to both parties’ expectations of the other’s intentions and ability to perform (Lui & Ngo, 2004). While the former has traditionally been emphasized in reciprocal exchange, more recently, emphasis has shifted to reputation rather than affect-based trust (Cook & Rice, 2003). These two dimensions of trust have more commonly been labelled goodwill trust and competence trust (Das & Teng, 2001; Lui & Ngo, 2004; Nooteboom, 1996). In addition, Sako and Helper (1998) pointed out that there exists a third dimension of trust, contractual trust, that refers to expectations that the other party will carry out its contractual agreements.
Relational norms relates to shared expectations about the behavior of each party in IORs (Cannon, Achrol, & Gundlach, 2000; Heide & John, 1992). The main dimension of relational norms are flexibility, information exchange, and solidarity (Griffith & Myers, 2005). More specifically, flexibility is conceptualized as willingness to adapt to one’s partner within the context of an exchange relationship, while information exchange defines a bilateral expectation that partners will proactively provide information useful to their partner in support of the ongoing relationship. Solidarity refers to the bilateral expectation that a high value is placed on the relationship (Heide, 1994; Heide & Miner, 1992; Laura Poppo & Zenger, 2002).

3.1.2.2 Functions

As discussed in Section 3.1.1, contractual governance may serve three types of function. Nevertheless, in the existing literature no study has yet specifically associated relational governance to function. This study argues that relational governance can also be applied as a safeguard for exchange, to enhance coordination between partners, and to promote adaptation when unexpected events occur.

Safeguard mechanism

Relational governance highlights the role of trust and social norms in IORs (Griffith & Myers, 2005; Gulati, 1995). On the one hand, Ring and Ven, van de (1992, 1994) suggest that as a key element in relational governance, trust helps to reduce the risk of opportunistic behavior. When a high level of mutual trust exists in a relationship, both parties share mutual confidence or belief that both parties will not exploit any adverse situation (Barney & Hansen, 1994) and they are more likely to consider their partner’s interests rather than just their own (Lui et al., 2009). Thus, trust and its underlying normative implication operates as a self-enforcing safeguard in preventing opportunistic behaviors (Laura Poppo & Zenger, 2002).

At the same time, relational norms provide a reference framework that guides firms to behave in ways that can be expected (Cannon et al., 2000; Lui et al., 2009). Therefore,
relational norms can also reduce the risk of opportunism (Lui et al., 2009; Laura Poppo & Zenger, 2002). More specifically, IORs may be governed by social processes characterized by high degrees of flexibility, solidarity, and information exchange (Laura Poppo & Zenger, 2002). These social processes safeguard against exchange hazards and facilitate the enforcement of obligations. By facilitating a bilateral approach to problem solving, solidarity, and information sharing, they help to consolidate the long-term business relationship (Rai, Keil, Hornyak, & Wüllenweber, 2012; Selviaridis & Spring, 2010). Partner organizations’ expectations of relationship continuity and longevity generate incentives to make exchange-specific investments (Laura Poppo & Zenger, 2002), since these investments are protected by the mutually imposed costs of termination. Also, expectations of longevity minimize the need for precise performance measurement in the short term, because partners expect that short-term inequities will be corrected in the longer term. In this context, social obligations enforce compliance with relational norms and practices (Uzzi, 1999). To conclude, trust and norms of flexibility, information sharing, and commitment help circumvent the potentially high costs of exchange hazards (Adler, 2001; Bradach & Eccles, 1989; Granovetter, 1985, 1992; Jones, Hesterly, & Borgatti, 1997; Macaulay, 1963; Palay, 1984).

Coordination mechanism

Relational governance can also function as a coordination mechanism, because, over time, relational governance improves mutual trust, and this help parties develop relational routines and actions (i.e. information sharing and deep collaboration) that facilitate work and information coordination (McEvily, Perrone, & Zaheer, 2003; Zollo, Reuer, & Singh, 2002). Furthermore, relational governance enables incentive alignments between partners, thus enabling the coordination of exchanges (Poppo et al., 2008). More specifically, such effective coordination is allowed to happen as a result of the trust in each other not to behave in a self-interested manner. Trust also encourage partners to provide the substantive resources and accurate and timely information that
enhances collaborative benefits (Krishnan, Martin, & Noorderhaven, 2006). To sum up, relational governance can operate as an organizing principle and represents a general logic for work coordination and information processing (McEvily et al., 2003).

Adaptation mechanism

The adaptation function of the relational governance stems mainly from the relational norms. As discussed above, relational governance is based on the social norms of solidarity, flexibility, and information exchange (Griffith & Myers, 2005; Laura Poppo & Zenger, 2002). When developing a norm of solidarity, organizations maintain a long-term, cooperative relationship and do not act to gain short-term benefits (Olsen, Haugland, Karlsen, & Husøy, 2005). This promotes a bilateral approach to problem solving, creating a commitment to joint action through mutual adjustment (Laura Poppo & Zenger, 2002). Flexibility also facilitates adaptation to unforeseeable events, since when developing norm of flexibility, partners are willing to adjust to expected circumstances. To be more specific, the norms of flexibility promote the fair distribution of reward between partners and motivate partners to adjust plans and strategy to changing circumstances (Olsen et al., 2005). Moreover, information exchange facilitates adaptation because parties are willing to share private information with one another, including short- and long-term plans and goals, which form the basis for the adaptation (Laura Poppo & Zenger, 2002). To conclude, relational norms such as solidarity, flexibility, and information exchange provide for mutual adaptation within the partnership in order to cope with the inevitable uncertainties that arise in an exchange.

3.1.3 Performance outcome

Recent literature review articles (Roehrich et al., 2019 and Cao & Lumineau, 2015) point out that many performance implications, such as reduction in opportunism (Lui et al., 2009; Mellewigt, Madhok, & Weibel, 2007; Zhou & Xu, 2012), satisfaction (Jap
and exchange performance (Cannon et al., 2000; Chen, Preston, & Xia, 2013; Zaheer, McEvily, & Perrone, 1998), have been associated in the existing literature with contractual and relational governances. This study chooses to focus on exchange performance, as the aim of the research is to investigate the root causes of success or failure in an outsourced infrastructure renovation projects in Dutch water authorities. The success of a renovation project is defined as achieving the project performance target in a contract, while the failure of a renovation project refers to not achieving the target.

Many scholars have relied on perceptual measures of exchange performance (Roehrich et al., 2019), as exchange performance is hard to specify, thus data are difficult to obtain (Poppo & Zhou, 2014). Roehrich et al. (2019) propose considering more objective measures of exchange performance in future research. In line with Gulati & Nickerson (2008), by combining perceptual measures with objective measures, this study relates exchange performance to project performance (Zaheer et al., 1998) and relational qualities, such as trust (Yaqub, 2013). The reason for using two measures is that these two constructs are closely associated. For example, the evaluation of project performance might affect judgment about trustworthiness, which in turn might lead to a different relational quality or trust level (Cho, 2006).

The study measures project performance (see more definitions in Appendix 6) in terms of schedule performance (e.g. delivery), operational performance (e.g. quality), and financial performance (e.g. costs) (Zaheer et al., 1998), while relational quality is measured by level of mutual trust between partners (Kelleher & Miller, 2006; Yaqub, 2013). As mentioned in the previous section, trust is considered in this research as an outcome rather than a component of relational governance. Many studies (e.g. De Wut, Odekerken-Schrocler, & Lacobucci, 2001; Sirdeshmukh, Singh, & Sabol, 2002) have seen trust as an important relational outcome and separate them from relational norms, because considering relational norms and trust together as one relational concept at a more abstract level might prevent us from finding out the relationship between these
two. For instance, by creating a highly relational environment, relational norms might enhance relation qualities such as trust (Yaqub, 2013).

3.1.4 **Relationship between governances**

The interplay between contractual and relational governance can be described in two main approaches (Cao and Lumineau, 2015). One studies the mutual relationship between these two types of governance, while the other investigates the joint impacts of the two governance mechanisms on performance. The two research streams are discussed in more detail in what follows.

3.1.4.1 **Mutual relationship**

Existing research on the mutual relationship between contractual and relational governance proposes two opposing views (e.g. Klein Woolthuis et al., 2005). Some researchers view contractual and relational governance as substitutes (Dyer & Singh, 1998; Gulati, Lawrence, & Puranam, 2005), while others provide evidence on the complementary roles of contracts and trust (Poppo and Zenger, 2002).

**Substitution view**

The substitution view suggests two main mechanisms: “replacing” and “dampening” (Huber et al., 2013). The replacing mechanism refers to the substitution caused by the functional equivalents of contractual and relational governances. The main message is that the use of relational governance replaces the functions of contractual governance. Researchers argue that relational governance, such as trust, effectively reduces transaction costs by replacing contracts with handshakes (Adler, 2001). For instance, Adler (2001) and Gulati (1995) argue that relational governance based on trust and relational norms facilitates cooperative relationship without the costs and complexity associated with contractual agreements. In a similar vein, Dore (1983) argues that relational governance facilitates cooperation in relationships through norms and obligations that economize on the use of contractual governance. Therefore, higher
levels of trust lead to lower levels of costs (Cummings & Bromiley, 2012). In other words, the presence of trust economizes on the implementation of control, as higher levels of trust call for less control through contracts (Nooteboom, 1999; Nooteboom, Berger, & Noorderhaven, 1997). Moreover, in sharp contrast to contracts, trust is seen as having positive side-effect on IORs, as partners who trust each other are prone to consider each other's ideas and have less need to use control mechanisms (Zaheer & Venkatraman, 1995). There are also some studies that have investigated the financial advantage of using relational governance mechanisms to manage long-term IORs. For example, Dyer (1997) states that while the initial costs of developing trust are high, over time, trust will be more effective than contracts, because the latter require revision for most transactions to safeguard the partnership. In conclusion, relational governance such as trust can substitute for contractual governance in terms of control or safeguard functions. In addition, Ring and Van de Ven (1992) claim that trust results in more open and frequent information sharing, hence facilitating coordination and rendering formal contracts obsolete for the coordination function of contractual governance.

The dampening mechanism refers to the substitution caused by the adverse effects of one type of governance on the other type of governance (Huber et al., 2013). Both contractual and relational governance mechanisms are deployed to increase predictability about the future behaviour of partnering organizations (Nooteboom, 2002). They are therefore considered as alternative ways of arriving at stability in relationships (Gulati, 1995). However, complex contracts can crowd out trust as there are fewer opportunities for relational arrangements whereby trust can be established in the exchange relationship (Puranam & Vanneste, 2009). Macaulay (1963) argues that contractual governance is not only unnecessary, but also damages the formation and operation of relational governance. He claims that “not only are contract and contract law not needed in many situations, their use may have, or may be thought to have, undesirable consequences” (Macaulay, 1963, p.64). Along the same lines, Sitkin and Roth (1993) claim that “legalistic remedies can erode the inter-personal foundations of
a relationship they are intended to bolster because they replace reliance on an individual’s ‘goodwill’ with objective, formal requirements” (p.376). The main argument is that the use of contracts signals that partners are neither trusted nor trustworthy enough to behave appropriately without such contracts (Ghoshal & Moran, 1996; Gulati & Nickerson, 2008; Malhotra & Murnighan, 2002). In addition, applying contracts as a form of power may be effective in some cases, but more often yields disadvantages, such as provoking conflict and defensive behavior (Hirschman, 1984).

**Complement view**

The complement view also suggests two main mechanisms: “compensating” and “enabling” (Huber et al., 2013). The compensating mechanism indicates that contractual governance can address the limitation of relational governance and vice versa (Huber et al., 2013). For instance, trust may help overcome the adaptive limitations of contracts when unexpected complications and conflicts occur, and the continuity and cooperation encouraged by trust may generate contractual refinements that further support greater cooperation (Poppo and Zenger, 2002). Contracts can also stipulate tailored approaches and agreed procedures for dealing with adaptations and changes in long-term, trusting relationships (Selviaridis & Spring, 2010). Deploying contractual safeguards that promote expectations of cooperative behaviour result in mitigation of relational governance limits (Klein-Woolthuis et al., 2005; Pfaff & Vélez, 2012). Formal contracts are inherently incomplete (Klein-Woolthuis et al., 2005) and relational governance becomes an appropriate complement by facilitating continuance when changes and conflicts arise in a relationship (Collins, 1999). That is seen as promoting flexibility in changing environments, and encouraging value-creation activities beyond the contractually stipulated terms (Liu, Luo, & Liu, 2009).

In the presence of trust, incomplete contracts are seen as offering more protection against opportunism (Arrow, 1974). Relationships characterized by trust may foster open communication and discussions with regards to contract details (Klein-Woolthuis et al., 2005). In addition, information sharing initiated by trusting relationships (Dyer
& Singh, 1998), “enables organizations to record aspects of their relationships in formal contracts” (Vlaar et al., 2007, p.414). Cooperation encouraged by relational governance may also lead to contractual refinements that reinforce inter-firm trust and learning and thus further promote inter-organizational cooperation (Mayer & Argyres, 2004; Vanneste & Puranam, 2010).

The enabling mechanism refers to the fact that one type of governance creates conditions to facilitate the other type. The complementary argument is supported by (North, 1990, p.46), who states that “formal rules can complement and increase the effectiveness of informal constraints”. Earlier studies suggest that legal regulation of IORs is an important precondition for trust (Gulati et al., 2005; Malhotra & Murnighan, 2002) and detailed and lengthy contracts may signal a reaffirmation of expectations between both organizations (Bachmann, 2001). Similarly, well-specified contracts may promote cooperative, long-term, trusting exchange relationships, as such contracts narrow the domain and severity of risk in an exchange and thereby encourage cooperation and trust (Poppo & Zenger, 2002).

The process of writing contracts itself helps in constructing a shared definition of the exchange and facilitates increased mutual understanding of the parties’ goals, expectations, and requirements (Lumineau, Fréchet, & Puthod, 2011). Formal contracting forces articulation, thus serving as a means to make better sense of an inter-organizational exchange and encouraging greater knowledge during the early relationship development phases (Lui, 2009; Szulanski, Cappetta, & Jensen, 2004; Vlaar et al., 2007). It also helps in delineating the roles and responsibilities of parties and in promoting the development of trust (Cannon et al., 2000). Contractual provisions (e.g. dispute resolution, monitoring and performance reporting procedures) may help to record the partner’s behavior and increase transparency and confidence in inter-organizational cooperation (Mellewigt et al., 2007). Relational governance can complement contractual governance by creating a new contractual mindset. For example, in the servitization context, Bastl et al. (2012) find that inter-party trust could
create a “win-win” mindset, which facilitates the contracting process. Conversely, higher degrees of trust enable higher levels of formal coordination and control through contracts (Dekker, 2004).

3.1.4.2 Joint impact on performance
As is the case with the first perspective on mutual relationship between two governances, two opposing views of the joint impact on performance of the two governances have been developed in the other perspective. Some scholars have asserted that the joint use of the two governance mechanisms is negatively related to performance. Conversely, the other scholars have argued that the joint use of the two governance mechanisms increases performance. More specifically, the negative view contends that contracts may signal dis-trust and thus undermine the formation of relational governance, and in turn, trust may encourage partners to enforce contracts less strictly to avoid damaging the cooperative foundations of IORs. As a result, the two governance mechanisms reduce each other’s positive effect on performance (Antia & Frazier, 2001; Cao & Lumineau, 2015; Ghoshal & Moran, 1996; Lee & Cavusgil, 2006; Y. Wang, Vanhaverbeke, Roiakkers, & Chen, 2011). In addition, simultaneous use of contractual and relational governance may be redundant, since when one governance mechanism is well developed, it is unnecessary to develop another costly type. (Ben-Ner & Puttermann, 2009; Gulati, 1995; Li et al., 2010).

The positive view argues there are two reasons that joint use of contractual and relational governance increases performance. On the one hand, the simultaneous use of two types of governance can save ex post transaction costs by reducing the opportunities of contract breach and renegotiation (Yang et al., 2012). On the other hand, two governances can address each other’s limitations and complement each other to improve performance. In addition to the previously mentioned negative influences, Nooteboom (1999) argues that the TCE perspective, by supporting the deployment of contractual safeguards, imposes a straightjacket constraining, in particular, those
relationships that have a focus on innovation. Therefore, the use of both governance mechanisms may lead to more positive relationship outcomes than the use of either mechanism alone (Poppo & Zenger, 2002; Weick, 2001). However, the positive effects of combining trust and formal control mechanisms may depend on the type of relational ties and the context within which these develop. In particular, Yang et al. (2011) suggest that complementarity effects increase performance only in cases of relationships with weak relational ties, where formal controls are not interpreted as signals of distrust (as they are in case of strong relational ties).

3.1.5 Theoretical gap

The literature review shows that most quantitative studies that focus on the topic of contractual and relational governances have been mainly cross-sectional in nature (Cao & Lumineau, 2015; Roehrich et al., 2019), as they use survey data rather than longitudinal data (see Malhotra & Lumineau, 2011 and Palmatier, Dant, & Grewal, 2007 for exceptions). For example, Caniëls and Gelderman (2010) and Liu et al. (2009) assume that relationships are static in nature, thereby precluding a thorough understanding of the dynamic nature of IORs, because analysis from a static perspective is very likely to be unable to capture the dynamic aspects of an IOR. However, collaboration between organizations is unlikely to be static, nor is the role of the two types of governance, the interplay between them and their impact on performance (Cao & Lumineau, 2015).

More specifically, the importance of the role that the two governance models play in long-term IORs may vary over time. Skjøtt-Larsen & Halldórsson (2006) state that parties in an exchange alter and adjust governance periodically when necessary, and depending on the relative weight assigned to them at specific points in time. Selviaridis and Spring (2010) also demonstrate how parties switch their emphasis between the “contract” and the “relationship” as critical events unfold in the relationship. For
instance, suppose that the buyer fails to pay the supplier on time. In such circumstances, the supplier may adhere to relationship rather than contract since the benefits from the long-term relationship outweigh the short-term economic gains. Moreover, the development of trust between two parties is also very likely to be dynamic rather than static. In some situations, the development of mutual trust may lead organizations to renegotiate their initial contract, and in turn, this contractual renegotiation may foster new trust dynamics (Lumineau, 2017). The study from Olander, Hurmelinna-Laukkanen, Blomqvist, & Ritala (2010) suggests that both the relative importance of the two governances and the interplay between them may change in different phases of the collaboration. In the exploration phase, relational governance substitutes for contractual governance, while in the development phase they complement each other. The varied importance of the two governances and the dynamic process of the interplay between them very likely give rise to a performance dynamic.

Thus, for a better understanding of the dynamic nature of the two governances in IORs, a dynamic perspective is required. Many scholars (Cao & Lumineau, 2015; Faems, Janssens, Madhok, & Van Looy, 2008; Roehrich & Lewis, 2014; Roehrich et al., 2019; Zheng et al., 2008) have called upon researchers to conduct longitudinal research or to apply a process model in their research on the dynamic interplay of contractual and relational governances and their impact on performance over time. This is because research with a process or dynamic perspective that focuses on actors, temporal orders, and the sequence of critical events is able to explain how things change over time (Langley, 1999; Langley, Smallman, & van de Ven, 2013; Pettigrew, 1997; Van de Ven, 1992). Studying governances and performance as processes, through analysis of partners and critical events, could allow us to gain an enhanced understanding of how these two governance models and performance are related.

Nevertheless, only a few studies approach governance using a process perspective. For example, the study by Faems et al. (2008) illustrates that structural and relational aspects are linked and that they mutually influence each other over time. More
specifically, the nature of formalization (e.g. performance-oriented versus behavior-oriented monitoring mechanisms) triggers different kinds of trust dynamics. Trust is furthermore found to influence contract application (i.e. rigid versus flexible), which again affects trust dynamics (i.e. respectively, negative versus positive). Olsen et al. (2005) demonstrate that there is a specific and complex interplay between the use of incentives, authority, and trust. In line with Howard, Roehrich, Lewis, & Squire (2017), they find that the proper use of one governance mechanism improves the use of the other, while inadequate use of such one mechanism hampers the use of the other. Zheng et al. (2008) investigate how the two governances are deployed over time in long-term public – private partnerships. The study finds that the significance of relational governance follows an incremental, cumulative trajectory, and contractual governance is also incremental but cannot move with the same degree of freedom. Howard et al., (2017) find that inter-organizational disagreement on what governance mechanisms to use has a negative effect on performance. Furthermore, when one mechanism is not functioning (i.e. dysfunctional governance in the form of being unable to coordinate a project (contractual) or not honouring obligations (relational), this tends to dominate the relationship until resolution is achieved.

After reviewing these studies, it is clear that, in the main, attention has been paid to the changing significance of the two governances and the dynamic process of interplay. However, little attention has been paid to investigating the performance dynamics. In other words, the majority of the studies with a dynamic or process perspective focus on investigating how the two governances are applied over time and how these two affect each other. However, few studies have devoted themselves to the question of how the interplay between the two governances affects performance dynamics. Why is this question important? Because, as Roehrich et al. (2019) point out, actual performance in IORs may trigger adaptations in contractual governance and/or relational governance (e.g. Selviaridis & Spring, 2018). It means that performance can also have impact on the use of two governances. As a result, it might form a feedback loop between the
interplay of the two governances and performance. However, a thorough understanding of this feedback loop is still lacking in the literature of contractual and relational governance. To fill this theoretical gap, using a longitudinal research design, this research aims to develop a process theory by investigating how the two models of governance (contractual and relational) and performance affect each other, over time, in IORs. To be more precise, the aim is to contribute to the governance literature by providing an integrated view of the dynamic process, of both how these two governances affect performance dynamics, and how performance dynamics affects the use of the two mechanisms in IORs.

3.2 Performance shortfall and strategies

Section 3.2.1 introduces the construct of conflict and its relationship to performance shortfall, followed by a discussion of performance shortfall in PPPs. Section 3.2.2 explains two governance strategies in dealing with performance shortfall.

3.2.1 Performance shortfall in PPPs

Deutsch (1973) states that a conflict exists whenever incompatible activities occur. Rex (1981) explains further that a conflict happens in a situation in which A fully understands what is expected from him, but rejects the line of conduct that B requires, while A is prepared to pursue both his own goals and the line of action by which he proposes to achieve them. Vaaland and Håkansson (2003) extend this definition in the context of conflicts in inter-organizational relationship (IOR) settings, where a conflict occurs when one organization discovers that another party is hindering its interests or goal achievement (Cahill, Goldsby, Knemeyer, & Wallenburg, 2010). Based on the work of Pondy (1967), Vaaland and Håkansson (2003) conclude that an organizational conflict consists of five episodes, the latent conflict, perceived conflict, felt conflict, manifest conflict and conflict aftermath.
Conflict is one of the main characteristics of IORs, since IORs contain many potential conflicting forces: behavioral contradictions (cooperation vs. competition), temporal contradictions (short term vs. long term), and structural contradictions (rigidity vs. flexibility) (Das & Teng, 2000). Conflict is a critical area of study, because it happens frequently in IORs, and it has important economic and social consequences (Lumineau, Eckerd, & Handley, 2015).

Conflict is also almost inevitable in public–private partnerships (PPPs), because a PPP project normally involves a sophisticated and long-term agreement and multiple stakeholders with different beliefs, interests, and objectives (Osei-Kyei, Chan, Yu, Chen, & Dansoh, 2018; Zheng et al., 2008). This study refers to conflict as the manifested conflict suggested by Vaaland and Håkansson (2003), that may follow a path towards negotiation, voluntary mediation with third-party assistance, arbitration, or might even end up as a decision in court.

Several studies in conflict management have applied the theoretical lens of contractual and relational governances. For example, Malhotra & Lumineau (2011) state that if a conflict occurs in a PPP project, it calls for governance intervention (contractual or relational) in the dispute resolution process. Lumineau & Henderson (2012) investigate how and when different governance mechanisms influence buyer–supplier relations when a conflict has actually surfaced. Furthermore, Eckerd & Sweeney (2018) claim that the governance approaches that organizations use to resolve conflicts will have a discernible impact on the outcome. These studies have focused attention mainly on the two governance strategies after a manifested conflict or dispute has occurred. In other words, they focus on dispute resolution strategies in the conflict aftermath. However, conflict escalation is a process, which begins when one party perceives that another has frustrated, or is about to frustrate, some concern of theirs (Thomas, 1992). This starting point of the conflict escalation has been categorized as a perceived conflict (Pondy, 1967; Vaaland & Håkansson, 2003). To fill the literature gap, this study applies the theoretical perspective of the two governances at the very starting point of conflict.
escalation, rather than the conflict aftermath, and investigates how the two governance strategies may affect the direction of conflict development. The study refers to performance shortfall (i.e. actual project performance being lower than contractually required performance) as a perceived conflict that may or may not escalate to a manifested conflict or dispute. As this study progressed, it appeared that in all four projects studied (see Chapters 4-7) the two parties faced sudden increases in project complexity, a challenge that literature has not typically addressed (Chandrasekaran et al., 2016). These sudden changes often result in a performance shortfall. When that occurs, the business relationship can deteriorate and the outcome becomes uncertain (Vidal et al., 2016). On one hand, the changes may give rise to dissolution or conflict escalation, which lead to the breakup of the relationship. On the other hand, they may cause reactions that lead to restoring relationships that have already started to deteriorate. The deterioration of the business relationship begins with a performance shortfall as a trigger. The trigger not only gives rise to a technical process for problem resolution, but also leads the two partners to question the pursuit of the business relationship. Different strategies from the two parties involved play a role in determining project performance and relational quality between the partners over time, and in turn, project performance and relational quality might also determine the use of strategies. The next section elaborates further on the two different governance strategies used to deal with a performance shortfall that might trigger a conflict escalation or dissolution.

### 3.2.2 Two governance strategies

#### 3.2.2.1 Contractual governance strategy

In the specific context of PPP in this study, contractual governance strategy for dealing with a performance shortfall refers to the use of contractual control as a response and/or the use of a competitively self-serving solution in response to a performance shortfall (Bello, Katsikeas, & Robson, 2010). Contractual control means that partners tend to use
contract as a vehicle for solving performance shortfall. In other words, the organization explicitly measures and verifies its partner’s performance by directly monitoring whether agreed-upon actions have been implemented (Bello et al., 2010). For instance, the customer may carry out more tests or inspections to determine whether contractors are delivering contractually required performance. They may rigidly enforce penalties upon the discovery of performance shortfalls. On the other side, contractors may argue that the customer is responsible for a performance shortfall as they have not provided the correct inputs in accordance with the contract. Under a contractual governance strategy organizations increase the level of control over each other behaviors by referring to contracts. It is not necessary for partners to have had an initial intention of leaving the relationship when adopting this strategy, but nevertheless, mitigating performance shortfalls by emphasizing contractual agreements and possibly enforcement may diminish the potential for relationship restoration (Vidal, 2006), and this may eventually lead to the breakup of a relationship. In this line of reasoning, contractual control is a destructive response to performance shortfalls, as it might induce actions from two partners, such as searching for an alternative partner, threatening to end the relationship or actually ending relationship.

A self-serving solution is also a destructive reaction as it leads partners to turn away from solving problems, implying that partners progressively cease to pay attention to the business relationship and let it deteriorate (Vidal et al., 2016). A self-serving response refers to partners pursuing their self-interest by trying to get a partner to make some concessions while they make demands that are in conflict with their partners’ interests. This does not help address the problem at hand, as very often partners then withdraw resources from the partnership (Bello et al., 2010). When a performance shortfall occurs, the customer may show minimal supportive actions and demand that the contractor solves the problems alone as suggested by the contract. For his part, the contractor may withdraw resources to recover losses due to the performance shortfall.
3.2.2.2 *Relational governance strategy*

A relational governance strategy for dealing with a performance shortfall refers to a constructive response by sharing information to facilitate problem solving and/or an accommodative response by investing in the relationship (Bello et al., 2010). Both information sharing and relationship specific investment are responses that aim to restore the relationship that has started to deteriorate. Information sharing is a response that two partners use to facilitate problem solving through a direct discussion aiming to better understand the situation. The two partners suggest ideal solutions, show the logic of each other’s position and attempt to get all their concerns and difficulty into the open (Bello et al., 2010). This strategy allows unsatisfactory elements to be improved, as partners attempt cooperatively to search for solutions through open discussion and negotiation, while refraining from aggressive and competitive responses. In a business relationship, this strategy implies that the customer will attempt to deal with the problem by speaking and by turning to their contractor in a constructive way that focuses on the search for solutions. By voicing concerns, the customer gives the contractor the necessary indications for correcting the problem that is undermining the business relationship (Vidal et al., 2016).

An accommodative response refers to partners reacting proactively to address the task at hand by investing in the relationship (Bello et al., 2010). Partners work collaboratively toward a compromise and to find common ground between their conflicting interests. The behavior of the two partners is supportive and aims at a solution by investing in the relationship. This strategy implies that the loyal public partner waits for the private partner to bring a solution to the problem that has begun to affect the business relationship negatively, and continues to display symbols of involvement. This response is constructive, as the public partner believes that its private partner will resolve the problem, and this indicates their willingness to give priority to the preservation of the business relationship (Vidal et al., 2016).
To conclude, in a relational governance strategy partners work bilaterally to solve a problem through information sharing and making extra investment in the relationship. In other words, customers and contractors behave cooperatively to develop a solution via open discussion, compromise and negotiation, rather than behaving aggressively and competitively, with increasing resources from both sides of the relationship.

3.2.2.3 Operationalization of two governance strategies

To make clear what the two governance strategies imply in this study, this section compares them on three measurable constructs: resources, communication, and contractual control (Table 3.2). As discussed, a contractual governance strategy refers to the use of contractual control as a response and/or the use of a competitively self-serving solution as a response to a performance shortfall (Bello et al., 2010). Thus, a contractual governance strategy is applied when the partners in a PPP increase contractual control by explicitly measuring and verifying each other’s performance or responsibility against what is specified in the contract. Moreover, the partners might make no extra investment in resources or might even reduce resources in the project, as they pursue their self-interest by claiming that the other partner is responsible for the performance shortfall and trying to get that partner to make an extra investment.

Resources refers here to financial (e.g. euros), human (e.g. employees) and physical resources (e.g. equipment). Regarding communication, which in a contractual governance strategy stands for transparency, the intensity of information exchange between the two parties remains unchanged or may decrease. Becoming involved in a contractual discussion may prevent each party from sharing information that is useful for problem solving because the each party is concerned, that the other may take advantage of information they have shared.

A relational governance strategy is defined as partners in a PPP showing a constructive response to a performance shortfall by sharing information to facilitate problem solving and/or making an accommodative response with aim to recover the relationship. Thus,
a relational governance strategy is applied when partners increase transparency and intensity of the communication and make extra investment in resources. They aim to recover the relationship in a bilateral way by sharing useful information, suggesting possible solutions, and increasing resources to address the tasks at hand. Contractual control may remain unchanged or reduced, because after appreciating the logic of each other’s position and concerns, partners may focus less on the contract so as to give each other more contractual flexibility to adapt and coordinate better in the new situation and so to solve the problem collectively.

Table 3.2 Four strategies linked to governance mechanisms

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Resources</th>
<th>Communication</th>
<th>Contractual control</th>
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<td>Contractual governance</td>
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<td>Relational governance</td>
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3.3 Concluding remark

The literature review on the two governance models concludes that limited academic attention has been paid to investigating the dynamic aspects of the two governances, namely the changing roles of the two governances, the dynamic process of interplay, and performance dynamics. To the best of my knowledge, little research has studied how the dynamic interplay of the two governance models affects performance dynamics and how performance dynamics in turn affect the use of the two governance models. To fill this theoretical gap, the following research question is proposed: how do the two governances (contractual and relational) and performance affect each other over time in IORs. The literature in the domain of conflict management is also reviewed under the theoretical framework of the two types of governance and the result shows that much endeavor has been devoted to studying conflict development and escalation (Bijlsma-Frankema et al., 2015; Coleman et al., 2007; Perlow & Repenning, 2009), while only a few studies have applied the theoretical lens of governance mechanisms into the domain of conflict research. These studies focus their attention mainly on how
the two governance strategies are in play after a manifested conflict or dispute. In other words, they focus on dispute resolution strategies in the conflict aftermath. However, conflict escalation is a process, which begins when one party perceives that another has frustrated, or is about to frustrate, some concern of theirs (Thomas, 1992). There is a lack of understanding on how the two governance strategies come into play at the outset of the conflict escalation. In the specific research setting of this study, performance shortfall is considered as a trigger for this escalation process. Thus, the research question is refined as follows: “In an outsourced infrastructure innovation project that is a PPP, how do the two governance strategies for dealing with performance shortfall and performance affect each other over time.”
Chapter 4 The Case of Riverboard and Mouse

This chapter presents the first case study of the research, the case of Riverboard and Mouse. The chapter introduces the background to the case, followed by the narrative of how two parties, the Dutch Water Authority, Riverboard, and its contractor, Mouse, interacted during the project stages (the tender and selection stage, the design and building stage, and the operation and maintenance stage). The chapter concludes with a reflection on the case findings.

4.1 Case introduction

This case study involves a project to renovate a sludge treatment system in one of waste-water treatment plants owned by Riverboard. In addition to water management and water quality management services, Riverboard is also responsible for waste-water treatment. The waste-water comes from 493,000 households and 30,000 companies that are served by the sewer system. Riverboard produces 150 million cubic meters of treated waste-water and 100,000 tons of sewage sludge per year. Riverboard has approximately 150 employees, of whom half work in the headquarters, and the other half across its 17 treatment plants (See Appendix 2 for more information about the characteristics of this case).

January 2009 - Riverboard did a bench-scale lab study with Squirrel on a new technology of sludge treatment. Squirrel is a Dutch contracting and consulting company committed to developing sustainable technologies for the treatment of solid waste and waste-water. The technology involves pre-treatment of sludge to enhance the biogas production in the digestion process and also to reduce the amount of sludge for disposal.

June 2009 - The promising results of the lab study encouraged Riverboard to start a pilot project. The pilot project was set up in June 2009 with Mouse, who had acquired Squirrel. Mouse is a family-owned company with around 400 employees, offering sustainable solutions in the fields of water, energy and raw materials. The idea behind
the pilot was use the new technology for several months to process the sludge from two of Riverboard’s locations. In February 2010, the results proved to be very attractive: biogas production was increased by 53% and the dewatered sludge dry solids content in disposal sludge was increased by 10%. Both were large improvements to the existing process. More importantly, the new process was energy self-sufficient. Therefore, Riverboard decided to upscale the technology to plant level.

4.2 The narrative

The narrative describes key events that happened in the three stages of the contracting process. Figure 4.1 presents a timeline of key events. The aim of this narrative is to show the dynamic process of how a shortfall in performance occurred, how Riverboard and Mouse tried to resolve this performance shortfall and how the interaction between the two parties led to the outcome.

**Figure 4.1 Overview of key events in the case of Riverboard – Mouse**

4.2.1 Tender and selection stage

January 2011 - Riverboard started the public tender procedure for the up-scaled project. The aim of the renovation project was to achieve a CO2-neutral operation at a lower
cost than the existing plant. The design, engineering, construction, operations and maintenance of the new plant were to be outsourced. Riverboard applied European public tender procedure and required that the new technology should be used for the treatment of sludge and that the installation should be in operation by the end of 2012. There were two rounds of information exchange with contractors in the tender process which lasted for four months. Riverboard used the most economically advantageous tender as a selection criteria. An upper limit of investment in the main installations (€ 4.4 million) was enforced, meaning that bids with costings above this limit would not be considered.

In the tender documents, Riverboard specified input (e.g. around 7000 tons of dry solid sludge per year) and minimum requirements of output, such as the availability of the sludge treatment system, electricity production, dry solid content in disposal sludge, and the maximum chemical usage in sludge dewatering. After pre-selection, only two private companies made bids because of the requirement of the specific technology. Riverboard used the Net Present Value as the awarding criteria, taking into consideration both economic values and the quality of installations.

May 12, 2011 - The tender resulted in the selection of Mouse, as Mouse put in a very attractive bid with estimated performance substantially higher than Riverboard’s minimum requirements. Riverboard’s positive prior experience in the pilot project with Mouse helped create a good atmosphere for the start-up phase of the project. “We did a pilot test with them. The results were good. So they had a lot of confidence in the process and the technology. They really believed in us” - Mouse manager X.

August 2011 - Riverboard and Mouse signed a contract with a total value of € 6.5 million: € 4.4 million for the design and construction of the modified plant (two years), and €2.1 million for operation and maintenance (six years). The contract included an option to extend it twice, each time for a period of two years. A bonus-penalty scheme based on operational performance and availability was included, as well as the
following strict milestones: 60% of contracted operational performance in October 2012; 100% of contracted operational performance in December 2012.

### 4.2.2 Design and construction stage

Design, engineering and construction of the plant was started immediately after the contract was signed. The pilot project resulted in a smooth design and construction stage. “There was a lot of respect for each other. Though there were deadlines in the contract, we were able to manage and we had a good building process”. - Mouse manager X

### 4.2.3 Operation and maintenance stage

**April 2012** - The operation of the new installation started. In **August 2012** Mouse discovered some unexpected problems with the installation: heat exchangers and a steam injector did not work as they had done in the pilot project. Mouse tried to fix these problems by investing extra resources, thinking that there were simple solutions. Mouse designed and ordered a new heat exchanger from its supplier, and modified the steam injector.

**September 2012** - Despite Mouse’s efforts, operational performance did not improve. Even worse, Riverboard also discovered the problem of a high percentage of sludge in the water line due to the underperformance of Mouse in the sludge line. At this point, Mouse had to open up to Riverboard: “We saw the problems with the heat exchangers: we thought they were small, so we changed them quickly. But we were still having problems. Then we told Riverboard it was not working but we were working on it.”- Mouse manager X.

**October 2012** - Riverboard pointed out that too little sludge was being processed by Mouse, leaving a great deal of sludge returning to the water treatment line. Mouse explained the low processing volume was due to their building of a new decanter, the
carrying out of testing work, and the weekly inputs into the sludge treatment process being different from the contracted levels. As the first deadline was approaching quickly, communication was intensified, which enhanced mutual understanding and helped to maintain trust. “The open atmosphere was there.” - Riverboard manager X. “Both parties agreed communication had to be on a good level of frequency.” - Riverboard manager Y. “We had a meeting every two weeks to inform about the development of the project and problems that we were engaging with. We were always on speaking terms with Riverboard. I had the feeling that Riverboard was also satisfied with the way we worked together.” - Mouse manager X.

Meanwhile, Mouse had missed the first deadline of 60% of contracted operational performances, implying that according to the contract they would receive a penalty. Nevertheless, Mouse remained highly committed to solving the problems, as they had seen considerable interest from other water authorities, in the Netherlands and abroad. “What we did constantly is to communicate problems, associated risks and potential solutions. In this contract, we are responsible for performance, so it is our responsibility to find a solution.” - Mouse manager X. “If we failed, it would affect our reputation and future contracts with this water authority and with all others. We want to be a reliable partner.” - Mouse manager X.

While Mouse worked extremely hard to get the plant running and meeting original specifications, Riverboard invested additional resources to re-investigate the feasibility of the technology by carrying out an audit. “We got the order from top management to make some kind of audit. We checked the process, went through all equipment and ask questions: Does it work well technically? Can it reach capacity?” - Riverboard manager Z.

November 2012 - Mouse communicated new test results to Riverboard indicating that the steam injector would have to be further adapted, and that the new heat exchangers had been tested and improved. Even though the plant was not yet running at full capacity, performance was improving. Communication remained intensive and open.
The face-to-face communication was now also supported by objective performance data. “We informed the customer about our plans to solve problems and what progress we were making. We also paid more attention to the actual figures we produced. We had several appointments with each other to check what the performance of the installation was.” - Mouse manager X.

**December 2012** - Riverboard’s top management received the intermediate audit report, which demonstrated that the contracted operational performance would not be achieved on time, meaning that Mouse would get another penalty. However, it was still feasible for Mouse to achieve the initial contractual target. "It was an innovation. So they said they needed more time. In the contract, however, there was a paragraph saying if you are later, you pay for it." - Riverboard manager X. And he also said: “I believe when you start to work together, you got to trust each other. We knew the technology worked on a small scale. There were possibilities for Mouse. We saw they had technical problems, which, however, could be solved.”

**January 2013** - A new test result showed that the installation was still underperforming. Mouse had at this moment managed to solve the problem of the steam injector, but the problem of the heat exchangers remained. To show their commitment, Mouse proposed two other potential solutions: enlarging the capacity of the existing heat exchanger or adding an extra heat exchanger in parallel to the existing one.

The continued failure of Mouse to solve the problem started to reduce Riverboard’s confidence in the company successfully completing the project: “I did not lose my trust in Mouse, not at all. I only lost the belief that they could meet the requirements in the contract. The problems were too big: not a matter of weeks but of months and involving so much money.” - Riverboard manager X. “We told them that we had found the solution to the problem. However, the problem was still occurring. They (Riverboard) must have thought it was much more difficult to solve the problem, to manage this kind of installation under these conditions.” - Mouse manager X.
Riverboard redirected the issue to top management. Mouse in turn got to the point where they could no longer see a way out. “We had to go to the top manager of Riverboard saying that this was not working for us. We found it very hard to achieve. We would have to make a lot of changes which would cost us too much money.” - Mouse manager X.

By the end of January, Riverboard had an internal discussion on whether to formally terminate the agreement in mid-March 2013 (being the date of maximum penalty). Termination would enable Riverboard to avoid the period of non-compensation that would follow after receiving the maximum penalty. But irrespective of the financial aspect, the dependency of Riverboard on Mouse was very high, due to the limited number of providers that would be able to operate this black box installation. “If we had stopped, there would only be losers. Riverboard would not have an installation and we would have a failed project. Riverboard would have had to issue a new tender for the technology.” - Mouse manager X. “We wanted to have this new technology but we also knew we were not able to operate it. We were dependent on the skills and the knowledge of Mouse.” - Riverboard manager Z.

February 2013 - The final results of the audit starting from October confirmed that the new technology worked but with problems in heat exchangers. “The problems were big but it was a technical problem not a technological problem. From the audit, we knew the technology was working but with limited capacity and there was a problem with the heat exchanger.” - Riverboard manager Z. This enhanced Riverboard’s confidence that the required operational performance could be achieved, though not on schedule.

Riverboard, however, had to decide either to continue the contract, accepting the time delay and extra expenditure, or to terminate the contract, being left with a plant that was not running and facing reputational damage. Mouse was confronting essentially the same dilemma, where continuing would mean further financial loss, and termination would mean incurring substantial financial loss, a highly dissatisfied customer, reputational damage and a disinvestment in the new technology. All in all, it was clear
to both organizations that terminating the project was not an option. Instead, the senior management of both organizations got into a room and agreed that they would find a solution. “What has been very important was that the directors met and expressed their belief in a solution: ‘Whatever happens, we will solve this together!’ That was then the point of departure, top-down, for all solutions that were implemented thereafter.” - Riverboard manager X. This meeting finally resulted in a request to Mouse to continue the project and to 1) explain the financial implications of the current situation; 2) bring in a legal advisor; and 3) identify and illustrate different possible scenarios.

**March 2013** - Mouse reported the status of the project to Riverboard, outlined Mouse’s position and proposed a potential solution to continue optimizing the installation. An endorsement from Riverboard was needed, however, since the proposed solution involved an additional investment by Mouse of over € 500k, while Mouse was already suffering a €2 million loss. In addition, the current contract actually inhibited further development of the technology, as it provided no incentive for Mouse to make further investment. Mouse therefore proposed three scenarios, each involving financial and contractual adjustments: 1) realizing technical optimizations and finding a compromise between the two parties in the final financial arrangements; 2) extending the scope of the contract by including additional equipment, thereby enabling Mouse to earn back some of their investment; or 3) extending the duration of the contract and offering Mouse the possibility of fully earning back their investment over time. Both parties agreed that time would be crucial to make the project a success. “*Riverboard’s top management asked Mouse’s director: ‘Do you believe in it [the technology]? And if so, what do you need?’ Mouse’s answer was: ‘Yes, but we need time. We will do it eventually, but we cannot right now. If we have to pay the penalties stated in the contract, it is not possible for us, we will go bankrupt and the plant will have to be closed.’*” - Riverboard manager X.

**May 2013** - The original contract was redesigned. Contractually required performance was adapted to focus on the financial rather than the technical performance of the
installation. More specifically, the technical performance deadline was replaced by a financial performance framework measured by the annual operational cost. Mouse were required to achieve an annual cost saving of €600 K based on the technical performance they had described in their original bid. Furthermore, Riverboard explicitly expressed their intention to extend the duration of the contract to ten years. The old bonus-penalty scheme was also replaced with one that permitted 50:50 profit sharing on the saving amount that was above the target, and 100% compensation by Mouse if the savings fell below target. Together with bank guarantees, the new contract enabled Mouse to make a profit at a later point, which gave Mouse the time, flexibility and motivation to continue investing in the installation. “In the new contract, there was a drive to perform. Riverboard was guaranteed a certain level of financial profit and any extra costs were covered by us. We have the confidence that we can achieve it and we have the possibility of earning our investment back in time.”- Mouse manager X. “They [Mouse] looked at all the costs: chemicals, electricity, sludge disposal etc. All these values together resulted in a financial gain of € 600K. They are free to change the combination. Higher in chemicals and lower in sludge disposal or the other way around. That's the way to adjust the process and search for a best solution.” - Riverboard manager Z.

February - May 2014 - Mouse modified the installation once more to solve the problems in the heat exchangers. Mouse built an almost completely new installation (the technical solution was even patented), though reusing existing components. An additional € 2 million was invested (about 30% of the initial investment). The modification led to substantial improvements for various technical performance indicators. However, Mouse needed more time to optimize the installation to achieve the associated financial performance. “We reconstructed the installation and we saw that it was becoming better. But it still needed adjustments.” – Mouse manager X.

June 2014 - Two parties found out that the newly designed bonus-penalty scheme could not be effectuated because the financial framework was found to be an inaccurate representation of technical performance. “We changed the contract again with Mouse,
which was all about working together. When you got the problem, you went to each other, trying to find a solution and reach a win-win situation. It was about making clear on contractual boundary and measurement method.” - Riverboard manager X. As a result, the financial framework was redesigned in such a way that: 1) financial figures matched operational figures; 2) all prices were fixed at the level of the reference year 2011, thereby linking financial performance directly to technical performance; 3) all cost components that were unrelated to the installation were omitted; and 4) incentive schemes were improved (i.e., 100% profit for Mouse up to the first €120K; 50:50 sharing thereafter). Riverboard furthermore decided to grant the two contract extension periods of two years as soon as Mouse achieved the agreed-upon operational cost savings. In return, Mouse allowed Riverboard to increase the sludge input specified in the contract, even though this would make it more difficult for Mouse to achieve savings.

December 2014 - Mouse received a penalty of €132K, since the big modification in February had required the installation to be shut down completely. Nevertheless, this modification did result in a substantial increase in operational performance.

September 2015 - Performance was increasing, but still did not perform to target. Mouse therefore incurred a further penalty of €135K. The improvement in performance, however, made Mouse willing to invest further in optimizing the installation.

September 2016 - Following additional modifications, the full capacity of the installation was now realized. The percentage of dry solid content of disposal sludge had reached 32%-35%, approximating the performance of 34% that had been offered in the bid. Finally, in financial terms Mouse had started to earn a bonus (€180 K).
4.3 Case reflection

4.3.1 The road to a close relationship

The renovation project was highly complex. The project size (€ 6.5 millions) and scope (only a sludge treatment system) were relatively small, yet it involved a new sludge treatment technology, which was the first time it was applied at plant scale anywhere in the world. In order to secure the project, Mouse promised a very high operational performance at tender, assuming that upscaling the project would be unproblematic. Achieving such a high level of performance as was contractually required and within such a strict time framework made it even more challenging for Mouse. Not surprisingly, unexpected technical problems, which had not occurred in the lab and pilot projects, appeared at the operational stage, causing a performance shortfall, and meaning that actual project performance was lower than what was contractually required.

Mouse showed their loyalty to the partnership by quietly investing more resource and trying to solve the problems. However, the problems remained and the performance shortfall increased. Mouse chose to open up and voice their problem to Riverboard. The communication was intensified. Transparent information sharing helped build mutual understanding and sustain mutual trust. As a response, Riverboard were also loyal by investing more resource in the investigation of the problem and re-evaluating the feasibility of the new technology. Over time, the project performance continued to worsen, thus the performance shortfall enlarged, as a result, trust was negatively affected. But thanks to the transparent atmosphere and mutual understanding, trust was sustained at a level that was sufficient to continue the collaboration.

The result from the audit confirmed the feasibility of the technology. However, continued failures to solve the technical problems by Mouse made both parties realize it was impossible to achieve within the agreed time frame the high level of performance
that was contractually required. As the feasibility of the project became increasingly unlikely, trust decreased to a historically low level. At this tipping point, focusing on contract control and breaking the relationship was an option, yet both parties adhered to relational strategies. The trust in the technology and the goodwill of Mouse caused Riverboard to take such a decision, while confidence in the technology and potential future customers motivated Mouse to increase their commitment and make more relationship-specific investment. The two parties accommodated each other to solve performance shortfall. Riverboard allowed a contract redesign, through which a prevention-oriented contract (strict deadline, technical focus, big penalty and small bonus) was changed into a promotion-oriented contract (no deadline, financial focus, profit sharing and contract extension), meaning that the two parties focused less on contractual control. The redesign of the contract made it possible for Mouse to invest further in the project. Mouse saw the greater feasibility in the project as they did not have to achieve operational performance in the short term and had the chance to profit in the long run. Relational strategies allowed two parties to find the solution to the technical problem and rebuild trust. After more than two year’s continuous efforts, the two parties managed to increase project performance and reverse performance shortfall. In the end, the contractually required performance was achieved and the two parties developed a close relationship.

4.3.2 A static perspective

The static case reflection is done by using the five main concepts (Table 4.1): project complexity, performance shortfall, strategies to deal with performance shortfall, project performance and relational outcome, as introduced in Chapter 2. The high complexity of the project and the contractually required high performance lead to inevitable performance shortfall. The relational strategy to deal with performance shortfalls helps sustain mutual trust, when the project performance continues to decrease. When two
parties realize that achieving a high contractually required performance within a strict
time frame is an impossible mission, trust in technology and goodwill provides a
foundation for both parties to continue using a relational strategy, which in turn
accommodates them in finding the solution to the problem, improves project
performance and rebuilds trust.

Table 4.1 Summary of main concepts used in a static perspective

<table>
<thead>
<tr>
<th>Concepts</th>
<th>Case of Riverboard – Mouse</th>
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</thead>
<tbody>
<tr>
<td>Project complexity</td>
<td>High innovation level, small project size and scope</td>
</tr>
<tr>
<td>Performance shortfall</td>
<td>Low operational performance in the operation and maintenance stage</td>
</tr>
<tr>
<td>Strategy</td>
<td>Relational strategy</td>
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<tr>
<td>Project performance</td>
<td>Financial performance achieved</td>
</tr>
<tr>
<td>Relational outcome</td>
<td>Close relationship</td>
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</tbody>
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4.3.3 A dynamic perspective

In this section a dynamic perspective is taken to reflect on the narrative, as shown in
Figure 4.2. A highly complex project with innovative technical solutions often means
an unknown performance, as neither party knows exactly what level of performance
they can expect. Given this situation, it is very likely that a contractor bids an unrealistic
offer in a competitive market, with the result that a high level of performance is
contractually required. Unexpected technical problems lower the actual project
performance, and together with the higher one contractually required, it leads to a
performance shortfall. This performance shortfall reduces the perception of project
feasibility, and this has a negative effect on trust. Positive prior experience and high
potential of the project promote information sharing between two parties to
accommodate problem solving. This relational strategy, with its emphasis on
communicating concerns and sharing information transparently, helps build mutual
understanding of each other’s positions and problems, and sustains the trust. Focusing
on voicing concerns also implies that two parties focus less on contractual control. By means of a contract redesign, the contractually agreed operational performance may be achieved in the longer term and in a more flexible way. With sufficient trust in each other and in the technology, the two parties remain committed to the project. It motivates both parties to make extra relation-specific investment to the project, which improves project performance over time. In the end, the two parties are able to solve the performance shortfall collectively, which increases project feasibility and trust. All these dynamics eventually result in a close relationship.

Figure 4.2 The dynamic process in the case of Riverboard – Mouse
Chapter 5 The Case of Brookboard and Elephant

This chapter presents the second case study, the case of Brookboard – Elephant. The chapter begins with an introduction to the background of the case, followed by the narrative of how two parties, the water authority Brookboard and contractor Elephant, interacted at different stages in the project, namely the tender and selection stage, the design and building stage, and the operation and maintenance stage. The chapter concludes with the highlights of the narrative and reflects on the narrative from both static and dynamic perspectives.

5.1 Case introduction

This case concerns also a renovation project of a waste-water treatment plant (WWTP) in Brookboard. Brookboard is one of the 21 water authorities in the Netherlands. Like other water authorities, it provides secure dikes and quays, manages the quality of surface water, regulates the water level, and treats waste-water. Brookboard has eight WWTPs, through which it provides waste-water treatment services to households (around 840,000 residents) and industry in 34 municipalities (See Appendix 2 for more information about the characteristics of this case).

January 2010 - Brookboard decided to renovate one of their WWTPs and turn it into a new plant that could provide sufficient energy to account for 40% of its total consumption. The project aimed to apply the innovative sludge treatment technologies available in the market. The design, construction and some parts of the maintenance of the new sludge treatment facility were to be outsourced, while the operation and the majority of maintenance was kept in-house so as to fully leverage the knowledge and expertise within Brookboard.
5.2 The narrative

The narrative describes key events that happened in the major stages of the contracting process. Figure 5.1 presents a timeline of key events. The aim of this narrative is to show the dynamic process of how a performance shortfall occurred, how Brookboard and Elephant tried to solve this performance shortfall and how this interaction between the two parties led to the outcome.

Figure 5.1 Overview of key events in the case of Brookboard – Elephant

5.2.1 Tender and selection stage

July, 2011 - Brookboard started the tender with three boundary conditions, namely availability of installation (minimum 98%), energy production (minimum 6 million kWh/year), and most importantly the time interval of return on investment should not exceed 10 years. The scope of project consisted of design, build, and fifteen years’ maintenance of the sludge treatment system. Brookboard introduced functional specifications, which meant that a contractor had full freedom to design the process as long as they met the minimum functional requirements. The European tendering procedure was used, involving five pre-selected contractors, two rounds of information exchange over a period of seven months and using the most economically advantageous
tender as a main award criterion. This resulted in the preliminary selection in early March, 2012 of Elephant, a listed company specialized in property development and civil engineering. Elephant is active in the Netherlands as a technology partner who delivers know-how and concepts for private consumers, companies and public organizations. It has more than 6000 employees and an annual revenue of €2 billion.

Brookboard’s most recent experiences with Elephant in other projects were positive, so the project began in a good atmosphere. Brookboard officially awarded the contract to Elephant at the end of March 2012, since Elephant had offered the most economically advantageous tender, and an innovative technology in sludge treatment which was to be applied for the first time in the Netherlands on a plant-level scale.

April 2012 - The contract was signed for the design and build of the sludge treatment system (€26 million) and for fifteen years’ maintenance of certain parts of the system (€5 million). Contractually required performance was set to the performance offered by Elephant in the tender. The two parties specified the first deadline as December 2012 for a final design, with a penalty for delays of €750 per day. The second deadline was the end of operation testing. Elephant had to cover the extra cost in disposal sludge compared to the business case offered in the tender, if they did not meet the deadline.

The completion of construction was due in April 2014 with a penalty of €3K per day. The third deadline was the end of guarantee period. By April 2015, Elephant had to deliver the promised operational performance. The contract consisted of both penalty and bonus. However, the penalty limit of €26 million was much higher than the bonus limit of €1 million.

5.2.2 Design and building stage

September 2012 - Elephant underwent an organizational change, and, as a result, the original project manager from Elephant was replaced by a temporary manager. As a result, the communication between the two parties suffered, since much information
and many informal agreements were lost. “We had a good start up with the first project manager. But he was replaced by Elephant, which did not help in making arrangements and having discussions.” - Brookboard manager X.

December, 2012 - Elephant appointed a new project manager to the project. Soon Brookboard received a final design from Elephant proposing two big system changes compared to the general design in their original offer. Brookboard was surprised with the changes, as Elephant had not communicated them earlier. Elephant justified the changes on the grounds that they were beneficial for the technical performance of the system, but Brookboard did not understand the underlying logic, and was concerned about the impact of the proposed changes on the performance and the subsequent maintenance of the installation. In response to the changes, Brookboard began to voice their concerns. “We said to Elephant that they had to build what they offered, or they could change our agreement. We needed all the information about the changes to see if the system would perform in the same way as what they had offered and would meet our requirements.” - Brookboard manager X. Under these circumstances, the relationship, too, was under pressure. “The conflict has affected our trust. We saw that Elephant was only driven by money.” - Brookboard manager Y.

January, 2013 - Brookboard sent an official letter announcing that Elephant had failed to deliver a qualified final design by the first deadline, thereby emphasizing they would have recourse to the contract. In response, Elephant made a formal presentation in February explaining the proposed changes, before submitting a detailed implementation design in March. However, Brookboard continued to debate the availability and capacity of the altered system. As in the communication, Elephant did not truly address Brookboard’s questions. Brookboard manager X: “We communicated the problem. But our questions were ignored.” The trust continued to decrease after the announcement. Brookboard thought that Elephant had behaved opportunistically by applying a cost control strategy, while Elephant believed that Brookboard aimed to collect their penalty
by not agreeing the changes. “If we don’t believe each other, it is very difficult to act in a vulnerable way.” - Brookboard manager Y. In April, Brookboard stated explicitly that the detailed implementation design deviated from Elephant’s general design and did not fulfil the original tender requirements.

**June, 2013** - Elephant requested formally that the proposed design changes be implemented. Meanwhile, once again by means of an official letter, Brookboard announced Elephant’s failure to implement the contract and formally rejected the two implementation requests in the end of June.

**July, 2013** – With an official letter, Elephant announced to Brookboard: 1) that they would have to cancel certain planned activities due to the implementation requests being rejected; 2) that the delay incurred would have implications for the final delivery and overall costs; and 3) that Brookboard’s rejection of the changes and associated implementation requests were considered as improper actions. Brookboard then invited Elephant for follow-up discussions, but during these discussions, Elephant was still unable to provide sufficient justification for the changes, nor evidence for the positive impact thereof.

**August, 2013** - Elephant officially confirmed to Brookboard that it had stopped all activities on the site. After that, several mediation sessions took place but the conflict was not resolved. Consequently, Brookboard decided to go to arbitration: “Elephant was pushing it: ‘if you don't agree, you will receive a big claim from us and we will stop building.’ At that moment we decided to go to arbitration.” - Brookboard manager X.

**December, 2013** - Brookboard won the arbitration: Elephant had to deliver the final design in accordance with the original specifications and their own general design submitted during the tender phase, or to a changed design approved by Brookboard.
January 2014 - Elephant sent a list containing 71 design issues to Brookboard and scheduled meetings to explain and discuss their new proposal. Brookboard appreciated having such a list and the involvement of Elephant’s suppliers in the discussions.

March, 2014 - Two parties reached an agreement on all items on the list, except the one that was related to the legal dispute. Brookboard still did not want to give approval, as discussions with Elephant had not resulted in the desired understanding on the aspects of requirements, quality and maintenance. Next, Elephant made a formal appeal, and a new court date was set in November. Meanwhile, the directors of both organizations had engaged in discussions aimed at reaching some mutual agreement, so that the construction could restart. Unfortunately, the legal dispute and associated formal appeal had made open communication difficult. “The playing field is perhaps too small to play the game. You have to give and take, both parties do not know yet what to get or give away.” - Brookboard manager Y.

August, 2014 - Elephant appointed a new interim director, who immediately got involved in getting an agreement on the design issue that was part of the arbitration. Furthermore, Brookboard agreed to a penalty-free level that was within the limits of its powers as a public organization, evidencing its willingness to make room for Elephant to improve their performance. Despite these resolutions and the enhanced mutual understanding, both parties were still careful with their communication, so as not to disclose any sensitive information: “The new director helps build trust but as we said, there is still an appeal. So there is limited room for communication.” - Brookboard manager X.

October, 2014 - Elephant proposed a revised “detailed implementation design”, which still involved the major changes proposed earlier, but also had more capacity and quantity of machines. This increased Brookboard’s confidence in the proposed technical solution they finally believed that the system would result in the agreed-upon
availability and treatment capacity. Meanwhile, Elephant had also assigned more than forty engineers to the design team to finalize the detailed implementation design of the installation. Communication was improved over technical issues, since subcontractors of Elephant were - although limited - also involved in discussions, which helped in decision making. “Very good meeting to exchange information on design. You get clearer answers, which are very helpful in making progress. We got the latest design. We say, well, we can live with it.” - Brookboard manager X.

After a while though, more design issues were proposed by Elephant and communication started to become problematic again, “They wanted to make more changes after all these, so what we did was ask more questions. However, we got no answer.” - Brookboard manager X. Elephant sent a formal letter to Brookboard expressing complaints about the number of questions being asked. In their opinion, this was having negative effects on the design process. “We thought the process was going better, but the letter they've sent last week is not good for building trust.” - Brookboard manager X. Elephant did start construction, but at a very slow pace, as they were unable to get a construction permit. At this point, both parties were stuck in the moment, with neither of them willing to make the first move. Both were waiting for the outcome of the appeal. “It was still a fight. They said they would start if we pay. We said we were not going to pay. Build first and then we come with the money. A never ending story.” - Brookboard manager Y.

**January, 2015** - The verdict of the second arbitration was again favorable for Brookboard. Not only did this imply a financial loss to Elephant, it also created serious cash flow problems for the project, as the penalties (to be) incurred due to the delay canceled out Brookboard’s payments to Elephant. In addition, once more Elephant did not accept the outcome of the second arbitration and referred the decision to the Civil Court. Brookboard’s adherence to the contractually required performance (and likewise Elephant’s), in combination with the financial stakes, continued to hinder both
parties in making a deal, and maintained the performance shortfall. “We said they had to comply with these performance indicators. It would be difficult for them because they tendered with very high figures.” - Brookboard manager X. “The damage is too much at this moment so that it will be a negative project.” - Brookboard manager Y. Trust had more or less evaporated, and communication on maintenance had gone silent. “There's no trust, because we still feel Elephant is not open” - Brookboard manager X.

“There was a period of two or three months, during which we did nothing with maintenance. No meetings. No progress. It's not good to be very defensive in a meeting. To cooperate you must make yourself vulnerable and share information.”- Brookboard manager Y.

May 2015 - Since there were no more major technical issues in design, construction was ongoing and progressing fast due to the hard work of the builders. Project meetings were restored and focused only on technical matters; in contrast, all contractual issues were to be dealt with in a separate dedicated meeting with Elephant’s project director, who was again new to the project. A large part of the construction work finished in May 2015, and delivery of the installation was planned for October 2015. Though the construction was progressing, because of the legal conflict the relationship did not improve. “We still don't trust them. They're not saying anything about the contractual issues. Not really nice to work with them relationship-wise.” - Brookboard manager X.

September 2015 - Commissioning process started. In this phase, about 30 disagreements emerged, many of which were recurring items. As a result, Elephant announced a new delay for which they claimed Brookboard was responsible. “It was a disaster. You can't run a project like this”. - Brookboard manager X. Both sides hired external third parties to map the process and measure the performance of the installation, however cooperation between them was a big problem. “Elephant is very anxious about the penalties so that they would like to work with a grey area, while we
want to make things specific and clear.” - Brookboard manager X. Communication became highly problematic, as both parties continued to display strategic behaviors while waiting for the outcome of the civil court. “The communication is very rigid. It's all recorded now. We both read from papers. It's not a real meeting.” - Brookboard manager X.

**November, 2015** - Elephant delivered the majority of the construction work except for the pipes and cable work, and testing of the installation was commencing. Nevertheless, the handover date of the installation was still uncertain, and the plan for delivery changed several times.

**December 2015** - The disagreement on the delay and the money involved was still ongoing. “With normal contractors, you can discuss solutions. But with Elephant, no, we are too far away.” - Brookboard manager Y. As a result, no real effort was being made on the project. “Some parts of the installation are already running, so I asked them to show me the maintenance plan. They couldn't show it. They are waiting for the result of the civil court. The effort is very low.” - Brookboard manager Y. The judgment from the civil court came in January 2016, and was again negative for Elephant. At that point, both parties agreed to stop litigating and focus on coming to an agreement.

**5.2.3 Contract termination**

**March 2016** – The two parties were intensively engaged with fine-tuning the installation. Here, Elephant experienced a great deal of difficulties: all the individual components seemed to be working, but the installation as a whole did not work as desired. “Elephant don't know how to fix the problems. They've built a difficult system. You cannot just start operating.” - Brookboard manager X. Consequently, relationship continued to worsen: “The trust is zero. Even Elephant said it themselves during the meeting.” - Brookboard manager X.
September - December 2016 - Both parties engaged in discussion of possible contract termination, as Elephant had not been able to achieve the agreed performance technically. “They offered too much. That was the issue. For instance, can they achieve 35% of dry solid content in sludge? No, they can’t.” - Brookboard manager X. “The commissioning date was postponed several times. The feasibility of continuing was gone. We didn’t believe Elephant would finish the job.” - Brookboard manager Y. And relationally, it was also impossible to continue the project. “Belief in Elephant became less every day. Elephant was very defensive. They said they couldn’t achieve the results because of external factors: it was not the right sludge, not the right temperature specified in the contract. The commitment from Elephant had also disappeared because of money. They no longer did anything: they called it the stand-still principle.” - Brookboard manager Y. Eventually, the two parties terminated the contract in December 2016. Brookboard took over the plant as it was, planning to contract out maintenance and any further modifications to various specialist contractors. Elephant incurred penalties of millions of euros and suffered a major loss on this project.

5.3 Case reflection

5.3.1 The road to a broken relationship

The renovation project in this case study was a highly complex project, with a large project size (€ 31 million) and involved an existing, but new to the Netherlands, innovative technology in sludge treatment. Given this high project complexity, a performance shortfall was almost inevitable. As performance was unknown upfront due to the innovative nature of this project, delivering a high contractually required technical performance under a strict timeframe (a complete sludge treatment system in two years and the promised performance within one year after) was an extremely challenging job. The performance shortfall showed up as changes in final design, which did not conform to the general design offered in the tender. Brookboard first applied a
relational strategy by voicing their concerns over the quality of design. Elephant responded with a contractual strategy by neglecting the problem, providing no extra resources to create a new design. No extra effort was invested in finding technical evidence to properly address Brookboard’s concern, as Elephant believed that the quality of design met the contractual requirements. It was not surprising that both parties started to focus on contract, and this escalated, resulting in recourse to arbitration twice and a dispute in a civil court. As a result of the legal battles, project performance was further decreased because of reduced resource investments in the project. The contractually required performance became more difficult for Elephant to achieve, since they had to not only achieve the original contractual target but also to cover penalties and financial losses due to the delays. As a result performance shortfall persisted and became larger.

The focus on contractual control prevented the two parties from transparent information sharing, because both parties were afraid that the information they shared could be used against themselves in court. Thus, mutual trust kept eroding. For a short period of time, Elephant behaved relationally by recruiting more designers to the project, and adding more capacity and more machines to the design. Brookboard responded accordingly by accepting the new design and showing willingness to compromise on the penalty as a result of design submission delay as far as their powers as a public organization allowed them to. However, both parties switched to a contractual strategy as they discovered and realized that they were not able to achieve the high level of contractually required performance, i.e. high operational performance in a strict time schedule with an associated penalty. Consequently, project performance continued to drop, as did the perceptions on project feasibility, mutual trust and commitment to the project. In the end, the two parties reached an agreement to terminate the contract and break off the relationship.
5.3.2 A static perspective

A static perspective reflects on the five main concepts (Table 5.1): project complexity, performance shortfall, strategies to deal with performance shortfall, project performance and relational outcome as introduced in Chapter 2.

Table 5.1 Summary of five main concepts in case Brookboard - Elephant

<table>
<thead>
<tr>
<th>Concepts</th>
<th>Case Brookboard – Elephant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project complexity</td>
<td>High level of innovation, big project size and small scope</td>
</tr>
<tr>
<td>Performance shortfall</td>
<td>Unqualified design in the design and building stage</td>
</tr>
<tr>
<td>Strategies</td>
<td>Contractual strategy</td>
</tr>
<tr>
<td>Project performance</td>
<td>Delay and unachieved operational performance</td>
</tr>
<tr>
<td>Relational outcome</td>
<td>A broken relationship</td>
</tr>
</tbody>
</table>

The high complexity of the project and high contractually required performance lead to a performance shortfall. The contractual strategy to deal with performance shortfalls does not help improve project performance, but prevents the two parties from good communication and information sharing. As a result, mutual trust continues to decrease. After the two parties realize that achieving a high level of contractually required performance within a strict time frame and under severe penalty clauses is an impossible mission, trust drops to an extremely low level. The low level of trust does not allow two parties to accommodate each other in finding the solution to the problem, which eventually results in a broken relationship.

5.3.3 A dynamic perspective

In this section a dynamic perspective is taken to reflect the narrative, as shown in Figure 5.2. A high project complexity leads to a low project performance, and, the coming together of a strict contract (necessary because levels of performance cannot be
anticipated with the innovative technology) and an unrealistic offer results in a performance shortfall.

The perception that the project is feasible starts to diminish. Different contractual interpretations on quality requirements triggered a contractual strategy to deal with the performance shortfall. On the one hand, less relationship-specific investments are made in the project, causing even lower project performance. On the other hand, emphasis on contractual controls increases pressure to produce contractually required performances. Consequently, the shortfall in performance increased. Meanwhile, the emphasis on contractual controls prevents transparent information sharing, in turn resulting in less communication and mutual understanding. With reduced perceived project feasibility and mutual understanding, trust and commitment from both sides decrease dramatically.

Figure 5.2 The dynamic process in the case of Brookboard – Elephant
As a result of adhering to the contractual strategy, project performance continues to drop and the performance shortfall remains unresolved. In the end, ending the relationship becomes the only option for the two parties.
Chapter 6 The Case of Creekboard and Giraffe

This chapter presents the case of Creekboard and Giraffe resulting from within-case analysis. The chapter first explains the background to the project and the water authority Creekboard. It then proceeds with the narrative of how the two parties, the customer and the contractor, interacted at the three different project stages (tender and selection stage, design and build stage, and operation and maintenance stage). The chapter concludes with highlights of the narrative and reflects on the narrative from both static and dynamic perspectives.

6.1 Case Introduction

This case study concerns the renovation project for a sludge treatment system which is located in one of the seventeen waste-water treatment plants (WWTPs) in Creekboard. Creekboard is one of 21 water authorities in the Netherlands that are responsible for water management, water quality management and waste-water treatment. Regarding waste-water treatment, it provides a treatment service to households (around 810,000 residents) and industries (around 24,000 companies) in 21 municipalities. The sludge treatment system in this case study was built in 1973. After years of operation, the installation was still in good technical condition, yet its operational costs were very high due to its high energy consumption and the large amount of sludge generated for disposal. In April 2008, Creekboard decided to replace it with a new installation using sludge digestion and the dewatering of sludge, as this would generate more energy and reduce the amount of sludge to be disposed of. This was common practice in the waste-water treatment business but it took two years of preparation.
6.2 The narrative

The narrative describes key events in the three stages of the contracting process and figure 6.1 presents a timeline of these events. The aim of this narrative is to show the dynamic process of how a shortfall in performance occurred, how Creekboard and Giraffe tried to resolve this performance shortfall and how the interaction between the two parties led to a specific outcome.

*Figure 6.1 Overview of key events in the case of Creekboard – Giraffe*

### 6.2.1 Tender and selection stage

**February 2010** - Creekboard launched the tendering process for the renovation project which consisted of design, engineering, building and maintenance of a new sludge treatment installation, including civil works, equipment for biogas storage and transport, and systems for sludge transporting, handling and treating. Creekboard provided a general design for the installation and asked contractors to create a detailed design. It was the first time Creekboard had outsourced the maintenance of their installations. The purpose of outsourcing maintenance was to motivate contractors to deliver an installation with good quality and reduce the following up maintenance cost, eventually aiming to achieve a lower Total Cost of Ownership (TCO). Creekboard followed the
European public tender procedure and during that process had two rounds of information exchange with contractors. The criteria for awarding were the lowest price, with some minimum technical requirements, which were percentages of dry solids in the disposal sludge, chemical usage, biogas production and energy consumption. In terms of maintenance, contractors had to deliver an installation with minimum requirement of reliability (minimum mean time between failures of 320 hours) and availability (minimum availability of 98%).

**May 2010** – The company Giraffe, together with its partner, won the tender by offering the lowest price for the realization of the installation and 10 years’ maintenance. Giraffe was responsible for design, engineering and maintenance, while the partner was in charge of the construction. Giraffe is a private company that provides service to its customers in the area of new installations, maintenance, facility management, and onshore & offshore constructions and services. It has around 6000 employees and an annual revenue of 1.2 billion. Giraffe has many subsidiaries throughout the Netherlands.

Creekboard had a conflict with Giraffe in a previous project because of a disagreement on the quality of the installations that had been delivered. The conflict ended with the parties having recourse to legal procedures. Because of the conflict, the new project started in an awkward situation, although the new project was with a different subsidiary of Giraffe. “*Dutch regulations on public tendering don’t allow the tendering process to be affected by old relationships. But it was tricky.*” - Creekboard manager X

**July 2010** - Creekboard signed the contract with Giraffe for a price of € 5.7 million with design, engineering and a one-year maintenance guarantee. An installation that met the minimal technical requirements had to be delivered by October 2012. Surprisingly, the 10 years’ maintenance was not in the contract, even though the tender was based on the total cost of ownership including the price of 10 years maintenance.
6.2.2 Design and building phase

**December 2010** - The start of project went smoothly. However, a conflict began to emerge when Giraffe did not deliver the design work on schedule. This caused delay in the project, because Giraffe’s partner could not start building without a detailed design for the installation. Creekboard was very willing to help, but Giraffe was reluctant to communicate the problem. “*Giraffe had a lot of difficulties in design. However, if they had told us earlier, we could've helped them. It would have been better than just waiting.*” – Creekboard manager X. Giraffe was not active because they did not want to invest extra resources. “*They didn’t trust us, because they thought our engineers only wanted what was best for us.*” – Creekboard manager X.

**February 2011** - The conflict escalated to a higher management team as the problem with the delay persisted. After that, Giraffe promised to catch up by investing more resources, while Creekboard thought that what had caused the performance shortfall was the uncertainty over Giraffe getting the 10 years’ maintenance job. “*The uncertainty of getting the maintenance contract constrained Giraffe from spending money on getting the good stuff; they only spent money to get a minimum quality that complies.*” – Creekboard manager X.

**May 2011** - Creekboard signed a letter of intention in relation to maintenance with Giraffe. “*We tried to use a contract to win their (Giraffe’s) confidence.*” – Creekboard manager X. However, the performance of the project further decreased when one of Giraffe’s suppliers became bankrupt and this resulted in extra delay in the project. “*They promised to improve but it went from bad to worse.*” – Creekboard manager X.

**December 2011** - Giraffe changed the project manager and they started to make up time on the schedule. However, Creekboard soon found out that several items in the design did not fulfil the agreed contractual conditions. In other words, they had to renegotiate many of the contractual terms with Giraffe. “*Giraffe proposed twenty items*
and only two or three out of them he (project manager from Giraffe) was right” – Creekboard manager X. As a result, communication and collaboration turned sour. “The new project manager came to meetings but his colleagues were not allowed to talk. This was the moment that you knew things had gone wrong.” – Creekboard manager X. “The first manager did not get his people to do what he wanted them to do, however the intentions were right. While the second project manager made a higher priority of delivering the products, the downside was that he had only one goal to get this project finished as fast as possible at the lowest cost.” – Creekboard manager X.

6.2.3 Operation and maintenance stage

**July 2012** - Creekboard started the operation of the new installation, but the operation cost were three times higher than expected. “We really struggled with the new factory because there were all kinds of failures. The costs of operation went sky high.” – Creekboard manager X.

**December 2012** - Creekboard made a serious threat of legal action to Giraffe. In response, Giraffe agreed to cooperate and deliver the proper level of performance. “There was a message to the board of Giraffe: “Please follow the contract as we agreed otherwise we stop doing business with you. And we will claim every penny that we still need to pay another contractor to finish the job. They decided to not let it get to that point.” – Creekboard manager X.

On one hand, Creekboard thought that granting the maintenance contract to Giraffe could motivate them to deliver better quality. But at the same time, Creekboard started to doubt Giraffe’s ability to carry out good maintenance. “I had to convince maintenance colleagues that the maintenance contract was the way to go. But when the problem with Giraffe started in the building phase, people from maintenance lost their faith.” – Creekboard manager X.
January 2013 - Giraffe proactively sought to regain Creekboard’s trust. Giraffe arranged field trips to its clients’ locations to show they were capable of doing good maintenance. Creekboard finally decided to grant Giraffe the maintenance contract. “They did a good job in making us feel comfortable with the decision to give them the maintenance contract.” – Creekboard Manager Y. Giraffe replaced the second project manager and also appointed a new director to the project. With the new management team in place at Giraffe, both parties tried to improve the situation and rebuild the relationship.

February 2013 - The two parties signed the maintenance contract, which differed from the letter of intention on two points. First, the 10 years’ fixed term agreement was changed to one plus nine years, meaning that after one year, both parties had the right to terminate the contract. Second, the fixed price for maintenance was changed to a maximum price (€ 200 K per year), meaning that Giraffe would be paid upon actual maintenance work. “To rebuild the trust, we had to understand that this was a different team from Giraffe. We agreed to have a try for one year, after that both parties would be allowed to stop.” – Creekboard manager X.

May 2013 - Giraffe managed to solve the major problems with the installation and enhance the operational performance. Giraffe delivered the installation according to the agreed contractual requirements but with a seven-month delay and associated penalty. Both parties had compromised to reach a deal. “It was not optimal, but we tried to stay out of court since going to court would delay us even more.” – Creekboard manager X. Creekboard was satisfied with the installation, but not with the process of cooperation. “We were satisfied with the performance, but not with the process. We had a lot of trouble. It took too long and involved lot of effort.” – Creekboard manager X. The increase of project performance helped in rebuilding trust. “The new project team provided us with the right solutions. We trusted them again, and it worked out the best way possible.” – Creekboard manager X.
January 2014 - After seven months of maintenance, the two parties had many disagreements over the payment for maintenance due to differing opinions on contractual items. The issue was the lack of clarity of some clauses in the contract. For instance, one clause stated Giraffe was responsible for all technical issues, while another clause stated Creekboard was responsible for the cleaning of the installation. But what if the technical problem was caused by the dirt? Then the question was who would be responsible for the cost of repairing.

The situation became worse when the named contacts on both sides left their respective organizations. “At the start of the maintenance phase, communication was good. Then things changed as our contract manager went away. We had no one to provide continuity” – Giraffe manager X. In addition, both parties had a problem with the information system. “By the time I realized that the problems with the system were not yet resolved, it was already five months further down the line.” – Creekboard manager Z. As a result, mutual trust once more started to decrease. “I know I have to rely on them, and to trust. But I can't trust them. The quality issue will become a big problem in a few years when the machine gets old.” – Creekboard manager Z.

December 2014 - Giraffe did a good job in the maintenance in terms of availability and reliability, however Creekboard was not satisfied with the financial performance, as it was above maximum price in the contract. “They did very well in terms of availability, but it was too expensive.” – Creekboard manager Y. Moreover, there was much discussion over the contract and this prevented the two parties from cooperating well. For example, Giraffe proposed a new way of doing preventive maintenance to reduce cost but Creekboard did not support the proposal because they did not trust Giraffe. “It looks good on paper, but in real life, it does not work in this way. They just want to make it easier for themselves. We cannot hold them responsible for the work they do, as there is no penalty in the contract.” – Creekboard manager Z.
January 2015 - After a meeting at top management level, the two parties decided to put additional contract managers into the project. “A good contract manager was needed to improve the situation. In this kind of contract there are always things where you wonder if they are for you or for your contractor to do.” – Creekboard manager Y. With the new contract managers, both parties aimed to first improve the communication. “It was not clear to both parties what happened. The installation does work well. The issues are small. We were making them bigger than they were. We are now trying to make them clear.” – Creekboard manager W.

May 2015 - The communication improved after the new contract managers were in place. “Good meetings, good people. The process of acting together is getting better.” – Giraffe manager X. Giraffe was also more committed to investing in the relationship by trying to reduce the cost. “The message for this year and next year is to reduce the cost. So we must not go above the budget. That's the focus.” – Giraffe manager X. However, the two parties still had financial problems. “When I see the report, my first reaction is: this can't be true! I am inclined to say: I do not trust you.” – Creekboard manager Z.

October 2015 – The two parties clarified the issue of responsibility. The maintenance was divided into two types. The first type was small disturbances and small maintenance jobs which were to be undertaken by the operators of Creekboard. And the rest was for Giraffe – bigger disturbances, modifications, preventive maintenance. “The new contract manager brought a structure of communication. He is better educated on contracts. He knows what is possible. Communication was improved.” – Creekboard manager Z. However, Creekboard was still not satisfied with the financial performance, as there were still extra costs for maintenance jobs that fell outside of the scope of the project. Creekboard thought some of the cost should be borne by Giraffe. “Their maintenance engineer made a new plan, which was the same as the plan we already had but he also set down all his hours on the bill. Be open about cost. Be
realistic. The report still just does not inspire a lot of trust.” – Creekboard manager Z.

“The report is rather superficial. There is a gap between the image created by the report and the image we have as operators.” – Creekboard manager P.

November 2015 – The two parties reached agreement on the extra cost of the maintenance. “The costs for the first line of maintenance will be extra. There's no discussion about this. The costs are not for maintenance but for Operations.” – Creekboard manager X. “We asked for more so we had to pay more. But the problem was we never realized we had asked for more.” – Creekboard manager W.

The relationship was also improved. “The new contract manager from Giraffe is very positive. He wants to do it right and so there is trust. That is getting better.” – Creekboard manager W. More importantly, both parties started to work together to reduce costs. “We agreed with Giraffe that they worked out a complete list of spare parts. We can further improve to make the costs go down. And Giraffe told me they are going to improve the information system next year.” – Creekboard manager Z. Nevertheless, Creekboard still did not fully trust Giraffe, since the financial performance was still not entirely satisfactory. “I think the way we work now is OK. However, Giraffe was and is still, a stubborn firm. – Creekboard manager Z. “The performance of Giraffe is not as good as I expected. I thought they would be more proactive. They would solve things sooner” – Creekboard manager P.

March 2016 - The two parties continued to improve cooperation. “We both always try to find a solution. If you see the reports, you see that there are costs outside the scope of the project. But we are working on that. They send good people to us.” – Creekboard manager Y. The mutual trust continued to increase but there was still room for further improvement. “The relationship is good except for a couple of little disagreements. I think it is sufficient to continue the relationship.” – Creekboard manager Y. “It
improves, but not enough. We just have different perspectives. We have to understand each other's perspectives! It needs to be right for trust.” – Creekboard manager Z.

May 2016 - Collaboration continued and both parties invested more in further improvement. “We made progress. What really happened was that we got on speaking terms with each other: how we worked and who was responsible for what part within the contract.” – Creekboard manager W. The technical performance was good and the financial performance was also improved. “There were no breakdowns that are the responsibility of Giraffe. The feeling was that it is all working well.” – Creekboard manager P. “I think we are within budget. Good sign! I still think the cost is high. But I am happy with it. We are getting more insights into the different costs, which is very important.” – Creekboard manager W.

Giraffe also made improvements to the report, though there was still discussion arising from the problems with information system. However, it transpired that the main cause of the information system being incompatible lay with Creekboard. “To solve the transparency problem, we have to start with our own organization. However, our organization was not ready.” – Creekboard manager W. Trust continued to grow as a result of the improvement in performance. “I trust the people who are on the job. Giraffe is willing to improve or cooperate since they also want to make this contract a success.” – Creekboard manager W.

6.3 Case reflection

6.3.1 The road to an arm’s-length relationship

The renovation project in this case study was a project of relatively small size (€ 5.7 million) with a limited scope that involved only a sludge treatment system. Moreover, the technology used in the sludge treatment in this case was already common practice in the field of waste-water treatment. The project complexity was relatively low
compared to other renovation projects. However, performance shortfalls still occurred because of a delay in the submission of detailed designs and poor financial performance during the operation and maintenance stage. At the beginning of the first performance shortfall, Giraffe applied a contractual strategy, as they didn’t want to produce designs to a quality standard that was higher than requested. Creekboard used a relational strategy by showing their willingness to assist in design and to offer a maintenance contract. Because Giraffe ignored repeated requests, both parties were forced to focus on the terms of the contract. But the two parties did not agree on the level of performance that was contractually required. After a threat of legal action from Creekboard, Giraffe switched their strategy to a relational one, as they still perceived a sufficient level of project feasibility and could see the benefits of getting a long term maintenance contract. They began to initiate more communication, which convinced Creekboard to finally assign them the maintenance contract, and to invest more resources in the project, both of which led to better project performance. Creekboard also agreed to give a discount on the penalty resulting from delay. Fewer contractual controls and extra investment allowed Giraffe to deliver an installation with a good operational performance.

The second performance shortfall occurred in the maintenance stage. The monthly maintenance cost was higher than the maximum price in the contract. Both parties had to change the named contact person due to employees leaving, and this led to reduced human capacity on the project. There was much contractual discussion at the monthly meetings. After one meeting between directors, the parties agreed to deploy additional contract managers on both sides to improve the situation. Through more communication, more of the contractual items became clear to both parties and an agreement was reached on the costs associated with the different maintenance activities. In the meantime, Giraffe was committed to improving information systems and reporting. The two parties also worked collaboratively to reduce maintenance costs.
Again, extra investment and better communication helped both parties achieve the contractually agreed financial performance, though the relationship remained at arm’s length.

### 6.3.2 A static perspective

This section takes a static perspective to reflect on the narrative by using five main concepts (Table 6.1): project complexity, performance shortfall, strategies to deal with performance shortfall, project performance and relational outcome as introduced in Chapter 2. Despite the low complexity of this project, various performance shortfalls still occur. A contractual strategy to deal with performance shortfalls does not help improve project performance nor the relationship between the parties. A threat of legal action and the benefit of a long term relationship induces both parties to change tack and apply a relational strategy, allowing both parties to solve performance issues collectively, resulting in improvement in both project performance and mutual trust.

*Table 6.1 Summary of five concepts in case of Creekboard – Giraffe*

<table>
<thead>
<tr>
<th>Concepts</th>
<th>The Case of Creekboard – Giraffe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project complexity</td>
<td>Low innovation level, small project size and small scope</td>
</tr>
<tr>
<td>Performance shortfall</td>
<td>Delay in detailed design submission in the design stage and low financial performance in the operation and maintenance stage</td>
</tr>
<tr>
<td>Strategies</td>
<td>From contractual strategy to relational strategy</td>
</tr>
<tr>
<td>Project performance</td>
<td>Delay in construction and achieving operational performance</td>
</tr>
<tr>
<td>Relational outcome</td>
<td>Arm's-length relationship</td>
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</tbody>
</table>

### 6.3.3 A dynamic perspective

This section takes a dynamic perspective to reflect on the narrative, as shown in Figure 6.2. Due to the uncertainty over getting the follow-up maintenance contract, the contractor is reluctant to do the relation-specific investment. It leads to inadequate
resources. As a result, a performance shortfall appears and has a negative effect on the perception of project feasibility and on mutual trust.

![Diagram showing the dynamic process in the case of Creekboard – Giraffe]

Figure 6.2 The dynamic process in the case of Creekboard – Giraffe

To control cost, no extra relation-specific investment is made in the project, and this leads to lower performance while implying a larger performance shortfall. With lower perceived project feasibility, the two parties start to emphasize contractual controls, disagreeing on contractually required performance. When ending the relationship becomes an option, the two parties switch their strategy to a relational one, as both parties perceive benefits from establishing a long-term relationship and there being sufficient project feasibility. More relation-specific investments are made, with a positive effect on project performance. Communication is also improved, which promotes mutual understanding, trust and subsequent commitments from the both sides. The relational strategy also encourages the two parties to focus less on contractual controls (less penalty). This all helps to reduce performance shortfall and rebuild trust. A similar dynamic happens after the second performance shortfall emerges. Fewer relation-specific resources (less people) are invested in the project from both sides. The
two parties focus again on contractually required performance. Then extra relation-specific resources (additional people) are assigned to the project, and two parties again switch to a relational strategy with emphasis on raising and addressing concerns. This helps to increase mutual understanding and trust, and encourages less contractual control (i.e. agreement on contractually required performance). All these processes eventually result in an arm’s length relationship.
Chapter 7 The Case of Lakeboard and Panda

This chapter presents the fourth case study, the case of Lakeboard – Panda. The chapter first explains the background to the case. It then provides the narrative of how the two parties, Lakeboard and Panda, interacted at the different stages of the project (tender and selection stage, and design and build stage). The chapter concludes by presenting the highlights of the narrative and reflecting on the narrative from both static and dynamic perspectives.

7.1 Case introduction

The fourth case study in this research is a project to renovate a complete waste-water treatment plant (WWTP) run by Lakeboard, including both waste-water and sludge treatment systems. Like other water authorities, Lakeboard provides flood protection, and controls water quantity & quality by managing dikes, streams, watercourses and ditches in the region where it belongs. In the area of waste-water treatment, through its seven waste-water treatment plants it provides services to households (around 745,000 residents) and industry, spread across 29 municipalities.

The WWTP was built in the 1970s with a capacity to process 15 K m3 sewage per hour. The plant was approaching the end of its technical life, implying that a large-scale overhaul would be needed. In addition, the plant needed to be modified to meet environmental requirements. The project goal was to have a treatment process that met the legal and technical requirements at a low cost by applying innovations from the marketplace. More specifically, the technical objectives were to use innovation to meet the effluents requirements, to become energy neutral by producing extra energy, and to become a nutrient factory by extracting nutrients (e.g. N & P nutrients) from waste-water.
7.2 The narrative

The narrative describes key events that happened during the different stages of the contracting process. Figure 7.1 presents a timeline of these key events. The aim of this narrative is to show the dynamic process of how a shortfall in performance occurred, how Lakeboard and Panda tried to resolve this performance shortfall and how the interaction between the two parties led to the specific outcome.

Figure 7.1 Overview of key events in the case Lakeboard – Panda

7.2.1 Tender and selection stage

**October 2013** - The European public tender process started, consisting of a two-stage dialogue with contractors that lasted 12 months in total. Five contractors were invited to the tender after pre-selection based on references and experience. The first stage dialogue consisted of two rounds of information exchange meetings, where Lakeboard and the contractors discussed project vision and a risk management plan. After these two documents had been evaluated, three out of five candidates entered the second stage of dialogue. Lakeboard organized three information exchange meetings at this stage. During meetings the contractors had the opportunity to discuss the solutions they would
The aim of the second stage was to ensure all tender documents would be complete and ready for the final submission.

Lakeboard expected the renovation project would improve their energy production, so that they could meet the energy target (i.e. producing 30% of total energy consumption) with a 15-year term for return on investment. The scope of the project consisted of designing and building a complete waste-water treatment plant, and maintenance of part of installations. The contractors were required to submit an offer that included a price for maintenance, although the decision to grant the maintenance contract would be made after the delivery of the installations. The specific activities were general design, final design, detailed design, acquiring permits, building physical installation, and realization of the performance of installations. The requirements were categorized into the following groups: budget, availability, energy production, chemicals usage, disposal sludge, water quality and cost. All the bids had to meet two basic requirements: a maximum investment of 40 million euros and a guarantee of minimum availability of installation (i.e. 98%). Other aspects of technical performance were for the contractors to include in their offer.

The criteria for award were based on the most economically advantageous tender which took both price and quality into account. More specifically, price should include the investment, operational cost (multi-annual maintenance cost), cost & revenue of nutrient production, and management cost. Quality covered risk management plan and general design. The quality of general design consisted of functional reliability, sustainability, maintenance requirements and ease of operation, appearance and social recognition.

**December 2014** - The project was awarded to Panda, an engineering company that operates in the construction of buildings, infrastructure, and environmental projects, and is also active worldwide in the production of raw materials, facility management and real estate development. Panda has an annual revenue of € 2 billion. It has around 18,000 employees active in 22 countries on five continents. Panda offered the most
competitive bid in terms of both finance and quality of performance. In the offer, there were several innovations. “In water treatment, there was a new technology that was still at the development stage and was first applied in the Netherlands. For sludge treatment, they proposed a technology that was not very common in the Netherlands, with which sludge would be digested at a high temperature.” – Lakeboard manager X.

February 2015 - The two parties signed the contract with a price of € 40 million for the design and build of the WWTP. The maintenance contract would be granted if Panda could deliver an installation with guaranteed performance. Lakeboard had no prior experience with Panda. It was also the first time that Lakeboard had used a performance-based contract in such a large scale project, while Panda had much experience with performance-based contracts in large projects, although not in the area of waste-water treatment.

In the contract, there were three deadlines linked to a penalty-bonus schema. The first deadline was the delivery of the final design by October 2015 and the second was the delivery of the project by October 2018. The third was the delivery of guaranteed performance by October, 2019. For the first two deadlines, a penalty of 5000 euros per day applied for a delay. For the third deadline, Panda had to guarantee the full technical performance outlined in their offer. Moreover, a bonus-penalty scheme was linked to this, with a multiplying coefficient of 15, since TCO was calculated to have a life cycle of 15 years. The maximum penalty was four times higher than the maximum bonus, through which Lakeboard aimed to secure their investment. “The rule is: ‘good for us, good for them, bad for us, worse for them.’ The penalty is higher, so that they have an incentive to avoid it. That is the insurance and the control function of the contract.” – Lakeboard manager X.
7.2.2 Design and building stage

March 2015 - Lakeboard organized the first meeting with all project members at one of their biggest waste-water treatment plants. The purpose was to show Panda an example of a good project. “The first meeting was organized to get to know each other and there was also an element of trust. The aim was to start the project as one team.” - Lakeboard manager X. The relationship was very good between two parties in the beginning. “They are very capable, very polite and cooperative people.” – Lakeboard manager Y.

October 2015 - Panda delivered the final design, which was accepted by Lakeboard in early November. Lakeboard participated in every stage of decision making on design. The early involvement of Lakeboard in the design process contributed to the smooth acceptance of the final design. “There are two ways of getting to an accepted design. The contractor throws a design over the wall and then we study it, make comments and throw it back. That does not work. What we did at every stage was cooperate and comment on the design. That helped to accept the final design in an efficient way.” – Lakeboard manager X. “After months of design, if you had printed it out, you would have a big pile of documents and drawings. You go to your client and say, here’s your pile of documents, in two weeks I need approval. You can imagine, that does not work. But if you comment on a regular basis, 90 % of the design is already evaluated, and the rest is just documentation and a final touch.” – Panda manager X.

Although the acceptance of the final design was smooth, the co-design process was not without its problems, as changes to the general design were inevitable. “They made an offer with a general design, which was two years ago. Some changes were needed.” – Lakeboard manager X. Communication between parties was perceived as good: whenever Lakeboard had questions about design, answers were quickly provided by Panda. “Panda told us what the changes were and why they were making them. We had frequent meetings on design. They told us a change to the design was a better solution
for the project. We discussed and evaluated it.” – Lakeboard manager X. Information sharing facilitated mutual understanding and promoted commitment from both sides. “The greatest thing was that we had the same goal. We worked together.” – Panda manager X.

**December 2015** - With support from Lakeboard, Panda received all the permits needed for the construction from the government. Thanks to transparent communication, the relationship at this moment was in a healthy condition. “*You involve your client in the process. You discuss and work transparently. Then you get trust. You create the right atmosphere. They reinforce each other.*” – Panda manager X. Until that moment, the two parties were always reaching agreement in cases of dispute. “*Sometimes we had tough discussions but we always came to a compromise, it's never personal but professional.*” – Lakeboard manager X. “*Now and then, a small discussion, but if you can do it with mutual respect then it works. Make the problems mutual. There are limits of course. But if you can trust each other, then you can do it*” – Panda manager X.

**March 2016** – Panda started construction work on ground and piping. The project progressed steadily as planned. The two parties had regular meetings about detailed design elements. In this phase, Lakeboard could only make comment since they had already accepted the final design. “*We check the essential parts, but nothing more than that, to see if it is what we agreed upon.*” – Lakeboard manager X.

**October 2017** - There was an unexpected technical incident: leakages in sludge digesting tanks. This made it difficult for Panda to deliver the project on time, because it required extra time to investigate the causes of the problem, implement repairs to the tanks and restart the tanks. After the problem appeared, Panda’s named contact was changed. “*If they don't make money, the manager has to go. It happened that way, but it didn't help the project*” – Lakeboard manager X. As a result, communication suffered. “*The new manager didn't have a history in this project, and this caused a struggle.*” – Lakeboard manager X. Although Lakeboard realized that it would be impossible for Panda to deliver the project on time, the project plan submitted by Panda was not honest
in its assessment. “You know you are not going to meet your schedule, yet you set down on paper that you will still meet the schedule. It is silly. It is a fairy tale” – Lakeboard manager X.

**December 2017 -** Besides the unexpected incident, Panda discovered many so-called starting up problems in the delivered equipment, which caused extra delay in the project. “Panda struggled, not because they didn’t have experience, but because the installation was innovative and very complex. They made mistakes that they had to repair, and this took more time.” – Lakeboard manager X. The extra delay introduced more tension into the relationship. “A lot of pressure on the project, if there is a big delay in the end, there will be a big penalty.” – Lakeboard manager X.

Although Lakeboard wanted to help Panda to catch up technically, contractually speaking what they could do was very limited. “We did help them in technical bases, but taking some responsibilities from them is not going to do the trick. In the end the contractor could say: we didn’t achieve the desired performance, but that’s because of the thing you did by yourself. That’s the game.” – Lakeboard manager X.

The technical problems and delays resulted in a negative financial result for Panda. Under these circumstances, Lakeboard observed that Panda reduced the resources they were putting into the project. “We will have more trouble because they are not increasing resources. They tried to make cost reductions by reducing the number of people involved. Panda is pushing their work to the very end. They look at finance in short term. I am sure that was their strategy.” – Lakeboard manager X. Fortunately, Lakeboard still believed in Panda’s intention. “I don't see that they tried to cheat on us. I trust their intention. But I don't trust that they will be able to meet the schedule.” – Lakeboard manager X. However, Lakeboard gradually lost faith in the feasibility of achieving a successful project. On the one hand, in the tender Panda offered a very high level of performance in order to get the contract. “What Panda offered was not easy to achieve. It is innovative. They have now suffered some disappointments. But they only realized this after they started building.” – Lakeboard manager X. But on the other
hand, Lakeboard was perceiving less commitment on the part of Panda. “I am not sure about their commitment to solving this problem (delay), I have a feeling that in the end we have to go to court or we have to make another kind of agreement.” – Lakeboard manager X. As a result, Lakeboard started to pay more attention to the contract, and did more tests to check the quality of the installations. “I understand their situation, but I have to stick to the contract. If we don’t receive quality, we apply more pressure. They play the music, we dance.” – Lakeboard manager X.

May 2018 - Panda submitted a new project plan which indicated that they would deliver the installation with 14 months delay. The new plan was accepted by Lakeboard, yet the parties could not reach agreement on the financial consequences. Acceptance was a prerequisite for making payment to Panda for the finished work. And it had become clear that the biggest challenge for Panda was the technological problem. Lakeboard started to suspect the feasibility of the technology proposed by Panda. “In the tender, the description of the technology was on a general level. We are now three years from the start, and there is nothing more than what we have in the tender. That’s why my trust has been decreased.” – Lakeboard manager X. “Money-wise, it is not a very large project. But technology-wise, it is the most complex project we have had so far. To provide an integrated solution for a customer is complex. We are learning. Maybe in five years, we will have no problem at all.” – Panda manager X. The trust continued to deteriorate. “My fear is that we might end in failure. When this project finishes, I will have a long beard like Santa Claus. They can’t meet the performance standard they offered.” – Lakeboard manager X.

The two parties also started to have more contractual discussions on who was responsible for extra cost. “There were contradictions between data and contract, not everything stated in the contract was true.” – Panda manager X. "When something went wrong, it was never Panda’s fault but ours. The argument was they did not see it specified in the contract. They tried every way at every turn to get rid of the responsibility that they had accepted in the tender.” – Lakeboard manager X.
Communication kept going, but the transparent atmosphere was gone. “We agreed to disagree. The relationship was purely contractual. But we cannot just repeat what is on paper.” – Panda manager X.

June 2018 - Panda planned several tests on the feasibility of the technology offered in the upcoming five months. Panda needed the testing results in order to make investment decisions. "They think within five months, they can achieve a performance level on the basis of which they can decide whether they will go on or not." – Lakeboard manager X. However, Panda also perceived the low potential in the project. “The risk that water authorities asked the market to bear was beyond what contractors can handle, given the limited project budget. The risk is not in line with the price and there is no limit to the penalty. Technically everything can be solved, it is just a matter of time and money, but in this case, the new investment will result in no return.” – Panda manager X.

Due to the negative perception of project feasibility, trust continued to erode. “There are people with different goals. Do I trust them? No. I also don’t believe that the project will result in overall success.” – Lakeboard manager X. “Trust will not solve the problem, but help to find a solution. However, the trust we have now is not enough to negotiate a solution. We have to stop writing formal letters to each other. It has become purely contractual. It should be more relational. We each have to put a bit of water in the other’s wine. Both parties have to adapt or compromise, as the alternative (going to court) is worse. But If Lakeboard is not flexible, then we can’t be flexible.” – Panda manager X.

7.3 Case reflection

7.3.1 The road to a troublesome relationship

The renovation project in this case study was a highly complex project with a relatively big project size (€ 40 million) and scope (both sludge and water treatment systems). It
involved two separate innovations in the process. With this high project complexity, a performance shortfall was inevitable and this performance shortfall appeared in the construction phase. The project was delayed due to an unexpected technical problem. The negative financial consequence associated with the performance shortfall triggered a change of project manager for Panda and prevented Panda from voicing the issue to Lakeboard. Moreover, to control the cost, Panda reduced the number of employees on the project. The lowered investment led to a lower project performance and an increased performance shortfall (i.e. more delay in the project). Disagreement on the penalty triggered many contractual discussions. Panda's strategy was to look in the contract for opportunities to reduce either the cost or the penalty. Lakeboard began planning for more checks to test if Panda was meeting the contractual requirements. With associated penalties and controls, it became more difficult for Panda to achieve the contractually required performance. Panda perceived a low project feasibility, realizing that they had offered high performance that was contractually binding. Several tests on the feasibility of the technologies were planned. Before the results were in, Panda gradually reduced their efforts in the project. The two parties only communicated through official letters, and this hindered mutual understanding. As a result, the performance shortfall persisted, trust continued to be eroded and the relationship ran into trouble.

7.3.2 A static perspective

This section takes a static perspective to reflect on the narrative with five main concepts (Table 7.1): project complexity, performance shortfall, strategies to deal with performance shortfall, project performance and relational outcome as introduced in Chapter 2. In a highly complex project, performance shortfall occurs as a delay in the construction stage due to unexpected technical incidents. A contractual strategy to deal with performance shortfalls does not help improve project performance nor relationship. It results in more delay in the project and the relationship runs into trouble.
Table 7.1 Summary of five concepts in the case of Lakeboard – Panda

<table>
<thead>
<tr>
<th>Concepts</th>
<th>Case of Lakeboard – Panda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project complexity</td>
<td>High innovation level, big project size and scope</td>
</tr>
<tr>
<td>Performance shortfall</td>
<td>Delay due to unexpected technical incidents in construction stage</td>
</tr>
<tr>
<td>Strategies</td>
<td>Contractual strategy</td>
</tr>
<tr>
<td>Project performance</td>
<td>Delay in construction</td>
</tr>
<tr>
<td>Relational outcome</td>
<td>Relationship in trouble</td>
</tr>
</tbody>
</table>

7.3.3 A dynamic perspective

This section takes a dynamic perspective to reflect on the narrative, as shown in Figure 7.2. In a highly complex project, when a high level of performance is contractually required and potential performance is unknown and the offer unrealistic, a performance shortfall is inevitable. To control cost, no extra investment in the relationship is made, and this results in still lower project performance (more delay).

![Figure 7.2 The dynamic process in the case of Lakeboard—Panda](image-url)
The two parties also start to focus more on the contract, as they begin to have disagreements on the level of performance that is contractually required and the penalties that should result from the delay. As a result, it becomes more difficult to achieve the level of performance required by the contract. A change of contact person and an emphasis on contractual controls prevents the two parties from maintaining good communication, and developing mutual understanding. In addition, given the high level of contractually required performance and the persistent performance shortfall, the two parties perceive low project feasibility. Thus, trust in each other and in the technology decrease dramatically, as does commitment to solving the problem. All of this results in a troublesome relationship.
Chapter 8 Cross-case analysis: a static perspective

This chapter compares four cases under the five key concepts of project complexity, performance shortfall, strategies to deal with performance shortfall, project performance and relational quality (i.e. trust). This comparison applies a static approach and aims to answer the following questions: When and why does a performance shortfall occur? What is the relationship between strategies (contractual and relational) in dealing with a performance shortfall and exchange performance?

8.1 Project complexity

The project complexity is defined as the nature, quantity, and magnitude of organizational subtasks and subtask interactions posed by the project (Tatikonda & Rosenthal, 2000). This study measures the project complexity with project sizes, scopes, and innovation level (see definitions in Appendix 5).

Table 8.1 Project complexity

<table>
<thead>
<tr>
<th>Cases</th>
<th>Project complexity</th>
<th>Project size</th>
<th>Technological complexity</th>
<th>Project scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverboard – Mouse</td>
<td>3</td>
<td>6.5M</td>
<td>One innovation in sludge pretreatment</td>
<td>Sludge treatment system</td>
</tr>
<tr>
<td>Brookboard – Elephant</td>
<td>2</td>
<td>31M</td>
<td>One innovation in sludge pretreatment</td>
<td>Sludge treatment system</td>
</tr>
<tr>
<td>Creekboard – Giraffe</td>
<td>4</td>
<td>7.5M</td>
<td>No innovation</td>
<td>Sludge treatment system</td>
</tr>
<tr>
<td>Lakeboard – Panda</td>
<td>1</td>
<td>40M</td>
<td>Two innovations in water treatment and sludge digestion</td>
<td>Water and sludge treatment system</td>
</tr>
</tbody>
</table>

*: 1=high complexity, 4=low complexity

Table 8.1 shows that Lakeboard – Panda had the highest level of project complexity, as it had the biggest project size and two treatment systems, and applied two innovations. Creekboard – Giraffe had the lowest level of project complexity because it had the smallest project size with no innovation and it consisted of only a sludge treatment system. Brookboard – Elephant and Riverboard – Mouse rank in the middle. Given the
same number of innovations and project scope, Brookboard – Elephant had a higher level of project complexity than Riverboard – Mouse, because it had much bigger project size.

8.2 Performance shortfall

The comparison indicates that all projects experienced a performance shortfall, no matter the different levels of project complexity. The reason is that, generally speaking, technical complexity was high in all the projects, as waste-water treatment is a complex process that includes high level interactions between installations and processes. Therefore, even the case with lowest project complexity encountered a performance shortfall. Performance shortfalls, however, may appear in different forms and at different project stages (Table 8.2). In the case of Riverboard – Mouse, although the sludge treatment system was delivered on schedule, a performance shortfall showed up at the operational stage, as the operational performance target was not reached. In the case of Brookboard – Elephant, a performance shortfall occurred in the design stage because Elephant missed the deadline for submitting a qualified final design. In the case of Creekboard – Giraffe, performance shortfalls started to present at both design stage and maintenance stage. First, Giraffe was not able to deliver the detailed design on time. Later in the maintenance stage, it turned out that the maintenance cost was higher than the maximum price agreed in the contract. In the case of Lakeboard – Panda, a performance shortfall was caused by a delay in construction due to an unexpected technical incident.

Table 8.2 Performance shortfall

<table>
<thead>
<tr>
<th>Cases</th>
<th>Performance shortfall</th>
<th>Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverboard – Mouse</td>
<td>Low operational performance</td>
<td>Operation stage</td>
</tr>
<tr>
<td>Brookboard – Elephant</td>
<td>Unqualified final design</td>
<td>Design stage</td>
</tr>
<tr>
<td>Creekboard – Giraffe</td>
<td>Delay in design submission, and low financial performance</td>
<td>Design &amp; maintenance stage</td>
</tr>
<tr>
<td>Lakeboard – Panda</td>
<td>Delay in construction</td>
<td>Construction stage</td>
</tr>
</tbody>
</table>
8.3 Strategies to deal with performance shortfall

8.3.1 Strategies in the four cases

Water authorities and their contractors applied different strategies when performance shortfalls appeared in the project. Figure 8.1 shows strategies used by two parties (orange solid lines present water authorities, and green dot lines present contractors).

In the case of Riverboard – Mouse, unexpected technical problems with the heat exchangers and the steam injectors occurred at week 53. The two parties applied a relational strategy throughout the whole contracting process. Mouse kept investing in new heat exchangers and modification of the existing steam injectors, aiming to solve the problems quietly. After their attempts failed to solve the problems, Mouse disclosed the problem to Riverboard. Both parties continued to use relational strategies though the first deadlines were not met. Mouse maintained their loyalty to the project by committing new efforts to solve the problems as they hoped to win potential customers after this project was complete, while Riverboard showed also their loyalty by investing extra resources in re-investigating the feasibility of the new technology. The most
difficult decisions made by the two parties came at the moment they realized that solving the problems required much more time and resources than expected from both sides. With transparency, the two parties discussed the financial implication of problems and proposed solutions. The relational strategy continued: Mouse were willing to make new investment, and in response, Riverboard showed their willingness to accept a lower level of financial gain. In the end, they redesigned the contracts to fit with the new situation, accommodating a solution for both parties and increasing project performance.

In case of Brookboard – Elephant, at week 35 Elephant submitted the final design with two major changes to the general design offered during the tendering phase and this was later considered by Brookboard to be an unqualified design. Elephant applied a contractual strategy. They invested no extra effort or resources in redesign, since they believed the original design met the contractual requirements. Furthermore, they believed they had the right to make changes to the final design. Meanwhile, Brookboard voiced concern about the changes and asked questions about the effect of changes on performance. Although communication was continuing, Brookboard did not get answers to their questions. At week 39, Brookboard sent an official letter stating that Elephant had failed to meet the first deadline. Since week 39 the two parties had been in contractual mode. Elephant formally requested permission to implement the design with changes. Brookboard formally rejected the implementation request and announced that Elephant were in violation of their contract. As a response, Elephant made a formal statement that they had to stop and that Brookboard was responsible for the consequences. Elephant stopped all activity, which pushed the two parties toward arbitration. The legal conflict was on-going until a result was announced by the civil court. After the first arbitration at week 122, Elephant behaved loyally for a period of time by putting more designers into the project, and adding more capacity and quantities of machinery into the design. A relational strategy was adopted by Brookboard. They
accepted the new design and showed willingness to reduce the penalty for delay as much as they could within the limit of their powers as a public organization. However, the situation did not last long. Elephant requested more changes to the design, and Brookboard once more began to ask questions. The vicious cycle repeated itself. Elephant gradually reduced the effort they were putting into the project, in particularly the effort at maintenance planning, as they discovered that they were not able to achieve the operational performance promised in the contract.

In the case of Creekboard – Giraffe, the performance shortfall showed up at week 22, during the design stage. Giraffe was not able to deliver the detailed design on time, and this also caused delay in construction. Inadequate resources were put into the project as Giraffe did not want to make a design with a quality that was more than required, given the uncertainty of receiving the contract for maintenance. While Creekboard adopted a relational strategy by showing their willingness to assist in design and by offering a maintenance contract to motivate Giraffe to invest in design, Giraffe continued to ignore the problem and at week 74 both parties started disagreeing on many contractual items. After a threat of legal action from Creekboard, Giraffe switched their strategy to a relational one. At week 126 Giraffe began to initiate more communication, which convinced Creekboard to finally assign them the maintenance contract at week 135, and to put more resources into the project. This led to better project performance. As a result, Giraffe was able to deliver a good operational performance, though with a delay. The two parties both compromised to reach a deal on the penalty due to the delay. The second performance shortfall occurred at week 183 at the maintenance stage. The monthly maintenance cost was higher than the maximum price in the contract. The parties disagreed about the payment due to their different interpretations of the contract. The situation became worse, as both parties changed their named contact persons because of employees’ leave arrangements, and this led to reduced human capacity in the project. Many contractual discussions happened during the monthly meetings. After
the meeting between directors at week 235, both parties agreed to put in extra contract managers from both sides to improve the situation. With more communication, many contractual items were made clear to both parties. In the meantime, Giraffe was committed to improve their information system and reporting. The two parties also worked collaboratively to reduce maintenance costs.

In the case of Lakeboard – Panda, the performance shortfall appeared at week 239 in the construction stage. The project was delayed due to an unexpected technical problem. Panda changed their project manager and did not voice the issue to Lakeboard. The project plan submitted to Lakeboard did not reflect the problem of the delay and to control the cost, Panda reduced the number of employees on the project. Later, at week 248, Panda experienced more technical difficulties in the project, resulting in further delay. Disagreement over the penalty triggered many contractual discussions. Panda's strategy was to look at the contract and seek out any opportunities to reduce cost/penalty, while Lakeboard planned more tests to check if Panda was actually meeting the contractual requirements. Over time, Panda realized that it would be very difficult for them to achieve the promised operational performance. Many tests on the technologies were planned. Before knowing the results, Panda reduced gradually their efforts in the project. Two parties continued to communicate through official letters.

From a static perspective, as shown in Table 8.3, in the case of Riverboard – Mouse the relational strategy was applied, while in cases of Brookboard – Elephant and Lakeboard – Panda the contractual strategy was used. In case of Creekboard – Giraffe, the contractual strategy was used at first, then the two parties switched to a relational strategy.
Table 8.3 General strategy

<table>
<thead>
<tr>
<th>Cases</th>
<th>Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverboard – Mouse</td>
<td>Relational</td>
</tr>
<tr>
<td>Brookboard – Elephant</td>
<td>Contractual</td>
</tr>
<tr>
<td>Creekboard – Giraffe</td>
<td>Contractual and relational</td>
</tr>
<tr>
<td>Lakeboard – Panda</td>
<td>Contractual</td>
</tr>
</tbody>
</table>

8.3.2 Strategy comparison

The strategy comparison reveals that contractors are the first movers in this strategic game, as they are the ones who first notice when a performance shortfall appears. In three out of four cases, the contractors use a contractual strategy. They start with a self-serving response by reducing investment in the relationship, then focus on using the contract to solve a performance shortfall.

What has contributed to the use of a contractual governance strategy? When contractors see the profitability of projects is low, or even negative, as a result of a performance shortfall (e.g. the cases of Creekboard – Giraffe and Lakeboard – Panda), what they normally do is to control their costs. The most effective way to enhance profitability in the short term is to reduce the resources being put into the project. However, the side effect of this is that it does not help in solving the problem at hand and it may have negative impact on long-term project profitability. Moreover, when contractors have a different understanding or interpretation of contractual requirements from that of the public organizations, it is very likely that they will ignore the performance shortfall, as they believe that they have achieved sufficient performance (e.g. in the cases of Brookboard – Elephant and Creekboard – Giraffe ). A persistent self-serving response is very likely to encourage both parties in a PPP to focus on contract, as a self-serving response with no extra, or even reduced, investment in the relationship does not help improve project performance or reduce performance shortfall. In addition, a performance shortfall often produces in negative financial consequence for contractors.
because of the associated penalty. To escape from, or reduce, the level of penalty, contractual control becomes a logical option for them both.

When a contractor sees the potential benefits of investing in relationship (in the case of Riverboard – Mouse, Mouse envisaged many potential customers after a successful project, while in the Creekboard – Giraffe case, Giraffe was aiming to win the maintenance contract), the contractor is likely to choose an accommodative response to solve the problem at hand. This response is guided by trade-offs between costs and benefits. Costs include the risk of no return and the direct costs of new investment. Benefits refer to return on investment that includes profitability of the current project and future projects. In the public sector, the shadow of future possible collaboration does not play a big role (Ligthart, Oerlemans, & Noorderhaven, 2016), as most of the projects need to apply a public tendering procedure. A good performance in current project might not guarantee the future project, though it might bring them a good reputation. An accommodative response motivates information sharing, in particular, in a complex project setting, where the contractor is not able to solve the problem at hand by themselves.

In the case of high project complexity (the case of Brookboard – Elephant and Lakeboard – Panda), once a contractual strategy is activated, contractors tend to stick to this strategy, as new investment in the relationship is likely to result in no return. This is particularly true if they discover that, because of the associated high penalty, it is impossible for them to solve the performance shortfall. In the case of low project complexity, contractors may switch their strategy to a relational one (in the case of Creekboard – Giraffe), if they see the possibility of solving the performance shortfall and the potential benefits of extra investment.

Public organizations are the followers in this strategic game, as contactors are taking greater risks and responsibility in a PPP. When public organizations discover the
performance shortfall, they tend to first apply a relational strategy. If the strategy of the contractors is also relational, the two parties are likely to continue trying to solve the performance shortfall in a relational way until the moment that contractors change strategy or the problems are solved (as in the case of Riverboard – Mouse). If the contractors use a contractual strategy, the public organizations respond contractually (the case of Brookboard – Elephant and Lakeboard – Panda) until the moment the contractors switch to relational mode (in the case of Creekboard) or the relationship breaks down (the case of Brookboard – Elephant).

8.4 Project performance

Though the four projects all encountered a performance shortfall, which is a situation where a gap between actual performance and contractually required performance exits, they experienced different performance dynamics (see more performance data in Appendix 7). Project performance refers to schedule performance, operational performance or financial performance (Suprapto, Bakker, Mooi, & Moree, 2015). In the case of Riverboard – Mouse, the performance was on schedule in the design and building stage. The performance shortfall started from the very beginning of operation: the sludge treatment system was underperforming with regard to chemical usage, dry solid content of disposal sludge, and energy production. However, thanks to continued effort, in the end Mouse managed to achieve the contractually agreed financial performance, calculated on the basis of operational performance.

In the case of Brookboard – Elephant, the first delay was Elephant missing the deadline for submitting the final design in December 2012. While commissioning of the sludge treatment system was due in April 2015, the ongoing discussions on the design changes resulted in delivery of the installation being rescheduled for July 2016. As a result, the projected moment for achieving the guaranteed value was based on a delay of 27
months. After several times of postponements, two parties decided to terminate the contract in the end of 2016.

In the case of Creekboard – Giraffe, the first delay was caused by the late delivery of engineering work by Giraffe. Later, due to the problems in the startup of the sludge treatment system, the commissioning of the project was delayed in total for seven months. After maintenance started, the financial performance did not conform to contract for more than two years (i.e., the actual yearly cost was higher than the yearly budget), though the technical performance was sufficient.

In the case of Lakeboard – Panda, the performance shortfall appeared as delay in the design and building stage. The first delay was around four months because of an unexpected technical incident. However, later more delays were projected as the contractor encountered more technical problems. The project is still ongoing, however, both parties expected there to be more delay in the project.

Table 8.4 Project performance

<table>
<thead>
<tr>
<th>Cases</th>
<th>Project performance</th>
<th>On time</th>
<th>Operational performance</th>
<th>Financial performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverboard  – Mouse</td>
<td>1</td>
<td>On time delivery</td>
<td>-</td>
<td>achieved agreed performance</td>
</tr>
<tr>
<td>Brooboard  – Elephant</td>
<td>4</td>
<td>Unfinished</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Creekboard  – Giraffe</td>
<td>2</td>
<td>Delay of 7 months</td>
<td>achieved agreed performance</td>
<td>achieved agreed performance</td>
</tr>
<tr>
<td>Lakeboard  – Panda</td>
<td>3</td>
<td>Delay of 14 months</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*: 1= high performance, 4= low performance

To conclude this static view, all cases encountered a performance shortfall. In the cases of Riverboard – Mouse and Creekboard – Giraffe, the two parties managed to resolve the problems and achieve the contractually required performance (i.e. operational and/or financial performance) in the end, while in the cases of Brookboard – Elephant and Lakeboard – Panda, the two parties failed to find, or have as yet not found, a solution to reduce the performance shortfalls.

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8.5 Relational quality

Relational quality refers to the level of trust on both sides of the partnership (Kelleher & Miller, 2006; Yaqub, 2013). Trust was manifested very differently in the four cases (Figure 8.2). In the case of Riverboard – Mouse, the trust grew steadily from the beginning, then experienced a sharp decrease. However, it was able to recover in the end. In the case of Brookboard – Elephant, the level of trust was very good at the start of the project, but continued to erode and had vanished completely in the end. In the case of Creekboard – Giraffe, the level of trust followed a more dynamic pattern. After a period of gradual decrease, the trust began to be rebuilt, but there soon followed a period of erosion. Finally, it picked up again in the later stages of the project. In the case of Lakeboard – Panda, the level of trust increased gradually from the beginning. After a period of stabilization, it started to decrease slowly and then the rate of decrease accelerated. Various scores for trust (scale: 0-1) were established based on illustrative quotes of the interviewees (see Appendix 8). This study measures the total trust or mutual trust (R. Thomas & Skinner, 2010) between two parties. Trust asymmetry (R. Thomas & Skinner, 2010) certainly exists in reality. However, in a long-term relationship, this discrepancy between customer’s trust and contractor’s trust is very likely to converge over time. It is unlikely that one party is going to trust the other party for a long period, given that the later distrust the former. This was evidenced in these cases. For instance, in the case of Lakeboard – Panda, both parties pointed out that there was a high level of trust before the performance shortfall appeared and a lower level of trust after the performance shortfall appeared. Deriving scores from interview quotes is admittedly somewhat arbitrary; however, it is the overall trust pattern (as opposed to actual levels of trust or the sizes of the deltas) that is informative for this study. While each individual score may not be fully accurate, the scores together reveal patterns that neatly communicate how trust developed over time in the cases.
The general pattern is that water authorities and contractors kick off a project in good faith, unless they have a bad or negative prior experience (e.g. the case of Creekboard – Giraffe). Trust then tends to build up during the start phase until performance shortfall appears. Trust continues to deteriorate if project performance continues to fall (e.g. the cases of Bookboard – Elephant and Lakeboard – Panda). Trust recovers as a result of improved project performance (e.g. in the case of Riverboard – Mouse). Trust shows a dynamic behavior as project performance fluctuates over time (e.g. the case of Creekboard – Giraffe). Taking a snapshot of the moment when data collection was stopped, we can see that in the case of Riverboard – Mouse, the two parties had a close relationship with high level of mutual trust. In the case of Brookboard – Elephant, the relationship between two parties broke down, with no trust left at all. In the case of Creekboard – Giraffe, the two parties managed to maintain an arm’s length relationship with a medium level of trust. In the case of Lakeboard – Panda, the relationship between the two parties remained in trouble, because the trust level was decreasing at a pace.
Table 8.5 Relationship between project performance and relational outcome

<table>
<thead>
<tr>
<th>Cases</th>
<th>Project performance</th>
<th>Relational outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverboard – Mouse</td>
<td>1</td>
<td>Close relationship</td>
</tr>
<tr>
<td>Brookboard – Elephant</td>
<td>4</td>
<td>Broken relationship</td>
</tr>
<tr>
<td>Creekboard – Giraffe</td>
<td>2</td>
<td>Arm’s-length relationship</td>
</tr>
<tr>
<td>Lakeboard – Panda</td>
<td>3</td>
<td>Relationship in trouble</td>
</tr>
</tbody>
</table>

8.6 Conclusion

To conclude, in this research context of the Dutch water authorities, a performance shortfall is inevitable in complex projects such as the renovation of waste-water treatment plants. Performance shortfalls, however, may appear in different forms and at different project stages. Different strategies for dealing with performance shortfall have led to varying exchange performance. More specifically, in the case of Riverboard – Mouse a relational strategy was applied, and because of that the two parties were able to achieve the highest project performance (i.e. the contractually agreed operational and financial performance). This was the only one among the four projects to do this. As a result, these two parties have a close relationship with a high level of mutual trust. In the cases of Brookboard – Elephant and Lakeboard – Panda, a contractual strategy was used and with this, in neither case was the performance shortfall resolved. This led to a severed relationship in the case of Brookboard – Elephant and a troublesome relationship in case Lakeboard – Panda. In the case of Creekboard – Giraffe, both contractual and relational strategies were in position (first a contractual strategy and then a relational strategy). Once the two parties applied a contractual strategy, the performance shortfall became greater. After the two parties resorted to a relational strategy, they managed to resolve problems and increase project performance. At the last data collection session, both parties had achieved agreed financial performance and had an arm’s length relationship.
This study therefore concludes that in a complex project setting a performance shortfall is inevitable. A relational strategy in dealing with performance shortfall helps enhance the project performance and facilitates trust building, resulting in a good relationship. In contrast, a contractual strategy has negative impact on project performance, leading to deterioration in trust and a bad relationship.

Table 8.6 Overall relational performance

<table>
<thead>
<tr>
<th>Cases</th>
<th>Strategies</th>
<th>Project performance</th>
<th>Relational performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverboard – Mouse</td>
<td>Relational</td>
<td>1</td>
<td>Close relationship</td>
</tr>
<tr>
<td>Brookboard -- Elephant</td>
<td>Contractual</td>
<td>4</td>
<td>Broken relationship</td>
</tr>
<tr>
<td>Creekboard -- Giraffe</td>
<td>Contractual and relational</td>
<td>2</td>
<td>Arm’s-length relationship</td>
</tr>
<tr>
<td>Lakeboard – Panda</td>
<td>Contractual</td>
<td>3</td>
<td>Relationship in trouble</td>
</tr>
</tbody>
</table>
Chapter 9 Cross-case analysis: a dynamic perspective

Till now the study has adopted a static perspective in the cross-case analysis. The main conclusion is that, in a complex project setting, the relational strategy that focuses on information sharing and investing in relationship when dealing with performance shortfall helps improve project performance and prevent trust deterioration. In contrast, the contractual strategy that focuses on contractual control and finding a self-serving solution does not help solve problems and causes further relationship dissolution. However, the dynamic processes of how these two strategies affect project performance and how the performance dynamic affects the use of the two governance models remain unknown. For that reason, this chapter takes a dynamic perspective in the analysis by using a system dynamics approach. This research develops a causal loop diagram (CLD) based on the findings from the four cases. It shows how the two different strategies lead to different performance dynamics and how the performance dynamics in turn affects the use of the two strategies. Section 9.1 shows, first, the CLD that consists of four feedback loops. It then discuss further the four feedback loops respectively to show in detail how the feedback loops link to the findings in each case. Section 9.2 concludes how the interaction of these feedback loops contributes to the success or the failure of an outsourced infrastructure innovation project.

9.1 A causal loop diagram

The narratives (Chapter 4-7) have shown what happened in the four cases, all of which started from fairly similar relationships and technical challenges, yet had totally different outcomes. To better understand dynamic processes – why the Brookboard – Elephant case ended up in early termination and the Lakeboard – Panda case experienced a troublesome relationship, while Riverboard – Mouse and Creekboard – Giraffe continued the relationship, even in the presence of a sustained performance shortfall – this study synthesizes the causal chains (Figure 4.2, 5.2, 6.2, and 7.2)
developed in the within-case analysis into a causal network presented in the CLD. It consists of four interconnected feedback loops that together can generate the complex behavior observed in the four cases as shown in Figure 9.1. In the system dynamics methodology, feedback loops are seen as the key elements of what is driving the behavior of the system as a whole (Meadows, 1999; Sterman, 2000). The study supports these feedback loops in the CLD with observations and quotes from interviews in the four case studies (Appendix 7).

![Figure 9.1 The causal loop diagram](image)
Together, they constitute what is called the dynamic hypothesis (Sterman, 2000) for what actually happens in these four cases: how the two strategies result in different performance dynamics and how performance dynamics affects the use of the two strategies.

9.1.1 The performance and feasibility loop (L1)

The first causal feedback loop is the performance and project feasibility loop (L1), as shown in Figure 9.1. A performance shortfall is caused by a sudden increase in project complexity (e.g., unexpected technical problems) from the source of innovation and by complex technical processes with many interactions between different equipment, as well as by inadequate resources (i.e., knowledge, materials, equipment’s or human resources). These are represented by the discrepancy between the resources that are required and the resources that are in place. When an unexpected problem shows up, the demand on resources increases suddenly and substantially. The larger the resource discrepancy, the bigger the performance shortfall. The required resources are determined by the complexity of the project, and this is determined by technology complexity (i.e., number of innovations applied), and process complexity (i.e. project size and scope), as well as the level of contractually required performance that stems from the initial contractual targets set in the offer from the contractors in the tender.

The performance shortfall leads to lowered perceived project feasibility, as it then becomes more difficult to complete the project on time or meet other contracted performance targets. The best way to address this problem is to invest more resources in the project, as it helps reduce resource inadequacy, and thus increases project performance. In the case of Riverboard – Mouse, Mouse responded with a relational strategy (as did Riverboard) and indeed increased their investment in the project, by experimenting with potential solutions, working harder, and by being committed to solving the problem at hand. This basically reflects “normal” project management: a
balancing feedback loop (Figure 9.2) which aims to correct performance deviations by increasing investment and resources.

In the case of Brookboard – Elephant, Elephant first seemed to opt for ignoring the performance shortfall by not really responding to Brookboard’s concerns, and only later acknowledging the shortfall while waiting for arbitration results or slowing the pace of construction works to force Brookboard to make a first move. In this case, a negative reinforcing loop (Figure 9.3) is active, in which performance shortfalls are not countered by increased resource investment, and hence maintain (or even enlarge) the performance shortfall. The same happened in the case of Lakeboard – Panda, after the performance shortfall appeared as a delay in the project as a result of an unexpected technical incident. Instead of investing more, Panda chose to use a contractual strategy by reducing resource to control cost, and this resulted in a persisting performance shortfall.

Figure 9.2 The balancing performance and project feasibility loop
In the Creekboard case, Giraffe started with a contractual strategy by using materials of insufficient quality to control the cost. In this way, a negative reinforcing loop (Figure 9.3) was activated, which caused a further shortfall in performance (i.e. many problems in the start-up phase of operations). After that Giraffe switched the strategy to a relational one by putting new people into the project and providing qualified equipment, thus activating the balancing feedback loop. Later, a system that conformed to the contractually required performance was delivered. However, because their contact persons left the organizations, Giraffe had less human resource working on the project, and this again triggered the negative reinforcing loop. After escalation of the problem, both parties, again, chose to be loyal to the relationship. More resource (an additional contract manager) was invested and two parties worked together to reduce the maintenance cost. The balancing loop was again active. In the end, the performance shortfall was overcome.

9.1.2 The trust and commitment loop (L2)

The second causal feedback loop is the trust and commitment loop (L2) in Figure 9.4. Starting on the left-hand side of the loop, a performance shortfall causes a lower
perceived project feasibility, which negatively affects trust and subsequently commitment. Lower commitment leads to lower relation-specific investments, and thus lower project performance, and this enlarges the performance shortfall. The trust & commitment loop is a reinforcing feedback loop, meaning that once the performance shortfall occurs, the loop starts a vicious cycle. The shortfall continues to become larger, consequently project feasibility and trust continue to vanish. When parties in the relationship display loyalty by investing in relationship (see Figure 9.2), the lowered trust and commitment will affect the parties’ investments in the relationship, but it become negligible. When parties opt for a contractual strategy by making no extra investment or even reducing the investment (see Figure 9.3), lowered trust and commitment will enlarge the negative effect on relationship-specific investments.

9.1.3 The contractual control loop (L3)

The third causal feedback loop is the contractual control loop (L3). The loop (Figure 9.5) shows that once a performance shortfall occurs, lowering the perceived project feasibility, it triggers emphasis on the contract, leading to performance targets being
more strongly adhered to, with additional requests for more information, explanation and proof being likely. In essence, contractual requirements become stricter and higher (due to the penalty), and this actually increases the performance shortfall. The contractual control loop is a reinforcing feedback loop, since once performance shortfall appears, it leads to a larger performance shortfall.

![Contractual control loop](image)

**Figure 9.5 Contractual control loop**

In response to lower perceived project feasibility, the two parties could basically opt for one of two responses: focusing on contract by increasing contractual control or focusing on relationship by sharing more information. In the case of Brookboard – Elephant, two parties applied a contractual strategy. The focusing on the contract by both made it more difficult to achieve contractually required performance, as contractual disagreement resulted in more strict control on performance (e.g. two parties invited third parties to map the process and evaluate performance). It also resulted in extra delay (without contractual agreement from Brookboard, Elephant was not allowed to proceed) and associated financial consequence (e.g. penalty and legal cost). Consequently, project milestones were not met, with the final design being delivered in January 2015, only months before the formal due date for full performance (April 2015).
This negative reinforcing feedback loop was also active in the case of Lakeboard–Panda. As performance shortfall persisted, Lakeboard started to doubt the feasibility of a successful project. They began to do more quality tests on the installation to check if they met the contractual requirements. Later, two parties also had many contractual discussions on the financial consequences, as a heavy penalty was imposed due to the performance shortfall. Two parties had not only to catch up with the schedule, but also resolve the disagreements on the associated financial issue, and this did not help them tackle the performance shortfall.

In the case of Creekboard–Giraffe, after the project experienced delay, both parties opted to focus more on contract. The two parties disagreed with each other on whether the quality of installation conformed to the contract specification. Therefore, a negative reinforcing feedback loop was activated. After observing the poor performance during the start-up of the operation, Creekboard decided to lay further emphasis on the contract. The two parties almost ended up in court. Fortunately, this time Giraffe responded positively with the intention of restoring the relationship by applying a relational strategy. A new management team from Giraffe was assigned and after that they entered the mode of focusing on the relationship. This will be discussed in further detail in Section 9.1.4.

However, in the early period of the operation and maintenance stage, a performance shortfall appeared again when Giraffe started to claim extra costs, as the maintenance cost was higher than the maximum budget indicated in the contract. Each party used the contract to argue that the other side was responsible for the cost. The contractual control loop was again activated. The disagreements on the scope of the contract hindered both parties from focusing on finding out how to reduce the cost or improve financial performance. As a result, the project performance continued to deviate from the contract over a long period of time. Luckily, after the additional contract manager arrived, the strategy of voicing issues started to take over. More details on this, too, will be provided in the next section.
9.1.4 Voicing and mutual understanding loop (L4)

The fourth causal feedback loop is the voicing and mutual understanding loop (L4). As shown in Figure 9.6, a performance shortfall leads to a lowered project feasibility. By focusing on voicing concerns, communication intensity is increased and more information is shared, and this increases both parties’ mutual understanding and subsequent trust. The increased trust helps to bring more commitment and investment, which lead to improvement in project performance, thus narrowing the performance shortfall. The voicing and mutual understanding loop is a balancing feedback loop, as a performance shortfall triggers the loop to generate a behavior that corrects itself.

In the case of Riverboard – Mouse, Riverboard voiced their concerns without resorting to the contract (although the contract was not completely ignored, as penalties were indeed invoked in October and December 2012, in December 2014 and in September 2015). This voicing started as soon as the initial performance shortfall was found to persist, and underlying serious problems had been identified. Mouse communicated these problems - as well as proposed solutions - to Riverboard who responded positively to this openness, and communication intensity was increased. Both parties maintained
that they had always been on speaking terms, and were indeed very open with regard to the project, its problems, advantages, and disadvantages of (dis)continuing and to possible solutions. Consequently, both parties had a detailed understanding of each other’s viewpoints and interests. Communication furthermore cut across multiple organizational levels. The commitment of the directors of both organizations seems to have been critical for the turnaround in this project. The ongoing communication enabled two contract redesigns, and even an adjustment to the contractually required performance, all of which enabled Mouse to further invest in solving problems. All this happened as a balancing feedback loop helped to correct the performance shortfall.

In the case of Creekboard – Giraffe, after the warning of legal action, and with the new management team from Giraffe, the quality of communication started to become better. Problems with the delivery of the installation could be openly discussed through informal meetings and communicated in formal written documents, helping to build mutual understanding. This mutual understanding subsequently facilitated further building of trust. It triggered Giraffe to invest more in delivering installations with better quality. In the end, operational performance was improved and the performance shortfall was resolved.

In the operation and maintenance stage, after the additional contract manager arrived, communication intensity was rapidly increased and was also more structured. On the one hand, the two parties devoted more time to discussing how to reduce maintenance cost. On the other, they invested time in communicating what the contract said about the boundary of the maintenance activities. This increased mutual understanding of the responsibilities specified in the contract and of better ways of the three main stakeholders (operation and maintenance departments of Creekboard and Giraffe) collaborating. The ongoing communication contributed to the development of trust, and the contribution of more resource in reducing maintenance costs. In the end that mitigated the performance shortfall.
9.2 Conclusion

This section concludes that the success or the failure of an outsourced infrastructure innovation project is determined by the interaction between four feedback loops, namely the performance and project feasibility loop, the trust and commitment loop, the contractual control loop, and the voicing and mutual understanding loop. In complex projects, such as the renovation of waste-water treatment plants with DBOM contracts/PBCs, a performance shortfall is inevitable due to the high project complexity in general. Once the performance shortfall appears, it triggers the trust and commitment loop, which is a reinforcing feedback loop. As a consequence, the performance shortfall become larger and trust fades, resulting in less resource invested in the project and even lower performance, if there is no interaction from other loops. The performance dynamics are very much determined by the other loops. In other words, whether public organizations and contractors can achieve a successful project depends on the strategies that they apply to deal with the performance shortfall, since the strategies impact differently on the interactions between the trust and commitment loop and the other three loops.

In dealing with performance shortfall, the contractual strategy is likely to induce vicious cycles in two reinforcing loops (the performance & project feasibility loop and contractual control loop), resulting in an even bigger performance shortfall; and it rules out the activation of the voicing & mutual understanding loop and that leads to bad communication and subsequent trust deterioration. It aggravates the negative effect on performance and trust created in the trust and commitment loop. In other words, the contractual strategy is likely to have a negative impact on project performance and thus also trust. In turn, the lowered project performance and trust are also likely to stimulate the two parties to adhere to the contractual strategy, as two parties perceive the costs of extra investment to be higher than the benefits. This was exactly the process in the Brookboard – Elephant case and the Lakeboard – Panda case. The contractual strategy
eventually resulted in early break-up of the partnership in one case, and a troublesome relationship in the other.

The relational strategy in dealing with performance shortfall is likely to trigger the two balancing loops (the performance and project feasibility loop, and the voicing and mutual understanding loop), helping to correct performance shortfall and maintain trust. Moreover, when the relational strategy is in use, the reinforcing contractual control loop is not active, or it is active in a positive way by focusing less on contractual control. In contrast to the contractual strategy, the relational strategy compensates the negative effect on performance and trust created in the trust and commitment loop. The maintained or improved project performance and trust are likely to encourage the two parties to stick to the relational strategy. In the case of Riverboard – Mouse, a relational strategy helped the two parties to resolve the problem of performance shortfall and rebuild trust. The case of Creekboard – Giraffe displayed a combination of these two processes. In the early stages of design & building and operation & maintenance, the contractual strategy was in place. Subsequently, the strategy was switched to a relational one. As a result, the two parties were able to resolve the conflict and continue the relationship, but maintained only a medium level of trust.

All in all, once a performance shortfall occurs, a relational strategy is likely to help enhance the project performance and this results in a good relational outcome. In turn, enhanced project performance and a better relationship promotes the continuous use of a relational strategy. In contrast, a contractual strategy is likely to have negative impact on project performance, thus leading to a bad relational outcome. As a result, it is likely to trigger the repeated use of the contractual strategy.
Chapter 10 **Theory building through simulation**

This study has developed a causal loop diagram that explains how, in a complex project setting, a contractual governance strategy for dealing with performance shortfall may induce negative reinforcing feedback loops. This enlarges performance shortfalls, stimulates repeated use of the contractual strategy and causes relationship dissolution and possible breakdown. The study also shows how a relational governance strategy may promote balancing feedback loops that correct performance shortfalls, promote continuous use of a relational strategy, and lead to relationship restoration. However, the conditions under which these conclusions hold/ or do not hold remain unknown. As discussed in Chapter 2, a system dynamics simulation is particularly useful for identifying how specific conditions affect the stability of the system. Thus, this chapter aims to further develop the dynamic theory and address this question by using system dynamic modelling. The chapter first describes the system dynamic model in Section 10.1. It then, in Section 10.2, shows the base case behaviors of the model which replicate the performance outcomes of the two different governance strategies applied in real cases. Based on model analysis in Section 10.3, propositions regarding the relationship between two governance strategies and performance dynamics are developed. Thanks to a sensitivity analysis, Section 10.4 provides more insights on the boundary conditions of the effectiveness of strategies in dealing with performance shortfall. This chapter offers a conclusion in Section 10.5.

### 10.1 Model description

The study has translated the causal loop diagram (Figure 9.1) in chapter 8 into a quantitative system dynamic model. The key components of this simulation model (See Appendix 10) are the four feedback loops (L1-L4), which are the same loops in the causal loop diagram. This section describes the most important equations in these loops.
The complete list of model equations (EQs) and parameter values, following the guidelines provided by Rahmandad and Sterman (2012), is provided in Appendix 11.

10.1.1 **Performance & project feasibility loop (L1)**

Current performance is a function of how complex the task at hand is, and how many resources are dedicated to the task.

Project performance (PP):

\[
PP(t) = PP(0) + \int_0^t pcr(s)ds \tag{1}
\]

\[
pcr(t) = MAX(-PP(t), (cp(t) - 1)/pc) \tag{2}
\]

\[
cp(t) = RA(t)/rr(t) \tag{3}
\]

*pcr*: performance change rate, *cp*: current performance, *RA*: resources available,

*rr*: resources required, *pcd*: performance change delay

When there is a change in project complexity, it will lead to a drop in project performance (EQ 1). When project performance is below what is contractually agreed (EQ 4), there is a performance shortfall (EQ 6).

Contractually required performance (CRP):

\[
CRP(t) = CRP(0) + \int_0^t rpcr(s)ds \tag{4}
\]

\[
rpcr(t) = (ct(t) - CRP(t))/rpcd \tag{5}
\]

*rpcr*: required performance change rate, *ct* (contract target), *rpcd*: required performance change delay

Performance gap (pg):

\[
ps(t) = \frac{PP(t)}{CRP(t)} \tag{6}
\]
When \( ps(t) \) is small then 1, it indicates a performance shortfall. The larger the performance shortfall, the lower the perceived project feasibility (EQ 7).

Perceived project feasibility (PPF):

\[
PPF(t) = PPF(0) + \int_0^t pfcr(s) \, ds
\]  
(7)

\[
pfcr(t) = \text{MAX}( -PPF(t), \text{MIN}( epsf(t), 1 - PPF(t)) ) / pfcd
\]  
(8)

\( pfcr \): perceived feasibility change rate,  \( epsf \): effect of performance shortfall on feasibility,  \( pfcd \): perceived feasibility change delay

In the equations so far, no explicit managerial decision has been represented. However, now it arrives at a crucial one: what to do when the project becomes less feasible? One can either react relationally by adding more resources, or contractually by doing nothing or even quietly reducing resources. In the former case, relation-specific investment increases; in the latter case it will be reduced:

Relation specific investment (rsi):

\[
rsi(t) = -sr \ast eppfi(t)+ar*(eppfi(t) + eci(t))
\]  
(9)

\( sr \): Self-serving response (0 or 1),  \( ar \): Accommodative response (0 or 1),  \( eppfi \): effect of perceived project feasibility on investment,  \( eci \): effect of commitment on investment

With an accommodative response, the loop as a whole becomes a balancing – and hence stabilizing – feedback loop, as greater performance shortfalls will lead to more investment and hence to higher performance and so to a smaller shortfall. As a result of using a self-serving response, loop L1 will become a reinforcing – and hence destabilizing – feedback loop, as lower performance will lead to lower investments and so to even lower performance and a larger shortfall.
10.1.2 **Trust and commitment loop (L2)**

This second loop will always be a reinforcing feedback loop, as there are no managerial decision variables that are assumed to be either positive or negative. Partly, this loop contains variables and links from L1. For instance, perceived project feasibility plays a key part here as well. In the current loop, there is an effect of feasibility on trust on both sides. If feasibility improves, trust will go up and vice versa.

Trust on both sides (T):

\[
T(t) = T(0) + \int_0^t tgr(s) - ter(s)ds \tag{10}
\]

\[
tgr(t) = \left(\text{MAX}(0,\text{MIN}(eft(t),1 - T(t)))\right)/tgd \tag{12}
\]

\[
ter(t) = \left(\text{MAX}(0,\text{MIN}(T(t),(-eft(t)+eut(t))))\right)/ted \tag{13}
\]


When trust goes down, commitment will go down and vice versa.

Commitment (cm):

\[
cm(t) = etc(t) \tag{14}
\]

\[
etc(t) = 9.4 * T(t) \tag{15}
\]

*etc: effect of trust on commitment*

When commitment goes down, relationship-specific investment will go down (see EQ 9). From there on, the links back into perceived project feasibility are the same links as in L1.

10.1.3 **Contractual control loop (L3)**

The third loop where perceived project feasibility plays an important part is the contractual control loop. With a contractual response in particular, lower feasibility will
lead to more emphasis on contractual controls and hence to even greater performance shortfalls. If the response is relational, then contractual controls will not be tightened and so this loop will not be active.

Emphasis on contractual controls (ecc):

\[
ecc(t) = cc * efc(t) + nc
\]  
\[
efc(t) = 7 - 7 * PPF(t)
\]  

\(cc\): contractual control (0 or 1), \(nc\): normal control, \(efc\): effect of feasibility on control

Therefore, with a contractual strategy, this formula generates a reinforcing feedback loop as more control leads to greater shortfalls. With a relational response, using “normal” control, there is no change to the contractually required performance and so this loop remains inactive.

10.1.4 Voicing and mutual understanding loop (L4)

The fourth feedback loop also includes perceived project feasibility. With a relational strategy, decreased feasibility will lead to intensified communication.

Emphasis on voicing concerns (evc):

\[
evc(t) = is * efcm(t) + mci
\]  

\(is\): Information sharing (0 or 1), \(efcm\): effect of feasibility on communication, \(mci\): minimum communication intensity

This then leads to enhanced understanding on both sides (EQ 16)

\[
ecu(t) = LOOKUP(\text{evc}(t), \text{rci}, \{[0,0] - (10,0.99)], [0,0], [1,0.3], [2,0.35], [2.5,0.38], [3,0.45], [4,0.6],[5,0.82] \})
\]  

\(ecu\): effect of communication on understanding, \(evc\): emphasis on voicing concerns, \(rci\): required communication intensity
Rather than building trust, the enhanced understanding will prevent trust erosion (see also EQ13). This then hooks into the other loops, as more trust will lead to more relation-specific investment, which will boost performance, which will lead to higher project feasibility. So, with a relational response, this loop operates as a balancing feedback loop.

10.2 Base case behaviors: how things go wrong and how things get put right

This section uses the Riverboard – Mouse and the Brookboard – Elephant cases for the calibration of the dynamic simulation model, as these two cases are the most contrasting ones. In the case of Riverboard – Mouse, the two partners applied a relational strategy to deal with a performance shortfall, and this helped to enhance the project performance and restore the deteriorated relationship. On the contrary, in the case of Brookboard – Elephant, the two partners adhered to a contractual strategy, which worsened the project performance and resulted in the break-up of the relationship. Interestingly, the initial settings of the two cases are not that different. Project complexity was high in both cases to start with, and in both cases this complexity steadily increased after the first “honeymoon period”, as it gradually became obvious that the task at hand was significantly more complex than initially assumed. And yet, project performance in both cases evolved dramatically differently, as did less easily traceable constructs such as commitment and trust. In this parameterization of the simulation model, the behavior of these constructs in the two cases has been mimicked in a detailed manner. Rather, as Figures 10.1-10.3 illustrate, the model exhibits so-called “history-friendly behavior” (Malerba, Nelson, Orsenigo, & Winter, 2001).
In the case of Brookboard – Elephant, trust starts off fairly high but crumbles rapidly, and performance never reaches acceptable levels. While, dramatically differently, in the case of Riverboard – Mouse, trust starts off fairly high, receives some serious blows but recovers, and performance eventually reaches acceptable levels. This dramatic difference in performance is generated by making only one change in the choice of parameters in the simulation model, and that is to change the response from the contractual strategy in the Brook – Elephant scenario to the relational strategy in the Riverboard – Mouse scenario.
This simple change leads to very different reactions to the performance shortfall, which itself is firstly triggered by an exogenous series of increases in project complexity.
Under both responses, this performance shortfall leads to a dramatic drop in perceived project feasibility (Figure 10.4).

![Perceived project feasibility](image1.jpg)

*Figure 10.4 Perceived project feasibility under two strategies*

What is different is the managerial response to this drop. With the contractual response, relation-specific investment goes down, and so the allocated resources go down. With the relational response, investment goes up, resulting in greater resources being available (Figure 10.5 below).

![Resource available](image2.jpg)

*Figure 10.5 Resource allocation under two strategies*
10.3 Theory development

These simulation findings, in combination with the qualitative analysis, results in a number of theoretical propositions regarding the interplay of contractual and relational governance and its impact on performance. Contractual and relational governance are operationalized in terms of managerial responses to performance shortfalls (accommodative, self-serving, contractual control, and information sharing). The interplay between the two is evidenced from the fact that emphasizing one governance strategy comes at the expense of the other. On the one hand, the focus on the contractual control is likely to prevent the two parties from information sharing, as both are worried that shared information might be used by the other parties to take advantage. On the other hand, the increased information sharing promotes mutual understanding, thus stimulating the two parties to focus less on contractual control.

The first proposition relates to the phenomenon of sudden changes in project complexity triggering managerial responses. Here it is assumed that the responses from two parties are the same in a long run, and this is evidenced in the cases. Two parties may use different responses when a performance shortfall shows up, however, it is not long before two parties start to use the same strategy:

P1a  In complex projects experiencing sudden changes in project complexity, the contractual response of the parties involved may trigger a number of self-fulfilling vicious cycles, which are not only self-reinforcing but also reinforce each other’s adverse effects.

P1b  In complex projects experiencing sudden changes in project complexity, the relational response of the parties involved may trigger a number of self-balancing cycles, which are able to correct the adverse effects from sudden changes in project complexity.

Accommodating performance shortfalls resulting from sudden changes in project complexity generally requires investment in additional resources of various kinds (e.g.
more people, materials or money etc.). The more investment, the quicker the performance shortfall will decrease, and this will prevent the project from being terminated (in contrast: in case of doing nothing, the performance gap would eventually also be closed, but it would take much longer and the project would be terminated long before).

While the performance shortfall generally puts pressure on the contract (e.g. not meeting performance targets, penalties being invoked), it also affects the relationship (e.g. weakening future prospects, trust):

\[P2\]

*In complex projects experiencing sudden changes in project complexity, the growing gap between required performance and achieved performance (i.e., performance shortfall) will negatively affect trust and commitment, and hence investment made in resources necessary for meeting required performance.*

In view of a performance shortfall caused by a sudden increase in project complexity, organizations may opt for different managerial responses: contractual or relational. The associated propositions read:

\[P3a\]

*A contractual response to a performance shortfall caused by a sudden increase in project complexity will put more emphasis on contractual controls, which further increases required performance, which leads to an even stronger performance shortfall, and subsequently to a stronger contractual response.*

Note that in this scenario, the root cause of the problem, i.e., insufficient resource investment, is not being addressed. Furthermore, using contractual control limits the possibilities of using responses that are effectuated in practice through relational governance. As it has been observed in the case of Brookboard – Elephant, increasing contractual control reduces communication and inhibits (re)building the trust and commitment necessary for additional resource investment.

Furthermore, responding with a self-serving response will also worsen the situation:
A contractual response to a performance shortfall caused by a sudden increase in project complexity will decrease the resource investments needed to meet required performance, which leads to an even stronger performance shortfall, and subsequently to a stronger contractual response.

In contrast, adopting a relational response will indeed address the root cause of the performance shortfall, i.e., the lack of the extra investment needed to close the performance gap. This effect is strengthened when “information sharing” is added.

A relational response to a performance shortfall caused by a sudden increase in project complexity will address the issue of insufficient resourcing in two ways:

1) by loosening the contractual controls, thereby lowering performance requirements and the performance shortfall;

2) by intensifying communication between parties, thereby increasing mutual understanding and, subsequently, trust.

Note that the first effect in the cases involved redesigning the original contract. Focusing on the relationship thus leaves room to make adjustments to contractual governance, while the reverse is not the case. Furthermore, note that the second effect, i.e., the increase in trust, in turn increases commitment, leading to resource investments that help to reduce the performance shortfall.

A relational response to a performance shortfall caused by a sudden increase in project complexity will increase the resource investments needed to meet required performance.

The study presents a single model that behaves very differently, when only one key policy variable is changed. However, these two behaviors, as well as the policies chosen, are in line with the facts of the cases. Obviously, there is the notion of equifinality: there may be many other simulation models derived from clues from the case data that are
capable of generating similar behaviors. However, this research has tried to stay as close as possible to the facts of the cases and have in that sense built the model “from the ground up” (MacLeod & Nersessian, 2013).

Staying within the constraints of the known parameter values of the base case model, this study identifies history-friendly behaviors with other managerial responses and with combinations of responses. The results shows that in the case of Riverboard – Mouse, in order to reverse a vicious cycle as a result of unexpected increase in project complexity, a relational strategy with both focusing on information sharing and extra investment will be needed, simply because either information sharing or extra investment alone will take too long, even though both responses are able to reverse the situation in the end on their own (Figure 10.6).

There is a different situation in the case of Brookboard – Elephant. One is reminded of what is stated in Tolstoy's (1980) book Anna Karenina: “Happy families are all alike; every unhappy family is unhappy in its own way.” In the case of Brookboard – Elephant, there are several different managerial responses that all will trigger accelerated decline and, eventually, total collapse: a contractual strategy with only contractual control alone can do the trick, as can a contractual strategy with only a self-serving response. Even

![Figure 10.6 Riverboard-Trust behavior under alternative response strategies](image-url)
“information sharing” plus “self-serving” will replicate historical behavior (Figure 10.7). In the end, this study chose the managerial response of a contractual strategy with both contractual control and self-serving as a base case since these two responses were both identified in the evidence from the case.

The study summarizes the results of the simulation analyses in the following two additional propositions:

**P4**  
_In complex projects experiencing sudden changes in project complexity, a relational strategy with a combination of accommodative response and information sharing is required to overcome a performance shortfall in a timely manner._

The reason for this is that these two responses, in combination, effectively trigger the balancing cycles and correct the performance shortfall, leading to project success. Using information sharing might lead to lower contractually required performance, while the use of an accommodative response at the same time will increase resource investments. Both will contribute to reducing the performance shortfall, the first one by – in essence – lowering demand, and the second by increasing capacity.

Figure 10.7 Brookboard – Elephant trust behavior under alternative response strategies
In contrast:

\[ P5 \] In complex projects experiencing sudden changes in project complexity, a contractual strategy of either self-serving response or contractual control, or of a combination of both, will result in a performance shortfall of sufficient length and size for the project to be terminated.

Underlying this proposition is the argument that these two responses, in combination, effectively trigger and reinforce the interacting vicious cycles leading to project failure. Using contractual control will increase contractually required performance, while the use of self-serving response at the same time decreases resource investment. Both will contribute to sustaining and even growing the performance shortfall, the first one by – in essence – increasing demand, and the second by decreasing capacity.

### 10.4 Sensitivity analysis findings

After a series of sensitivity analysis, where parameter values are changed and their impacts on model performance are evaluated, this section discusses the findings (the full report of sensitivity analysis can been found in Appendix 12). The aim of this sensitivity analysis is to identify under which conditions, the conclusion regarding the relationship between two strategies in dealing with performance shortfall and performance dynamics holds or does not hold. Section 10.4.1 shows that under certain conditions a relational strategy might still fail to solve a performance shortfall, while Section 10.4.2 reports conditions under which a contractual strategy may lead to a successful project. Section 10.5 offers a concluding remark.

#### 10.4.1 Situations in which relational strategies still fail

The sensitivity analysis shows that under one of the following conditions, a relational strategy still fails to solve the performance shortfall and results in the breakup of relationship: small “maximum resources available”, high level of “minimum resources available”, and high level of “minimum resources required”.
required”, long “resource change delay” and high “initial contractual requirements”.

“Maximum resources available” is related to the maximum level of resources that the
two parties have reserved for the project. “Resource change delay” refers to the average
time that two parties need to adapt their resources into the project. “Minimum resources
required” is the minimum resources needed to achieve one unit of performance. “Initial
contractual requirement” is the initial performance target set by both parties in the
contract.

More specifically, when the value of “maximum resources available” is smaller than
23 (57.5% of “maximum resources available” in base case (see values of base case in
Appendix 10) and 15% higher than “minimum resources required”), or when “resource
change delay is equal to or larger than 169 weeks (about 20 times larger than the
“resource change delay” in the base case), using relational strategies still result in an
unrecovered relationship. The study interprets these as: when the buffer of project
resources is inadequate or when it takes a very long time to increase resources,
relational strategies do not help in solving the performance shortfall problem.

Also when “minimum resources required” is higher than 33 resources per performance
(65% higher than the “minimum resources required” in the base case), or when “initial
contractual requirements” is higher than 4.4 performance (4.4 times higher than “initial
contractual requirements” in the based case), using relational strategies still leads to a
broken relationship. This research interprets these two situations as: when project
complexity is very high and requires very high minimum resources, or when an
unrealistic performance target is set in the contract, a relational strategy is not able to
restore the deteriorating relationship.

**10.4.2 Situations in which contractual strategies work**

The sensitivity analysis shows that there are situations where a contractual strategy
might lead to good results. These situations are under one of the following conditions:
high “initial resources”, high “initial performance”, high “minimum resources available”, short “resource change delay” low “minimum resources required”, and short “performance change delay”. “Initial resources” is about resources that the two parties have initially out into the project. “Initial performance” represents the performance at the starting point of the project. “Minimum resources available” is related to minimum resources that the two parties have reserved for the project. “Resource change delay” refers to average time that the two parties need to increase or decrease their resources in the project. “Performance change delay” is the average time that two parties need to achieve one unit of performance.

To be more specific, when the value of “initial resources” exceeds 25 (25% higher than the value in the base case and the value of “minimum resources required”), when the value of “initial performance” is higher than 1.5 (50% higher than the value in the base case), when the value of “minimum resources available” is higher than 25 (2.5 times higher than the value in the base case), or when the value of “resource change delay” does not exceed 1 (12% of the value in the base case), trust will decline initially but recover in the end. This result shows when the two parties initially invest in extra resources, when the two parties have an adequate minimum level of resource buffer, or when the two parties are able to increase resources quickly, a successful project behavior may be generated, even when a contractual strategy is active.

Also, when the value of “minimum resources required” is smaller than 16 (20% smaller than the value in the base case), or when the value of “performance change delay” is smaller than 4 (16% of the value in the base case), The study interprets these two situations as: when project complexity is low so that it requires a very low level of minimum resources, or it is possible for two parties to catch up in a short time period, a contractual strategy is able to restore the deteriorating relationship.
10.5 Concluding remark

The study has developed a system dynamic simulation model based on the causal loop diagram introduced in Chapter 9. The simulation model is able to produce outcome behaviors observed in two real cases, the cases of Riverboard – Mouse and Brookboard – Elephant. The findings from model analysis, in combination with the qualitative analysis, lead to a number of theoretical propositions regarding the interplay of contractual and relational strategies, its impact on performance and the impacts of performance on the use of strategies. It confirms that a contractual strategy does not help in solving performance shortfall and restoring a deteriorating relationship, both of which, in turn, stimulate the continuing use of a contractual strategy. In contrast, a relational strategy helps to mitigate performance shortfall and rebuild trust, in turn encouraging the two parties to adhere to the relational strategy. Thanks to the sensitivity analysis, the research identifies the boundary conditions on the effectiveness of two different governance strategies in dealing with performance shortfall.
Chapter 11 Conclusions, limitations and recommendations

The final chapter presents the main conclusions of the study, its theoretical contributions and the managerial implications. The research limitations are discussed and recommendations for future research made. Section 11.1, presents the conclusion, based on findings from the cross-case analysis and simulation analysis. Section 11.2 proposes theoretical contributions to two different literature streams, governance and conflict management. Section 11.3 provides recommendations to managers on how to increase the chance of a successful outsourcing project. The final section discusses research limitations and proposes some directions for future research.

11.1 Conclusions

This section aims to address both the practical research question: “how does a PPP deliver success or result in failure in infrastructure innovation projects outsourced by Dutch water authorities?” and the theoretical research question: “how do two governance strategies for dealing with performance shortfall and performance affect each other over time in an outsourced infrastructure innovation project that is a PPP?”

11.1.1 Mechanisms for a success or a failure

In capital intensive infrastructure projects, such as projects renovating waste-water treatment plants, Dutch Water Authorities (DWAs) form Public Private Partnerships (PPPs) with contractors to achieve innovation and cost-efficiency. Due to innovations and complex technical processes these projects are characterized by a high level of technical complexity. Moreover, there is also contractual complexity. DWAs often use Design-Build-Operate-Maintain (DBOM) contracts in this outsourcing setting. DBOM contracts are long-term and performance-based in nature. Greater risk is transferred to contractors compared with traditional contracts, and many different functions are integrated into one single contract. In such a complex outsourcing project, a
performance shortfall in which the actual project performance is lower than contractually required performance, is virtually inevitable. These performance shortfalls may trigger different responses from two parties, namely relational or contractual strategies. A contractual strategy focuses on contractual control to unilaterally solve problems and/or seeks for a self-serving solution rather than increasing resources invested in the relationship. Meanwhile, a relational strategy focuses on communication and information sharing and/or seeks to solve problems bilaterally with increased investment in resources and compromise on both sides.

A failure story typically starts with a self-serving response from both sides, as no extra relationship-specific investment is made in the project – it may even be reduced – leading to lower project performance, in turn enlarging the performance shortfall. This is followed by a contractual strategy with increased contractual control. The two parties begin to explicitly measure and verify each other’s role performance by directly monitoring whether agreed-on actions are being implemented. As a result, the contractually required performance becomes more difficult to realize, since the emphasis on the contract leads to performance targets being more strongly adhered to and contractual requirements become higher due to the penalties to be applied for performance shortfall. As a result performance shortfall becomes even greater, leading to a lower perceived project feasibility and a decline in mutual trust. This process stimulates the two parties to adhere even more firmly to the contractual strategy. Another adverse effect of a contractual strategy is less communication or information sharing, and this results in less mutual understanding, even lower trust, and subsequently less commitment to the project. This certainly does not help improve project performance or solve the performance shortfall. The dynamic of this process eventually leads to a sustained performance shortfall and a deteriorated relationship.

In contrast, a relational strategy produces a success story. Once a performance shortfall occurs, the perceived feasibility of the project decreases, and this has a negative impact
on mutual trust. A relational strategy that focuses on communication and information sharing helps to build mutual understanding of problems and of each other’s position, and this helps to sustain a sufficient level of mutual trust and commitment for further collaboration. The mutual understanding and trust facilitates adaptations and promotes less focus on contractual control, with the parties responding to the problems identified and addressing those problems in revised contractual agreements (cf. Mayer & Argyres, 2004). At the same time, a relational strategy that focuses on working bilaterally to solve problems, also leads to increased relation-specific investment from both sides. It helps to improve project performance and hence to reduce performance shortfall. The two processes together help to mitigate performance shortfall and reverse the deteriorating relationship.

Hence, the responses to a performance shortfall is crucial for project success, as the right (wrong) response may reduce (increase) the performance shortfall in complex projects. This study concludes that the relational strategy is an essential factor in the success of capital intensive infrastructure outsourcing projects.

11.1.2 Two governance strategies and performance dynamics

When a performance shortfall shows up in a PPP project, it calls for a governance intervention (contractual or relational) in the contracting process (Lumineau & Malhotra, 2011). The governance approaches that organizations use to resolve performance shortfall have a discernible impact on the outcome (Eckerd & Sweeney, 2018). The findings show that a relational governance strategy is likely to help solve performance shortfall and restore the relationship that has started to deteriorate. On the other hand, a contractual governance strategy is likely to leads to a conflict escalation and eventually a dissolution of the relationship.
Interplay between two governance strategies

This research concludes that once one type of strategy for dealing with performance shortfall is in use, it reduces the chance that the other type of strategy will also be used, or affects the intensity with which the other strategy is followed. Specifically, focusing on contractual control crowds out information sharing, as the two parties are afraid that the information shared might be used against them. While voicing concerns and sharing information allows unsatisfactory conditions to be improved, partners attempt to search for a resolution cooperatively through open discussion and negotiation. This restrains partners from focusing on contractual control and facilitates revision of the original contractual agreement. The contract is thus considered dynamic rather than static, requiring adaptation to unforeseen contingencies (Mayer and Argyres, 2004). When partners pursue their self-interest by trying to get the other partner to make concessions and withdrawing resources from partnership, it inhibits loyalty to the relationship and accommodating behavior, as, by definition, they are opposing strategies.

Relationship between two strategies and performance

Once partners choose a contractual governance strategy to resolve a performance shortfall in a highly complex project setting, it actually reduces project performance because of the reduced relation-specific investment, and increases contractually required performance because of the greater contractual control. Consequently, the conflict is bound to escalate further, because of an enlarged performance shortfall. Given a continued performance shortfall, it is very unlikely that partners will change their strategy to a relational one since relational strategies imply extra relation-specific investments. In a highly complex project, the costs often outweigh the benefits of such investments. In particular, partners do not make such decisions in a situation where there is a low level of mutual trust. Thus, a contractual governance strategy has a
negative impact on project performance and relational quality, and in turn this stimulates the continued use of the contractual strategy.

However, if a relational governance strategy is first applied to solve a performance shortfall, it helps to enhance project performance as a result of increased relation-specific investment, and to sustain trust because of increased communication, information sharing and mutual understanding. With sufficient trust and potential to solve the performance shortfall, partners are encouraged to continue with a relational governance strategy, as the benefits of further investment and information sharing outweigh the costs.

11.2 Theoretical contributions

11.2.1 Contribution to governance literature

Chapter 3’s literature review on the two types of governances indicates that limited academic attention has been paid to investigating the dynamic aspects of the two types of governance (Cao & Lumineau, 2015; Roehrich et al., 2019), namely their changing roles, the dynamic process of interplay, and performance dynamics. Some exceptions (Faems et al., 2008; Howard et al., 2017; Olsen et al., 2005; Zheng et al., 2008) that have applied a dynamic or process perspective to this stream of literature focus mainly on the changing significance of the two governances and the dynamic process of interplay between them. To the best of my knowledge, there has been little research into the performance dynamics of the two governance strategies. In other words, few studies have asked the questions: “how do the two governance approaches affect performance over time and, in turn, how do the performance dynamics affect the use of two governances?” This study contributes to the literature about the two governance approaches by developing a process theory that explains these interactions over time via a multi-method research design, including a longitudinal qualitative multi-case
study and a quantitative simulation model. The study enriches our understanding of the dynamic nature of the interplay between the two governance types, their impact on performance, and the effect of performance on the use of two governances (Figure 11.1).

Figure 11.1 Dynamics interaction between two governances and exchange performance

11.2.1.1 Interplay between two governances in a complex project setting

The literature review in Chapter 3 has shown that there are two opposing views on the mutual relationship between contractual governance and relational governance (e.g. Klein Woolthuis et al., 2005). Some researchers view these two governances as substitutes (Dyer & Singh, 1998; Gulati et al., 2005), while others provide evidence on the complementary roles of the two (Poppo and Zenger, 2002). This debate over substitution and complementary logic is ongoing and is likely to continue (Roehrich et al., 2019), because in different situations or at different moments, formal contracts may serve different functions, control, coordination or adaptation (Schepker et al., 2014).

Scholars (e.g. Cao & Lumineau, 2015; Howard et al., 2017; Lumineau, 2017) have pointed out that the different functions of formal contracts interplay in different ways with relational governance. For instance, a control function signals a lack of trust, and therefore has a negative influence on trust, while the coordination function of contracts creates a shared knowledge structure, that helps mutual understanding and the development of trust (Malhotra & Lumineau, 2011; Weber & Mayer, 2011). This study argues that relational governance can also have control, coordination and adaptation
functions. The study contributes to the debate on the interplay between the two governance approaches by suggesting a possible interplay between the different functions of governances. In a complex project, a relational governance strategy for dealing with a performance shortfall serves as a coordination mechanism by sharing information and an adaption function by promoting extra relation-specific investment to resolve unexpected problems. A contractual governance strategy serves as a control function by focusing on contractual control. The control function of contractual governance may negatively influence the coordination and adaption functions of relational governance, because the research suggests that contractual control reduces the possibility of good communication and information sharing, and this lowers the trust, commitment and relation-specific investment. The coordination function of relational governance also has a negative impact on the control function of contractual governance, since the research suggests that information sharing improves mutual understanding and trust and encourages less focus on contractual control. Moreover, the coordination function of relational governance may trigger the adaption function of the contract and enhance its coordination function. For instance, in the case of Riverboard – Mouse, a relational strategy induces two instances of contract redesign. In the first redesign, the prevention-oriented contract is changed to a promotion-oriented contract, allowing the two parties to further invest in the project. In the second redesign, contract is used as a vehicle for solving the coordination problem.

To conclude, in a complex project setting with a performance shortfall, if a contract is seen as having a control function, it has a negative effect on relational governance. Vice versa, when relational governance is in use, it facilitates partners in applying contracts as coordination and adaptation mechanisms and enables them to focus less on contractual control. To be more specific, the use of contractual governance does not leave much room for coordination and adaption. In contrast, the use of relational governance does allow for, and even requires, adaptations of the contract.
11.2.1.2 Interplay between governances and exchange performance

Impact of the two governances on exchange performance

The literature review in Chapter 3 has revealed that two governance mechanisms (relational and contractual) have been commonly used to govern public private partnerships and these two governance mechanisms have joint impact on project performance. However, there are also two conflicting views on the joint impact on performance of the two governance types. On the one hand, some scholars conclude that the joint use of the two governance mechanisms is negatively related to performance (Ghoshal and Moran, 1996; Antia and Frazier, 2001; Lee and Cavusgil, 2006; Wang et al., 2011; Cao and Lumineau, 2015) as the two mechanisms reduce each other’s positive effect on performance. It is also argued that collective use of the two governance mechanisms increases cost, given one well developed governance is sufficient for good performance. On the other hand, other scholars state that the joint use of the two governance mechanisms increases performance (Yang et al., 2012; Nooteboom, 1999; Poppo and Zenger, 2002; Weick, 2001), because the two approaches can address each other’s limitations and be complementary in improving performance. It is also argued that using both can reduce cost by limiting the opportunities for breach of contract and renegotiation.

In the extant literature no consensus is found on the impact on performance of interplay between the two governances. This research contributes by providing a more nuanced understanding of the impact of governances on performance by taking into account the various functions of the two governance strategies. This research reveals that in complex project settings, a relational governance strategy in dealing with performance shortfall is positively related to exchange performance. In contrast, contractual governance is negatively related to exchange performance. In other words, focusing on the contract control (control function of contracts) triggers vicious reinforcing cycles
and reduces exchange performance, while focusing on the relationship (coordination and adaption functions) triggers balancing cycles that correct performance shortfall and increase exchange performance. This could be interpreted as a statement against contractual governance and in favor of relational governance. It resonates with studies that have argued contracts to be redundant when trust and relational norms are well-developed (e.g. Gulati, 1995), and even to be harmful to the development of relational governance (e.g. Ghoshal and Moran, 1996). However, such a conclusion should be drawn only with certain assumptions, as this research relates contractual governance to the control function of contracts. It study does not suggest that when there is a performance shortfall, the two parties should not refer to the contract at all. In contrast, it argues that the contract is still important, as is clearly observed in the Riverboard – Mouse case. Using a relational strategy here also involved adapting the contract, arguably making the relational governance strategy more effective. To put it more explicitly, the results suggest that when performance shortfall arises, recourse should be had to the coordination and adaptation functions of the contract, not its control function.

Impact of performance on two governances

As mentioned above, the most important contribution of this study to the literature on the two governance approaches is that it provides greater insight into how the dynamics of performance affect the use of the two governances, thus giving us a holistic view of the feedback loop between the two approaches and performance. This study develops a causal loop diagram that explains the different performance dynamics in four cases. Once a performance shortfall appears, the performance dynamics depends very much on the governance strategies that customers and contractors apply to deal with the performance shortfall, since the strategies induce different responses in the interactions between the four causal feedback loops. A contractual governance strategy is likely to induce vicious cycles in two reinforcing loops (the performance & project feasibility
loop and the contractual control loop). This results in increasing the performance shortfall and rules out the activation of the voicing & mutual understanding loop, in turn leading to bad communication and subsequent deterioration of trust. It not only aggravates the negative effect on performance and trust created in the trust and commitment loop, but also prompts the two parties to adhere to the contractual strategy. This is because in a highly complex project switching to a relational strategy with extra relation-specific investments might seem irrational because the costs often outweigh the benefits of such investments. Alternatively, a relational governance strategy triggers the two balancing loops (the performance and project feasibility loop, and the voicing and mutual understanding loop), and this helps to correct performance shortfall and maintain trust. Moreover, when relational strategies are in use, the reinforcing contractual control loop is not active. In contrast to the contractual strategy, it does not only compensate the adverse effect on performance and trust created in the trust and commitment loop, but also promotes the continued use of the relational strategy by both parties, as they both see that the benefits of further investment and information sharing outweigh the costs.

To sum up, in a complex project setting with a performance shortfall, the use of contractual governance decreases performance and triggers the repeated use of contractual governance. Conversely, the use of relational governance increases performance and promotes the continued use of relational governance.

Effectiveness of two governances in dealing with performance shortfall

The study has also contributed to the literature on the two governance approaches by providing more insight into the boundary conditions on the effectiveness of the two strategies when dealing with performance shortfall. More specifically, the study develops a system dynamics simulation model to further discover under which conditions a contractual governance strategy might correct performance shortfalls and
lead to relationship restoration, and under which conditions a relational governance strategy might not halt an expanding performance shortfall and might cause relationship dissolution and breakdown. The results shows that in an extremely complex project setting, even a relational governance strategy may not be able to solve a performance shortfall, whereas in a project with very low complexity, a contractual governance strategy may actually deliver a good outcome.

11.2.2 Contribution to conflict management literature

11.2.2.1 Contractual and relational strategies in solving conflicts

Many existing research endeavors have been devoted to studying conflict development and escalation (Bijlsma-Frankema et al. 2015; Coleman et al. 2007; Perlow & Repenning 2009). However, there is only scant research that applies the theoretical lens of governance mechanisms on the conflict research domain (Lumineau & Henderson, 2012, Malhotra & Lumineau, 2011 and Eckerd & Sweeney, 2018) are a few exceptions). In these exceptional researches, attention has mainly been paid to the two governance strategies after a conflict or dispute has manifested itself. In other words, they focus on dispute resolution strategies in the conflict aftermath. However, conflict escalation is a process, which begins when one party perceives that another has frustrated, or is about to frustrate, some concern of theirs (Thomas, 1992). This study contributes to the conflict management literature by applying the theoretical perspective of the two governances at the very beginning of conflict escalation, that is, the moment of a performance shortfall appears. The research provides more insight into the role of contractual and relational governance mechanisms in the development of inter-organizational conflicts, thus affecting performance. After a performance shortfall occurs in a complex project setting, a relational governance strategy help the two parties reconcile the perceived conflict because they facilitate finding solutions to performance
problems at hand, while a contractual governance strategy trigger escalation of the perceived conflict, as they do not help to resolve problems or increase performance.

11.3 Managerial implications

A general message for managers who involve in complex projects such as a renovation project of a waste-water treatment plant is that a performance shortfall, where actual project performance is lower than contractually required, is inevitable. Moreover, a relational strategy with focus on information sharing and relation-specific investment is required to overcome a performance shortfall in a timely manner, thereby achieving success with the project. The remainder of this section provides more detailed recommendations.

11.3.1 Performance shortfall

A performance shortfall is a situation in which actual project performance is lower than contractually required performance. There are three common performance shortfalls in a project setting with complex technical processes and innovations, namely project delay, low operational performance and low financial performance. A performance shortfall might show up in any phase of a contracting process after a contract has been signed: design, construction, operation or maintenance. Project complexity is an important factor that causes a performance shortfall. The higher the level of complexity a project has, the larger a performance shortfall there is. An increase in project complexity is likely to result in a decrease in actual project performance. It is also very likely to lead to a higher contractually required performance, because it becomes more difficult to predict the performance achievable, thus increasing the chance of setting an unrealistic performance target. The study indicates that in a project setting such as a project to renovate waste-water treatment plants, a performance shortfall is bound to happen, no matter the level of innovation involved, because, generally speaking,
technical complexity is high in such a project. Even a project with no innovation is likely to encounter a performance shortfall.

Thus, managers should be aware that a performance shortfall originates not in the contracting process after the contract has been signed, but beforehand: project complexity and contractually required performance are determined before the project even kicks off.

### 11.3.2 Benefits of a relational strategy

Given that a performance shortfall is virtually inevitable, the question for managers is how to deal with it in order to deliver a successful project. This research shows that a relational strategy focusing on information sharing and investing in relationships is required to overcome a performance shortfall in a timely manner. As far as contractors are concerned, managers should communicate the problem at hand promptly, because a performance shortfall normally starts from a small performance gap, and it is certainly easier to resolve it when it is small than when it gets bigger. Information sharing means not only more communication, but also establishing a transparent environment. Managers from public organizations should initiate and take the lead in creating such an open atmosphere. In reality, it very often happens that nominated contact persons are changed after a performance shortfall appears. The two parties should be cautious in doing that, as it does not help with information sharing because much useful information is lost. Furthermore, the two parties should see a performance shortfall as a collective problem rather than an individual one. Many managers of public organizations believe that contractors are responsible for all risks. The two parties should focus on finding solutions collectively rather than on finding out who is to be blamed for the problem. When communicating a performance shortfall, contractors should not only point out the problem and their difficulties, but should also show their willingness and commitment to solve problems by suggesting potential solutions.
Managers from public organizations should also make extra investment to facilitate or support contractors in resolving the problem.

The research shows that a contractual strategy with no extra, or even a reduced, investment, or increased contractual focus or a combination of both, is likely to result in an unsatisfactory ending in a complex project setting. However, in reality when contractors perceive low, or even negative profitability in a project, they often decide to make no new investment or even to reduce their investment to control costs, aiming to enhance profitability in the short run, though it does not help improve project performance and project profitability in the long run. If the project performance continues to be low, this action is very likely to encourage both parties in a PPP to focus on contract, as a performance shortfall often produces a negative financial consequence for contractors because of the associated penalty. To escape from, or reduce, the level of penalty, contractual control becomes a logical option.

One possible reason for being short-term oriented is that managers from contractors are under pressure from shareholders or top management to make a good annual financial statement. If a manager misses the yearly financial target, they might lose their job, meaning that they will not have a chance to achieve their long term target. In addition, managers from construction departments may have no motivation to build long term relationship as building is often short term oriented. This research also shows that once a contractual strategy is chosen, it is likely to have a negative impact on project performance and thus also trust. In turn, the lowered project performance and trust are also likely to stimulate the two parties to adhere to the contractual strategy, as managers from middle management perceive the costs of extra investment to be higher than the benefits. To overcome this vicious cycle of middle management continuing to use a contractual strategy, support from top management for a switch to a relational strategy is needed. The suggestion for the two parties is that they look at the long term results
rather than the short term. Investing extra resources to solve the problem at hand might cost extra in the short term, but it brings benefits in the long run.

11.3.3 Situations to be avoided

To have a successful project, some situations should be avoided since under these circumstances even a relational strategy might not work. These situations are incompetent contractors, unrealistic offers or unrealistic performance targets, and extremely innovative projects. An incompetent contractor means that a contractor has limited resources and is not able to respond to underperformance in a timely manner.

Unrealistic offers are situations where contractors offer a guaranteed performance that is beyond the maximum performance they can achieve. In three out of four cases in this research, a contractors had made an unrealistic offer. The reason might be twofold, high quality and strict deadline. On one hand, contractors have to offer an innovation in order to beat the competition. However, innovation means that the level of performance that can be achieved is unknown, making it very difficult for a contractor to submit a realistic bid. On the other hand, often a public project has to be delivered within a fixed time framework. Here again, because innovation entails high uncertainty, the very common contractual requirement of meeting deadlines may be difficult for contractors to achieve.

The challenge, then, is to prevent an unrealistic offer in the context of innovation, since it is will be difficult to know what is realistic and what is not. This is analogous to the winner’s curse: lacking advance understanding of the phenomenon, the party that wins an auction for a commodity of uncertain value when competing with a fair number of bidders typically pays more than the asset is actually worth. To prevent this “winner's curse”, thorough desk researches are required. Public organizations and private companies should both investigate the feasibility of new technologies and the maximum performances that these technologies can achieve. However, it is unlikely
that it can ever be known exactly what performance level can be reached when innovative technology is being applied. Contractors have to take the risk of unknown performance, yet the question is whether this risk should be applied to the contractor alone. For that reason, highly innovative technology should also be avoided.

Another situation that should be prevented is one where there is a big discrepancy between the two parties in their interpretation of the major legal obligations and rights that are specified in a contract. Due to bounded rationality, a contract will inevitably be incomplete. As a result, there will always be space for discussion, which may easily lead to legal dispute. To prevent this misunderstanding, a prolonged tender process is recommended, as it gives more time for the two parties to build mutual understanding on project documents, including contracts and trust. For a DBOM project, it is also recommended that progress is communicated and monitored from the beginning of the design phase, because if there is contractual disagreement, it can be resolved at an early stage. In any case, it is unlikely in a DBOM project that the design can be agreed in a short period of time without any discussion.

11.3.4 Situations to be stimulated

The research shows that there are also situations that we like to see. These are situations in which even a contractual strategy can help in solving performance shortfall. They are to be found under conditions of low project complexity, low contractual requirements, and high levels of initial resource from contractors. In other words, in order to make this happen, it requires contractors to have abundant resources, realistic offers or projects where the level of performance can be known. Unfortunately, a competent contractor with abundant resources is difficult to find in a complex and innovative setting. Already in a highly competitive market, contractors face the pressure of low margins. Moreover, realistic offers can probably only be expected in a project that is not innovative and has a small project scope. For example, when a contractor is
only responsible for the performance of one type of machine in the waste-water treatment process it is very likely that they can make a realistic offer as it is a specialist in this specific area.

### 11.4 Research limitations and future research recommendations

After concluding the theoretical contributions and managerial implications, it is time to reflect upon limitations of this research. Some of limitations can be seen as opportunities for future research.

#### 11.4.1 Case selection

The first limitation of this study is related to its generalizability. As far as the sample is concerned, the extensive data covers public – private partnerships consisting of two very specific entities, Dutch water authorities and their private suppliers. This study selected four cases from four different Dutch water authorities on conceptual grounds rather than representative grounds. To have a sufficient confidence in analytic generalizations, Miles et al. (2014) suggest five richly researched cases as a minimum for multiple-case study. Though this study does not meet this requirement, with four cases it is still able to develop a causal loop diagram, including four feedback loops, and this can explain very well how the two governance approaches affect performance and how performance in turn affects the use of the two governances in the context of Dutch PPPs. However, it is reasonable to suggest to readers that caution should be exercised in extrapolating the findings to other settings.

#### 11.4.2 Data collection

Next, some limitations are generally associated with longitudinal process studies. The data collection process began after the projects started, meaning that some of data is retrospective in nature. However, most of that data were collected well before the
dramatic performance shortfalls surfaced. The fact that most of the rest of the data has been collected in real-time limits that retrospective bias. Regarding interviews, the interviews in the case of Brookboard – Elephant involved only water authority representatives, though data collection in the other three cases was truly dyadic in nature (i.e., involving multiple interviews with both water authorities and suppliers). However, since the analyses are not only based on interview data, but also on observations during project team meetings (attended by supplier representatives), minutes of meetings and other archive documents, this was sufficient to obtain a comprehensive overview of this project.

11.4.3 Trust

This study assumes that trust between two parties in a dyad is symmetrical, meaning that the level of trust is assumed to be the same on both sides. However, as Zaheer and Harris (2006) point out, asymmetric trust often exists, because the bases for trust development differ between two partners. For instance, the presence of greater vulnerability of one party as a result of higher power dependence might give rise to asymmetric trust (Zaheer and Harris, 2006). Further, Wicks, Berman, & Jones (1999) suggest that such an imbalance in trust may affect performance outcomes. However, in this research, trust is considered as a relational outcome rather than one aspect of relational governance. The focus is on identifying the pattern of trust development rather than the exact level of trust in a particular moment. Moreover, asymmetric trust between two parties may exist for a short period of time, but is unlikely to last in the long run. Thus the trust on both sides is sufficiently informative for the study.

Moreover, this study focuses on the general trust on both sides, without considering specific types of trust. As discussed in Chapter 3, there are three types of trust, goodwill trust, competence trust, and contractual trust (Das & Teng, 2001; S. Lui & Ngo, 2004; Nooteboom, 1996; Sako and Helper, 1998). Perceived project feasibility might have a
different effect on different dimensions of trust. Thus this study recommends future research to focus on how the different dimensions of trust contribute to the interplay between two governance approaches and performance dynamics.

11.4.4 Contract

This study opens up opportunities for future research on functions of contractual governance and relational governance. Contract can serve three functions, control, coordination and adaptation (Cao & Lumineau, 2015; Malhotra & Lumineau, 2011; Schepker et al., 2014). However, the process model developed in this research only takes into account the control function of contract. The case evidence clearly illustrates that focusing primarily on contractual control stifles communication and eventually kills trust. Focusing on relationship encourages less focus on contractual control. In the case of Riverboard – Mouse, focusing on the relationship supports the contract to provide coordination and adaptation functions by way of the contract redesign. Future research is needed to study more thoroughly the interplay between the functions of contractual and relational governances.

This study also raises specific questions regarding contract design, as contracts that are both incomplete and highly detailed will generally be inflexible, making them less suitable for dealing with the issues that emerge in complex projects over time. In contrast, a good relationship seems to informally provide a safeguard against exchange hazards and to facilitate the enforcement of obligations and adaptation. Future research could focus on how a contract should be designed to facilitate problem solving and adaptations when unforeseeable contingencies appear in long-term relationships.

11.4.5 Triggering factors of strategies

The current research does not allow us to determine the decision-point triggers for mitigating performance shortfalls through a choice of either a contractual strategy or a
relational strategy. Both external (e.g. the institutional environment, technological uncertainty) and internal factors (e.g. history of the relationship, mutual dependency) may play a role in the decision to opt for a focus on contract rather than on relationship. For example, the findings suggest that the dynamics in trust levels and their future potential might serve to explain which response is triggered. Future research is needed to determine and to better understand the conditions that lead to these different responses being adopted in the first place.

Furthermore, in the causal loop diagram and system dynamics simulation model, the study considers strategic decisions as exogenous factors to the dynamic system, it would be interesting for future research to consider these strategic decisions as endogenous factors, studying how the factors that trigger strategic decisions affect the performance dynamic in the system.

11.4.6 Simulation

By development of a system dynamics simulation model, data from two cases (the cases of Riverboard – Mouse and Brookboard – Elephant) have been used for model calibration. To improve model accuracy, future research should also take into account the data from the other two cases. Also for simplicity, it is assumed that the strategies applied by two parties are symmetric. However, in reality, two parties might respond with different strategies at the same moment in time. This limitation might provide an opportunity for future research.
Bibliography


Gulati, R., Lawrence, P. R., & Puranam, P. (2005). Adaptation in vertical relationships:


Appendix 1 Waste-water treatment process

The waste-water treatment process (see Figure A1) starts from the moment that the sewage treatment plants receive waste-water from households and industries via pipes and pumps. After that, the screening process starts, which removes large objects, such as diapers, plastics bottles and sanitary items that may block or damage equipment. Grit is also removed before the waste-water entering the sedimentation tanks, where the organic solid matter is separated from the waste-water by gravity. At the bottom of these tanks, the settled sludge (so called primary sludge) is scraped continuously by scrapers and pushed towards the center where it is pumped away for further treatment. The water is then moved to the aeration tanks, into which air is pumped to encourage bacteria to break down the tiny bits of unsettled sludge. Next, the waste-water is passed through a clarifier/settlement tank, where, again, sludge (so called secondary sludge) is separated from water, scraped and collected for further treatment. The water at this stage is free from harmful substances and chemicals, and thus is allowed to be released to rivers or the sea.

*Figure A1 Waste-water treatment process*
The sludge treatment starts by combining the primary & secondary sludge and feeding them into an anaerobic sludge digestion tank where sludge is broken down by the bacteria, under a low-oxygen environment with a temperature of around 35°C, into non-decaying components. The biogas released during the process is stored and later converted into electricity and heat through gas engines. The remained sludge is transferred to sludge dewatering machines, where certain chemicals are applied to dewater the sludge. The resulting sludge cakes with approximate 25% dry solid or more are transported to the incineration plant for final treatment and the final product may be used for land remediation.
### Appendix 2 Main characteristics of the four cases

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Case of Brookboard – Elephant</th>
<th>Case of Riverboard – Mouse</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partners</strong></td>
<td>Brookboard</td>
<td>Riverboard</td>
</tr>
<tr>
<td></td>
<td>Elephant</td>
<td>Mouse</td>
</tr>
<tr>
<td><strong>Main activities</strong></td>
<td>Waste-water treatment</td>
<td>Wastewater treatment</td>
</tr>
<tr>
<td></td>
<td>Property development, (non-) residential building, roads and civil engineering</td>
<td>Sustainable solutions in the fields of water, energy and raw materials</td>
</tr>
<tr>
<td><strong>Size of the region serviced</strong></td>
<td>1500 km²</td>
<td>2200 km²</td>
</tr>
<tr>
<td><strong># inhabitants served</strong></td>
<td>890,000 residents, 32 municipalities</td>
<td>1.1 million residents, 33 municipalities</td>
</tr>
<tr>
<td><strong># wastewater treatment plants</strong></td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td><strong>Annual purified water production</strong></td>
<td>71 million m³</td>
<td>150 million m³</td>
</tr>
<tr>
<td><strong>Budget in 2017</strong></td>
<td>€ 103 million</td>
<td>€ 162 million</td>
</tr>
<tr>
<td><strong>Turnover in 2016</strong></td>
<td>€ 2 billion</td>
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</tr>
<tr>
<td><strong># employees</strong></td>
<td>350</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>6000</td>
<td>300</td>
</tr>
<tr>
<td><strong>Contract initiation</strong></td>
<td>In 2012</td>
<td>In 2011</td>
</tr>
<tr>
<td><strong>Contract duration</strong></td>
<td>2 years for design &amp; building</td>
<td>9 months for design &amp; building</td>
</tr>
<tr>
<td></td>
<td>15 years for maintenance</td>
<td>6.5 years for maintenance</td>
</tr>
<tr>
<td><strong>Project scope</strong></td>
<td>Renovation of a sludge treatment system involving application of an innovative external technology; DBM contract.</td>
<td>Modification to an existing sludge treatment system involving application of new external technology; DBOM contract.</td>
</tr>
<tr>
<td><strong>Project value</strong></td>
<td>€ 26 million for design and construction</td>
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<td></td>
<td>€ 5 million for maintenance</td>
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</tr>
<tr>
<td></td>
<td>€ 31 million in total</td>
<td>€ 6.5 million in total</td>
</tr>
<tr>
<td>Characteristics</td>
<td>Case of Creekboard – Giraffe</td>
<td>Case of Lakeboard – Panda</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td><strong>Main activities</strong></td>
<td>Wastewater treatment</td>
<td>Wastewater treatment and environmental projects;</td>
</tr>
<tr>
<td></td>
<td>New installations, maintenance and facility management, onshore and offshore constructions and services</td>
<td>raw materials, facility management, and real estate development</td>
</tr>
<tr>
<td><strong>Size of the region serviced</strong></td>
<td>1707 km²</td>
<td>1610 km²</td>
</tr>
<tr>
<td><strong># inhabitants served</strong></td>
<td>810,000 residents</td>
<td>745,000 residents</td>
</tr>
<tr>
<td></td>
<td>21 municipalities</td>
<td>21 municipalities</td>
</tr>
<tr>
<td><strong># wastewater treatment facilities</strong></td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td><strong>Annual purified water production</strong></td>
<td>73 million m³</td>
<td>53 million m³</td>
</tr>
<tr>
<td><strong>Budget 2017</strong></td>
<td>€ 142 million</td>
<td>€ 110 million</td>
</tr>
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<td><strong>Turnover in 2016</strong></td>
<td>-</td>
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<td><strong>Number of employees</strong></td>
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<td>400</td>
</tr>
<tr>
<td></td>
<td>6000</td>
<td>18000</td>
</tr>
<tr>
<td><strong>Contract initiation</strong></td>
<td>In 2010</td>
<td>In 2015</td>
</tr>
<tr>
<td><strong>Contract duration</strong></td>
<td>2 years for design and building</td>
<td>3 years 8 months for design and building</td>
</tr>
<tr>
<td></td>
<td>10 years for maintenance</td>
<td>15 years for maintenance</td>
</tr>
<tr>
<td><strong>Project scope</strong></td>
<td>Renovation of an existing sludge treatment system with no innovation; DBM contract.</td>
<td>Modification to both water treatment system and sludge treatment system involving application of innovative external technologies; DB (M) contract.</td>
</tr>
<tr>
<td><strong>Project value</strong></td>
<td>€ 5.7 million for design and construction</td>
<td>€ 40 million for design and building</td>
</tr>
<tr>
<td></td>
<td>€ 2 million for maintenance</td>
<td>€ for maintenance (not granted yet)</td>
</tr>
<tr>
<td></td>
<td>€ 7.7 million in total</td>
<td>€ 40 million in total</td>
</tr>
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</table>
Appendix 3 Interview protocols

A. Questions for middle management

1. Background questions
   a. Background of the interviewee:
      - Would you tell me something about yourself?
        Position, responsibility, time of working, involvement with PBC projects.
   b. Background of the company:
      - Would you tell me something about your company?
   c. Background of the project:
      - Would you please introduce me to the project?

2. Contracting:
   a. Tendering: how did you get this project?
   b. Contract:
      - What is your opinion of this type of contract? Any experience?
      - Did you get the chance to discuss the contract before signing?
      - How does this type of contract affect your way of carrying out the project?
      - What were the requirements of the contract? What do you think of them?
      - What were the performance indicators? What do you think of them?
      - What was the incentive mechanism? What do you think of it?
      - What was the payment arrangement? What do you think of them?
      - To what extent do you have autonomy?
      - How did this contract affect your relationship with your partner?
   c. Post-contracting
      - What was the level of performance achieved? Why? How did you communicate this to your partner?
      - How was the contract monitored? Who? Method? Information system?
      - Was there any change made/proposed by both of the parties after the contract was changed? How was it dealt with? Why?
      - What changes were made? What do you think about the change? How will this change affect you, and the project?
      - Why do you think your partner was willing to re-design the contract?
      - If they hadn’t done it, what would have been the outcome?

3. Relationship
   - How is the relationship between you and your partner in general?
   a. Conflict:
• Was there any conflict between you and your partner? How was it settled?
• How did any previous conflict affect the project here? Why?
• How was your relationship when the conflict was resolved? Did that help your relationship?

b. Mutual interest:
• Do you share any mutual interest with your partner? What?

c. Trust:
• What do you think of trust between you and your partner? Was there any difference between the period of the old contract and that of new contract?
• How did trust evolve during this entire project?
• How would trust affect your action in relation to your partner?
• How would trust affect your perception of the contract?

d. Communication:
• What do you think of the current communication between you and your partner? Good? Why?
• How often, which methods, who?

e. Extra:
• How will this current relationship affect your perception of the contract?

4. Final questions
• Is there anything I haven’t covered but you think is relevant to discuss?
• Do you have any questions for us?
B. Questions for senior managers

- **Background questions**
  a. Background of the interviewee:
     - Would you tell me something about yourself?
       - Position, responsibility, time of working, involvement of PBC projects.
  b. Background of the company:
     - Would you tell me something about your company?
  c. Background of the project:
     - Would you please introduce me to the project?
  d. Relevant people:
     - Who do you think are relevant to interview?
- **Contracting:**
  - What do you think of the contracting process?
  - What is your opinion of performance-based contracts?
  - What did you learn from these contracts?
  - How was the performance?
- **Relationship:**
  a. Communication :
     - What was the process of information exchange & sharing with your partner?
  b. Relationship development:
     - How was a working relationship developed at management level?
  c. Trust :
     - What do you think of trust between you and your partner?
     - How did the trust dynamic develop?
  d. Decision-making process:
     - What was the decision-making process?
     - After the problems were escalated to management level?
- **Final questions**
  - Is there anything I haven’t covered but you think is relevant to discuss?
    - Do you have any questions for us?
## Appendix 4 Overview of interviews

### Case of Riverboard – Mouse

<table>
<thead>
<tr>
<th>Number</th>
<th>Date</th>
<th>Interviewee(s)</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13-12-2013</td>
<td>Manager X,Y&amp;W</td>
<td>Riverboard</td>
</tr>
<tr>
<td>2</td>
<td>25-2-2014</td>
<td>Manager X</td>
<td>Mouse</td>
</tr>
<tr>
<td>3</td>
<td>17-3-2014</td>
<td>Manager X&amp;W</td>
<td>Riverboard</td>
</tr>
<tr>
<td>4</td>
<td>28-5-2014</td>
<td>Manager O</td>
<td>Riverboard</td>
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<tr>
<td>5</td>
<td>28-5-2014</td>
<td>Manager X&amp;Y</td>
<td>Riverboard</td>
</tr>
<tr>
<td>6</td>
<td>13-6-2014</td>
<td>Manager X&amp;Y</td>
<td>Riverboard</td>
</tr>
<tr>
<td>7</td>
<td>3-7-2014</td>
<td>Manager X&amp;P</td>
<td>Riverboard</td>
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<td>9-7-2014</td>
<td>Manager Q</td>
<td>Riverboard</td>
</tr>
<tr>
<td>9</td>
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<td>Manager Z</td>
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</tr>
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<td>Manager V</td>
<td>Riverboard</td>
</tr>
<tr>
<td>11</td>
<td>14-8-2014</td>
<td>Manager Z</td>
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<td>12</td>
<td>4-9-2014</td>
<td>Manager X</td>
<td>Riverboard</td>
</tr>
<tr>
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<td>4-9-2014</td>
<td>Manager W</td>
<td>Riverboard</td>
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<td>10-10-2014</td>
<td>Manager Y</td>
<td>Riverboard</td>
</tr>
<tr>
<td>15</td>
<td>16-2-2015</td>
<td>Manager X</td>
<td>Mouse</td>
</tr>
<tr>
<td>16</td>
<td>24-2-2015</td>
<td>Manager V</td>
<td>Riverboard</td>
</tr>
<tr>
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<td>8-6-2015</td>
<td>Manager Y</td>
<td>Riverboard</td>
</tr>
<tr>
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<td>7-9-2015</td>
<td>Manager X</td>
<td>Mouse</td>
</tr>
<tr>
<td>19</td>
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<td>Manager X&amp;Z</td>
<td>Riverboard</td>
</tr>
<tr>
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<td>Organization</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>----------------------</td>
<td>--------------</td>
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<tr>
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<td>Manager P</td>
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</tr>
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**Case of Brookboard – Elephant**

<table>
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<td>1</td>
<td>18-12-2013</td>
<td>Manager Y&amp;W</td>
<td>Brookboard</td>
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<td>4</td>
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<td>5</td>
<td>28-8-2014</td>
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<td>6</td>
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<td>10-3-2015</td>
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<td>10-3-2015</td>
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<tr>
<td>14</td>
<td>17-12-2015</td>
<td>Manager Y</td>
<td>Brookboard</td>
</tr>
<tr>
<td>15</td>
<td>17-12-2015</td>
<td>Manager V</td>
<td>Brookboard</td>
</tr>
<tr>
<td>16</td>
<td>29-6-2016</td>
<td>Manager X</td>
<td>Brookboard</td>
</tr>
<tr>
<td>Number</td>
<td>Date</td>
<td>Interviewee(s)</td>
<td>Organization</td>
</tr>
<tr>
<td>--------</td>
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<td>--------------</td>
</tr>
<tr>
<td>1</td>
<td>12-12-2013</td>
<td>Manager X,Y,Z</td>
<td>Creekboard</td>
</tr>
<tr>
<td>2</td>
<td>20-2-2014</td>
<td>Manager X,Y,Z</td>
<td>Creekboard</td>
</tr>
<tr>
<td>3</td>
<td>4-6-2014</td>
<td>Manager X</td>
<td>Creekboard</td>
</tr>
<tr>
<td>4</td>
<td>3-9-2014</td>
<td>Manager Y</td>
<td>Creekboard</td>
</tr>
<tr>
<td>5</td>
<td>3-9-2014</td>
<td>Manager Z</td>
<td>Creekboard</td>
</tr>
<tr>
<td>6</td>
<td>17-9-2014</td>
<td>Manager X</td>
<td>Creekboard</td>
</tr>
<tr>
<td>7</td>
<td>26-2-2015</td>
<td>Manager X</td>
<td>Creekboard</td>
</tr>
<tr>
<td>8</td>
<td>26-2-2015</td>
<td>Manager Z</td>
<td>Creekboard</td>
</tr>
<tr>
<td>9</td>
<td>20-5-2015</td>
<td>Manager Z</td>
<td>Creekboard</td>
</tr>
<tr>
<td>10</td>
<td>26-5-2015</td>
<td>Manager X</td>
<td>Giraffe</td>
</tr>
<tr>
<td>11</td>
<td>29-5-2015</td>
<td>Manager W</td>
<td>Creekboard</td>
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<tr>
<td>12</td>
<td>13-7-2015</td>
<td>Manager Y</td>
<td>Creekboard</td>
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<td>21-10-2015</td>
<td>Manager Y</td>
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<td>14</td>
<td>18-11-2015</td>
<td>Manager P</td>
<td>Creekboard</td>
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<tr>
<td>15</td>
<td>18-11-2015</td>
<td>Manager W</td>
<td>Creekboard</td>
</tr>
<tr>
<td>Number</td>
<td>Date</td>
<td>Interviewee(s)</td>
<td>Organization</td>
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<td>--------</td>
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<td>--------------</td>
</tr>
<tr>
<td>1</td>
<td>11-3-2015</td>
<td>Manager X&amp;Y</td>
<td>Lakeboard</td>
</tr>
<tr>
<td>2</td>
<td>28-5-2015</td>
<td>Manager X</td>
<td>Panda</td>
</tr>
<tr>
<td>3</td>
<td>27-10-2015</td>
<td>Manager Y</td>
<td>Lakeboard</td>
</tr>
<tr>
<td>4</td>
<td>9-12-2015</td>
<td>Manager Z</td>
<td>Lakeboard</td>
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<td>5</td>
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<td>Lakeboard</td>
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<td>9-3-2016</td>
<td>Manager X</td>
<td>Lakeboard</td>
</tr>
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<td>7</td>
<td>25-4-2016</td>
<td>Manager X</td>
<td>Panda</td>
</tr>
<tr>
<td>8</td>
<td>12-11-2017</td>
<td>Manager X</td>
<td>Lakeboard</td>
</tr>
<tr>
<td>9</td>
<td>15-5-2018</td>
<td>Manager X</td>
<td>Lakeboard</td>
</tr>
<tr>
<td>10</td>
<td>5-6-2018</td>
<td>Manager X</td>
<td>Panda</td>
</tr>
</tbody>
</table>
Appendix 5 Coding lists

- Initial list of codes

<table>
<thead>
<tr>
<th>Category 1: Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction: size and scope</td>
</tr>
<tr>
<td>Contractor</td>
</tr>
<tr>
<td>Experience</td>
</tr>
<tr>
<td>Innovation</td>
</tr>
<tr>
<td>Technical problem</td>
</tr>
<tr>
<td>Performance</td>
</tr>
<tr>
<td>Lesson learned</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 2: Contracting process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
</tr>
<tr>
<td>Requirement</td>
</tr>
<tr>
<td>Tendering</td>
</tr>
<tr>
<td>Contract design</td>
</tr>
<tr>
<td>Contract monitoring</td>
</tr>
<tr>
<td>Contract re-design</td>
</tr>
<tr>
<td>- Contractual adaptation: change in risk &amp; reward allocation, change in specifications (type, level of detail, etc).</td>
</tr>
<tr>
<td>Contract enforcement/arbitration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 3: Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude toward contract</td>
</tr>
<tr>
<td>Performance indicator</td>
</tr>
<tr>
<td>Bonus</td>
</tr>
<tr>
<td>Penalty</td>
</tr>
<tr>
<td>Payment</td>
</tr>
<tr>
<td>Risk</td>
</tr>
<tr>
<td>Termination</td>
</tr>
<tr>
<td>Autonomy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 4: Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous experience</td>
</tr>
<tr>
<td>Communication</td>
</tr>
<tr>
<td>Conflict (reason, solution, consequence)</td>
</tr>
<tr>
<td>Mutual interest</td>
</tr>
<tr>
<td>Trust</td>
</tr>
<tr>
<td>- Goodwill, competence and/or contractual.</td>
</tr>
<tr>
<td>Cooperation</td>
</tr>
<tr>
<td>Changing mind</td>
</tr>
<tr>
<td>Solution</td>
</tr>
</tbody>
</table>
- Adapted coding list

### Static (descriptive) codes

#### Category 1: Project
1. Introduction
2. Contractor
3. Innovation
4. Experience

#### Category 2: Contracting process
1. Feasibility assessment stage
2. Contract formulation & implementation stage:
   a. Contract design
   b. Tender & selection:
      - Bidding
      - Assessing
      - Selecting
      - Negotiating terms
      - Structuring terms
   c. Design & construction
   d. Operation & maintenance
3. Contract evaluation stage
   a. Contract monitoring
   b. Contract evaluation
   c. Contract redesign/ adaptation
   d. Contract enforcement/ arbitration
   e. Contract termination

#### Category 4: relationship
1. Previous experience

### Dynamic codes

#### Category 1: Project
1. Technical problem
2. Performance
3. Learning (Lesson-learned)

#### Category 3: Contract
1. Attitude toward contract
2. Contract type
3. Level of details
4. Contract terms:
   - Performance indicator
   - Bonus
   - Penalty
   - Payment
   - Risk
   - Termination
   - Autonomy
   - Duration
   - Milestone

#### Category 4: relationship
1. Communication
2. Conflict (-reason, -solution, -consequence)
3. Trust
   - Goodwill, competence and/ or contractual.
4. Attitude toward Contractor
5. Mutual interest
6. Cooperation
**Final coding list**

<table>
<thead>
<tr>
<th>Category 1: Project</th>
<th>Category 3: Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project complexity</td>
<td>Relational quality:</td>
</tr>
<tr>
<td>Project performance</td>
<td>• Trust</td>
</tr>
<tr>
<td>Performance shortfall</td>
<td>Commitment</td>
</tr>
<tr>
<td>Perceived project feasibility</td>
<td>Communication</td>
</tr>
<tr>
<td></td>
<td>Mutual understanding</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 2: Contract</th>
<th>Category 4: Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial contractual targets</td>
<td>Relational strategies:</td>
</tr>
<tr>
<td></td>
<td>• Accommodative response</td>
</tr>
<tr>
<td></td>
<td>• Information sharing</td>
</tr>
<tr>
<td>Contractually required performance</td>
<td>Contractual strategies:</td>
</tr>
<tr>
<td></td>
<td>• Self-serving response</td>
</tr>
<tr>
<td></td>
<td>• Contractual control</td>
</tr>
</tbody>
</table>
Appendix 6 Definitions of key concepts

1. **Contractual governance**: The extent to which one IOR is governed by a formal and written contract which explicitly stipulates the responsibilities and obligations of each party (Cao & Lumineau, 2015; Ryall & Sampson, 2009).
   - **Contractual governance strategy in dealing with performance shortfall**: An organization uses contractual control as a response to performance shortfall (Bello et al., 2010) and/or partners react competitively as a response to a performance shortfall by imposing each other a self-serving solution (Bello et al., 2010).
     - **Contractual control**: An organization explicitly measures and verifies its partner’s role performance by directly monitoring whether agreed-on actions are implemented (Bello et al., 2010).
     - **Self-serving response**: Partners pursue their self-interest by trying to get the partner to make some concessions, making demands that are in conflict with their partners’ interests, and withdrawing resources from partnership (Bello et al., 2010).

2. **Relational governances**: The extent to which one IOR is governed by informal and social relations and shared norms (Cao & Lumineau, 2015; Laura Poppo et al., 2008; Zhou & Xu, 2012).
   - **Relational governance strategy in dealing with performance shortfall**: Partners show a constructive response to a performance shortfall by sharing information to accommodate problem solving (Bello et al., 2010) and/or partners expressing an implicit or explicit aim of recovering the relationship through solving the performance shortfall with an accommodative response (Bello et al., 2010).
     - **Information sharing**: Partners proactively provide useful information to their partner in support of the ongoing relationship. They suggest an ideal solution, show the logic of each other’s position and attempt to get all their concerns and difficulties into the open (Bello et al., 2010; Griffith & Myers, 2005).
     - **Accommodative response**: Partners react actively to directly address the task at hand by investing in relationship (Bello et al., 2010).

3. **Project complexity**: The nature, quantity, and magnitude of organizational subtasks and subtask interactions posed by the project (Tatikonda & Rosenthal, 2000).
   - **Project size**: Project budget measured by euros.
   - **Project scope**: The number of treatment systems in the project.
   - **Innovation level**: The number of innovations in the project.

4. **Performance shortfall**: a situation in which actual project performance being lower than contractually required performance.
- **Project performance**: The actual level of schedule performance, operational performance and financial performance of the project (Suprapto et al., 2015).

- **Contractually required performance**: the level of performance required by a contract

5. **Perceived project feasibility**: The perceived likelihood of completing the project successfully

6. **Relational quality**: The level of trust on both sides in the partnership (Kelleher & Miller, 2006; Yaqub, 2013).

- **Trust on both sides**: The extent to which one organization has confidence in the exchange partner’s reliability and integrity (Morgan & Hunt, 1994).

7. **Commitment**: The intention or willingness to continue a business relationship (Morgan & Hunt, 1994).
## Appendix 7 Evidence of causal relationships

<table>
<thead>
<tr>
<th>Causal loop</th>
<th>Empirical information to support causal relations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Empirical observations</td>
</tr>
<tr>
<td><strong>1.1: Performance and project feasibility loop</strong></td>
<td></td>
</tr>
<tr>
<td><strong>a. Project complexity affects project performance</strong></td>
<td></td>
</tr>
<tr>
<td>1. A sudden increase in project complexity drives a lower project performance</td>
<td>Case of Riverboard—Mouse: Unexpected technical problems in heat exchangers and steam injectors led to lower operational performance.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>b. Resource adequacy affects project performance</strong></td>
<td></td>
</tr>
<tr>
<td>2. Resource inadequacy drives a lower project performance</td>
<td>Case of Brookboard—Elephant: Equipment changes in final design resulted in unqualified design.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>c. Project performance affects performance shortfall</strong></td>
<td></td>
</tr>
<tr>
<td>3. Lower project performance leads to bigger performance shortfall</td>
<td>Case of Riverboard—Mouse: Lower operational performance led to bigger gap between actual performances and contractually agreed operational performance.</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>
Case of Lakeboard—Panda: Extra time required in the project led to schedule delay in the project.

Case Creekboard—Giraffe: Late design submission caused failure of meeting the contractual deadline and delay of construction.

d. Performance shortfall affects perceived project feasibility:

| Larger performance shortfall drives lower perceived project feasibility | “They had a new heat exchanger and they said it would be ok. But it was not ok. That was the moment I did not believe they could make it.” (Riverboard) |
|———|———|
| “It was a big modification. We told them that we found the solution to the problem. However, the problem still occurred. They must have thought it was much more difficult to solve the problem, to manage this kind of installation under these conditions.” (Mouse) | “The commissioning dates were postponed several times. The feasibility of continuing was gone. We didn’t believe Elephant would finish the job.” (Brookboard) |
| “When the problem with Giraffe started in the building phase, people from maintenance lost their faith.” (Creekboard) | “I don't think they will be ready with this 14 months delay. They need more delay” (Lakeboard) |
| “The project was so complex that maintenance contract might also not be a solution and the new investment will result in no return” (Panda) |———|
### e. Perceived project feasibility affects relation-specific investments

| Lower perceived project feasibility leads to more relation-specific investments | Case of Riverboard—Mouse: In August, 2012, after unexpected problems were discovered, Mouse made extra investment in designing and purchasing new equipment, modifying existing equipment and experimenting these new solutions, while in October 2012, Riverboard invested additional resources to re-investigate the feasibility of the technology by means of an audit. Moreover, Riverboard was willing to accept a lower level of gains that Mouse promised.

Case of Creekboard—Giraffe: In December 2012, after conflict escalation to top management, Giraffe put extra human resource in the project team and provided qualified equipment. While, In February 2013, Creekboard decided to grant Giraffe the maintenance contract in order to motivate them to solve problems.

“We saw the problems with the heat exchangers, so we changed them quickly.” (Mouse)

“We reconstructed the installation, but it still needed adjustments.” (Mouse).

“We got the order from top management to make some kind of audit...” (Riverboard).

“They proposed a third manager. He did a lot of things that other managers did not do and solved a lot of problems.” (Creekboard)

“To rebuild the trust we had to understand that it was a different team from Giraffe. We agreed to have a try...” (Creekboard) |
| --- | --- |
| Lower perceived project feasibility leads to less, or no, extra relation-specific investments | Case of Brookboard—Elephant: In July 2013, After the implementation request for "final" design was rejected by Brookboard, Elephant stopped all activities on the site.

Case of Lakeboard—Panda: In December 2017, Panda reduced resources in the project, after noticing months of delay in the project.

Case of Creekboard—Giraffe: In December 2011, after conflict escalation, Giraffe tried to put low quality equipment into the design.

“They didn’t do anything anymore, which they called the stand-still principle.” (Brookboard)

“… they do not increase resources. They tried to make cost reductions by reducing the number of people.” (Lakeboard)

"… in this case, the new investment will result in no return.” (Panda)

“… he had only one goal to get this project finished as fast as possible at the lowest cost.” (Creekboard) |
### f. Relation-specific investments affects project performance

**Increased relation-specific investment leads to higher project performance**

Case Riverboard – Mouse: After a big modification to the plant, in December 2014, the operational performance has been substantially increased by Mouse.

Case of Creekboard – Giraffe: With increased investment, In May 2013, Giraffe managed to solve the major problems in the installation and enhance the operational performance.

"We reconstructed the installation and we saw that it was becoming better." (Mouse)

"The new project team provided us with the right solutions." (Creekboard)

**Decreased relation-specific investment leads to lower project performance**

Case Brookboard – Elephant: With decreased investment, the hand-over date of the installation was further delayed, and the plan towards delivery changed several times.

Case Lakeboard – Panda: After decreased resource in project, in May 2018, Panda submitted a new project plan which indicated extra delay.

"The commissioning dates were postponed several times." (Brookboard)

"Panda is pushing their work right to the end. You can't catch up by decreasing resource." (Lakeboard)

### L2: Trust and commitment loop

#### a. Perceived project feasibility affects trust on both sides

**Decreased perceived project feasibility leads to lower trust on both sides**

"It was a big modification. We told them that we had found the solution to the problem. However, the problem still occurred. They (Riverboard) must have thought it was much more difficult to solve the problem..." (Mouse)

"..I only lost the belief that they could meet the requirements of the contract." (Riverboard)

"The commissioning dates were postponed several times. The feasibility of continuing was gone. We didn’t believe Elephant would finish the job. (Brookboard)

"When the problem with Giraffe started in the building phase, people from maintenance lost faith.” (Creekboard)
### Increased perceived project feasibility leads to higher trust on both sides

"The new project team provided us with the right solutions. We trusted them again…" (Creekboard)

"They see we are working on it, having the confidence in technology and trust that the promises will be kept. We are glad that we got this trust" (Mouse)

### b. Trust on both sides leads to commitment and relation-specific investment

"The belief in Elephant became less every day … The commitment from Elephant was also gone … They did not do anything anymore..." (Brookboard)

"…they are waiting for the result of the civil court. The effort is very low" (Brookboard)

"If you do not believe each other, it is very difficult to act in a vulnerable way.” (Brookboard)

"They didn’t trust us, because they thought our engineers only wanted what was best for us.” (Creekboard)

"Trust will not solve the problem, but help to find solution, the trust we have now is not enough to negotiate a solution … We both have to put a put water into each other's wine. Both parties have to adapt or compromise…” (Panda)

"I am not sure about their commitment to solving this problem (delay), I have a feeling that in the end we will have to go to court or we have to make another kind of agreement.” (Lakeboard)
Increased trust leads to higher commitment and more relation-specific investment

"The new contract manager … wants to do it right, in that case, there is trust. That is getting better." (Creekboard)

“I trust the people that are on the job. Giraffe are willing to improve or cooperate since they also want to make this contract a success.” (Creekboard)

"I think Giraffe want to keep the relationship good. When we say we are not happy, they will react to that.” (Creekboard)

“What has been very important was that the directors met and expressed their belief in a solution: ‘Whatever happens, we will solve this together!’ That was then the point of departure, top-down, for all solutions that were implemented thereafter.” (Riverboard)

**L3: Contractual control loop**

**a. Perceived project feasibility leads to emphasis on contractual controls and contractually required performance**

<table>
<thead>
<tr>
<th>Lower perceived project feasibility leads to more emphasis on contractual controls, thus higher/stricter contractually required performance.</th>
<th>Case of Brookboard—Elephant: After receiving &quot;final&quot; design, in January, 2013, Brookboard sent an official letter announcing that Elephant had failed to deliver a qualified design by the first deadline.</th>
<th>“Elephant was pushing it: ‘if you don't agree, you will receive a big claim from us and we will stop building.’ At that moment we decided to go to arbitration.” (Brookboard)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Case of Creekboard—Giraffe: After observing a bad operational performance, in December, 2012, Creekboard made a serious threat of legal action to Giraffe.</td>
<td>&quot;We really struggled with the new factory… there was a talk to the board of Giraffe: ‘please follow the contract as we agreed otherwise we stop the business with you.’” (Creekboard)</td>
</tr>
<tr>
<td></td>
<td>Case of Lakeboard – Panda: After Lakeboard perceived the delay in the project, in December 2017, they paid more intention to the contract and did more tests to check the quality of the installations. After noticing extra delay in the project, since May 2018, both parties started to have many contractual discussions on financial issues.</td>
<td>“I understand their situation, but I have to stick to the contract. … If we don't receive quality, we put more pressure on it. They play the music, we dance.” (Lakeboard)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;Something wrong happened, it was never Panda’s fault but ours. The argument was that they did not see it specified in the contract. (Lakeboard)</td>
</tr>
</tbody>
</table>
| | | “We have to stop writing formal letters to each other. It was purely contractual... If Lakeboard
is not flexible, then we cannot be flexible” (Panda)

“There were contradictions between data and contract, not everything in the contract was correct.” (Panda)

**L4: Voicing and mutual understanding loop**

**a. Perceived project feasibility leads to emphasis on voicing concerns and communication**

| Lower perceived project feasibility leads to more emphasis on voicing concerns and communication | “We saw the problems with the heat exchangers: they were small, so we changed them quickly. But we were still having problems. Then we told Riverboard it was not working but we were working on it.” (Mouse) |
| | “We had a meeting every 2 weeks to inform the development of the project and the problems that we were engaging with. (Mouse) |
| | “What we did constantly is to communicate about the problems, the associated risks and the identified solutions. (Mouse) |
| | “It was not clear to both parties what happened. The installation does work well. The issues are small. We were making them bigger than they were. We are now trying to make them clear.” (Creekboard) |
| | “The new contract manager brought structure of communication... Communication was improved.” (Creekboard) |
| | “Good meetings, good people. The process of acting together is getting better.” (Giraffe) |

**b. Communication affects mutual understanding and trust on both sides**

| Better communication leads to more mutual understanding and sustains trust on both sides | “We were always on speaking terms with Riverboard. I had the feeling that Riverboard was also satisfied. There were discussions, but in general they were happy with the way we worked together.” (Mouse) |
“They said they needed more time... They knew they would get a penalty but they believed they would achieve it... I believe when you start to work together, you’ve got to trust each other and not to distrust each other.” (Riverboard)

“I like the new contract manager. The new manager listens and he is more honest and flexible. He is trying to get the best out of it.” (Creekboard)

What really happened was that we got on speaking terms with each other. How do we work and who is responsible for what part based on the contract.” (Creekboard)

“More costs than we agreed upon on the contract. We asked for more so we had to pay more. But the problem was that we never realized we had asked for more.” (Creekboard)

“There were no breakdowns that were the responsibility of Giraffe. The feeling was that it was all working well.” (Creekboard)

“Worse communication leads to less mutual understanding and deteriope trust on both sides

“There's no trust, because we still feel Elephant is not open about many things.” (Brookboard)

It's not good to be very defensive in a meeting. To cooperate you must make yourself vulnerable and share information.” (Brookboard)

“We still don't trust them. They're not saying anything about the contractual issues. Not really nice to work with them relationship-wise.” (Brookboard)

“The new project manager came to meetings but his colleagues were not allowed to talk. This was the moment that you know things had gone wrong.”(Creekboard)

"In the tender, the description of the technology was on a general level. We are now
three years from the start, and there is nothing more than what we have in the tender. That's why my trust has been decreased.”
(Lakeboard)
Appendix 8 Performance data

This appendix discloses performance behaviors in the four cases. In the cases of Riverboard – Mouse and Creekboard – Giraffe, project preceded already in the operation and maintenance stage, financial data regarding operational cost and maintenance cost were collected, while in the cases of Brookboard – Elephant and Lakeboard – Panda, projects were still in the design and building stage, the data were mainly related to progress with schedule.

Figure A2 shows the target operational cost and actual operation cost sludge treatment from the moment Riverboard and Mouse consistently started to measure operational performance (January 2013). The performance shortfall continued to exist for three years. In 2016, Mouse finally managed to overcome the performance shortfall.

![Figure A2 Financial performance in the case of Riverboard -- Mouse](image)

The majority of the data for the case of Brookboard – Elephant concerns the construction stage. The project performance in the case of Brookboard – Elephant was evaluated as project realization relative to the project plan (Figure A3). Elephant delivered the project management plan on time on July 2012. Elephant submitted a final design on December 2012, which was judged as unqualified design, as it was different from a general design offered in the tender. After 21 months, two parties finally agreed on the final design. Due to disagreement on final design, the detailed design submission
was also with a 19 months delay. Two parties did not have an agreement on the time of delivery of the sludge treatment system until they decided to stop the relationship in December 2016. The project performance continued to worsen after the performance shortfall appeared in December 2012, which in the end resulted in a breakup of the partnership.

In the case of Creekboard – Giraffe, the financial performance (Figure A4) was analyzed by comparing the actual maintenance cost to the budget specified in the contract. I observed that the actual cost overshot the budget since 2013 for a period of three years. In 2016, Giraffe finally managed to achieve the target financial performance.
In the case of Lakeboard – Panda, the project performance was again evaluated as project realization relative to the project plan (Figure A5). Panda was able to deliver project management plan and final design on time. Upon the last data collection session in June 2018, according to the interviewee, the whole treatment plant would be delivered with 14 months delay compared to original project plan.

![Figure A5 Project performance in the case of Lakeboard – Panda](image-url)
Appendix 9 Trust dynamics

This appendix shows more details over the trust dynamics in four cases. In the case of Riverboard – Mouse (Figure A6), two parties had a positive prior experience with each other (i.e., shadow of the past), and hence a high level of initial trust (“We did a pilot project together and the results were good. Therefore Riverboard had a lot of confidence in the process and technology.”). The design and construction of the plant went well, as a result the trust increased steadily “(...a lot of respect for each other ... we had a good building process”). Moreover, both parties perceived relationship continuity (i.e., shadow of the future) to be high (“When we [Mouse] fail in things like this, it affects our reputation and future contracts with this water authority and with all others.”) (October 2012). Although Riverboard’s confidence in Mouse remained strong (“They [Mouse] said: ‘... we will make the investment as we eventually get a return on this investment.’ That creates goodwill.”; “They [Riverboard] always had the confidence that we would do what has to be done.” (December 2012)), in January 2013, Riverboard seriously started to doubt whether Mouse would be able to deliver a complete solution at all: “I did not lose my trust in Mouse, not at all. I only lost the belief that they could meet the requirements in the contract.” In February 2013, the audit results demonstrated the feasibility of the technology at plant level. This enhanced Riverboard’s perceived project feasibility and trust started to increase again: “...we trust because we know the people from Mouse very well. We see them everywhere; they cannot do a bad job.” The redesign of the contract (May 2013), followed by a big modification and subsequently a substantial performance increase (February 2014), further increased project feasibility and enhanced trust. In September 2016, trust was at the highest possible level.
In the Brookboard – Elephant case (Figure A7), trust started to deteriorate from the moment Elephant first presented their design changes (December 2012), first slowly, but then more quickly as Elephant did not adequately respond to Brookboard’s questions. While project feasibility decreased over time, so did trust. A large drop takes place when Brookboard decided to go for arbitration (August 2013). As they explained after the arbitration (December 2013): “The conflict [i.e., arbitration with Elephant] has affected our trust.” Evidence also seemed to suggest Elephant’s behavior to be confirming past experiences (i.e., shadow of the past): “I hope it [the level of trust] will change, but I don’t think so. It’s [Elephant] a contractor; it’s their nature”. The interim director who came on board in August 2014 “helps build trust, but … there is still an opportunity for an appeal.” However, the design changes that followed this delicate trust increase (October 2014) triggered more questions from Brookboard, which – Elephant formally stated – delayed the process. This was “not good for building trust”. The delivery of the installation was delayed multiple times in the last quarter of 2015, which diminished project feasibility and, subsequently, trust: “…trust is like zero. It’s a disaster.” By December 2015, trust was gone, and so was commitment: “They [Elephant] are waiting for the result of the civil court. The effort is very low, almost
absent.” Even in the operational stage “trust is…zero. There is no trust. Even Elephant said it themselves during the meeting.”

![Brookboard – Elephant trust dynamics](image)

Figure A7 Trust dynamics in the case of Brookboard – Elephant

In the Creekboard – Giraffe case (Figure A8), two parties had a legal conflict before the start of the project, which resulted in a relatively low initial trust compared to other cases (‘we must make it apart, but it was tricky.’). The trust started to deteriorate after the event that Giraffe had a delay in submitting engineering work, the feasibility of delivering the installation on time was reduced. It thus resulted in deterioration of the trust (The delay problem was because Giraffe didn’t want to design what was better than needed and they didn’t trust us. (December 2012)). The feasibility of finishing project on time was further reduced, as the bankruptcy of one of the Giraffe’s suppliers caused extra delay in the project. The trust continued to erode (“They promised to improve but it got from bad to worse”. (May 2011)). Later on the new project manager brought in a short period of progress, however, at the cost of the quality of project. Creekboard’ perception of Giraffe not building an installation with good quality, further lowered the trust (“The new project manager was very competent in getting jobs done but his intention was not to work together.” (December 2011)). In July 2012, the operation started and the delivered installation didn’t brought the required performance with low reliability & availability and high operational cost. The perceived project...
feasibility became even smaller, which resulted in further loss of the trust (“That was the moment we said we had to stop this”). After a warning of legal action to Giraffe, the new management team invested in more resource in solving operational problems and acted proactively to demonstrate their capability in doing good maintenance work. The progress in the project facilitated the rebuilding of the trust (“They did a good job in making us feel comfortable with the choice to give them the maintenance contract.” (December 2012)), since the perceived project feasibility also started to grow. In June 2013, Giraffe delivered an installation that conformed to the contract, which lead to the increase of the trust (“The new project manager provided me with the right solutions. I trusted them again”). The unclearness in the contract caused many disagreements on the maintenance cost. Though the technical performance (reliability and availability of installation) was sufficient, the extra cost claimed by Giraffe made Creekboard to question the feasibility of achieving the projected total cost of ownership, which led to the decrease of the trust. The bad communication as a result of the leave of contact persons made the situation worse (“They use every gap in the contract. I know I have to rely on Giraffe and to trust him. But I can't.” (Jan 2014)). In the end of 2014, the continued unsatisfied financial performance made the collaboration between two parties more problematic due to the lowered trust (“It doesn’t work in this way. They just want to make it easier for themselves. When something bad happens. They say goodbye.”). The conflict escalated and extra contract manager was assigned in early 2015, which helped to improve the communication. However, the problem of extra cost remained in May 2015, which kept the trust in the low level (“When I see the report, my first reaction is: this can't be true! I almost say: I don't trust you.”). More problem solving effort from Giraffe was put into the project. The progress in the project and agreement on extra cost between two parties contributed to the relationship continuity (“The relationship is good except a couple of little disagreements. I think it is sufficient to continue the relationship.” (March 2016)). Finally the improved financial
performance in 2016 has driven the trust continue to grow ("I trust the people that are on the job").

Figure A8 Trust dynamics in the case of Creekboard – Giraffe
Appendix 10 The simulation model
Appendix 11 The list of model equations and parameter values

## Generic Simulation and Scenario Parameters

<table>
<thead>
<tr>
<th>Formulations</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial time = 0</td>
<td>Weeks</td>
<td>The initial time for the simulation.</td>
</tr>
<tr>
<td>Final time = 200</td>
<td>Weeks</td>
<td>The final time for the simulation.</td>
</tr>
<tr>
<td>Time step = 0.0625</td>
<td>Weeks</td>
<td>The time step for the simulation.</td>
</tr>
</tbody>
</table>

## Project performance

<table>
<thead>
<tr>
<th>Formulations</th>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{PP}(t) = \text{PP}(0) + \int_0^t \text{pcr}(s) , ds )</td>
<td>Performance</td>
<td>The cumulative project performance (PP) is determined by the initial project performance (ipp) and performance change rate (pcr).</td>
</tr>
<tr>
<td>( \text{PP}(0) = 1 )</td>
<td>Performance</td>
<td>Initial project performance (ipp) of the project.</td>
</tr>
<tr>
<td>( \text{pcr}(t) = \text{MAX}(-\text{PP}(t), \frac{\text{cp}(t) - 1}{\text{pcd}}) )</td>
<td>Performance/week</td>
<td>Performance change rate (pcr) is impacted by current performance (cp), the cumulative project performance (PP) and the performance change delay (pcd).</td>
</tr>
<tr>
<td>( \text{cp}(t) = \frac{\text{RA}(t)}{\text{rr}(t)} )</td>
<td>Performance</td>
<td>The current performance (cp) is determined by resource available (RA) and resource required (rr).</td>
</tr>
<tr>
<td>( \text{pcd} = 25 )</td>
<td>Weeks</td>
<td>Performance change delay (pcd) of the project.</td>
</tr>
<tr>
<td>( \text{rr}(t) = \text{mrr} + \text{pc}(t) )</td>
<td>Resource</td>
<td>Resource required (rr) is determined by minimum resource required (mrr) of the project and project complexity (pc).</td>
</tr>
<tr>
<td>( \text{mrr} = 20 )</td>
<td>Resource/Performance</td>
<td>Minimum resource required (mrr) to achieve one unit of performance.</td>
</tr>
</tbody>
</table>
The project complexity increases between week 5 and week 42.

### Contractually required performance

<table>
<thead>
<tr>
<th>Formulations</th>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( CRP(t) = CRP(0) + \int_0^t rpcr(s) ds )</td>
<td>Performance</td>
<td>Contractually required performance (CRP) is influenced by initial contractually required performance (icrp) and required performance change rate (rpcr).</td>
</tr>
<tr>
<td>( CRP(0) = 1 )</td>
<td>Performance</td>
<td>Initial contractually required performance (icrp) of the project.</td>
</tr>
<tr>
<td>( rpcr(t) = \frac{ct(t) - CRP(t)}{rpcd} )</td>
<td>Performance/week</td>
<td>Required performance change rate (rpcr) is determined by contract targets (ct), Contractually required performance (CRP) and required performance change delay (rpcd).</td>
</tr>
<tr>
<td>( ct(t) = ot + ecc(t) )</td>
<td>Performance</td>
<td>Contract targets (ct) is the sum of original targets (ot) and the effect of controls on contract targets (ect).</td>
</tr>
<tr>
<td>( rpcd = 8 )</td>
<td>Weeks</td>
<td>Required performance change delay (rpcd) of the project.</td>
</tr>
<tr>
<td>( ecc(t) = \frac{3 \times ecc(t) - 9}{32} )</td>
<td>Performance</td>
<td>The effect of controls on contract targets (ect) is influenced by the emphasis on contractual controls (ecc).</td>
</tr>
<tr>
<td>( ecc(t) = cc \times efc(t) + nc )</td>
<td>Control</td>
<td>When the cc (contractual control) is on, emphasis on contractual controls (ecc) is the sum of the effect of feasibility on control (efc) and the normal control (nc). Otherwise, emphasis on contractual controls (ecc) is equal to normal control (nc).</td>
</tr>
<tr>
<td>( efc(t) = 7 - 7 \times PPF(t) )</td>
<td>Control</td>
<td>The effect of feasibility on control (efc) decreases as the perceived project feasibility increase, and vice versa.</td>
</tr>
<tr>
<td>( cc = 0 \ or \ 1 )</td>
<td>Dimensionless</td>
<td>When Contractual control (cc) is equal to 1, a contractual strategy is applied in the project. Otherwise it is not.</td>
</tr>
<tr>
<td>( nc = 3 )</td>
<td>Control</td>
<td>The normal control (nc) in the project.</td>
</tr>
</tbody>
</table>
## Perceived project feasibility

<table>
<thead>
<tr>
<th>Formulations</th>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$PPF(t) = PPF(0) + \int_0^t pfc(t) , ds$</td>
<td>Feasibility</td>
<td>The perceived project feasibility ($PPF$) is determined by initial perceived project feasibility ($ippf$) and perceived feasibility change rate ($pfc$).</td>
</tr>
<tr>
<td>$PPF(0) = 1$</td>
<td>Feasibility</td>
<td>The initial perceived project feasibility ($ippf$) in the project.</td>
</tr>
<tr>
<td>$pfc(t) = \text{MAX}\left(\frac{-PPF(t) \cdot \text{MIN}(epsf(t),1-PPF(t))}{pfcd}\right)$</td>
<td>Feasibility/week</td>
<td>The perceived feasibility change rate ($pfc$) is determined by the effect of performance shortfall on feasibility ($epsf$) with the perceived feasibility change delay ($pfcd$).</td>
</tr>
<tr>
<td>$epsf(t) = 0.02 - 0.841 \cdot ps(t) + 0.8 \cdot ps(t)^2$</td>
<td>Feasibility</td>
<td>The effect of performance shortfall on feasibility ($epsf$) is determined by the performance shortfall ($ps$).</td>
</tr>
<tr>
<td>$ps(t) = \frac{PP(t)}{CRP(t)}$</td>
<td>Dimensionless</td>
<td>The performance shortfall ($ps$) is the comparison between Project performance ($PP$) and the Contractually required performance ($CRP$).</td>
</tr>
</tbody>
</table>

## Trust on both sides

<table>
<thead>
<tr>
<th>Formulations</th>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T(t) = T(0) + \int_0^t tgr(s) - ter(s) , ds$</td>
<td>Trust</td>
<td>The trust on both sides ($T$) is determined by the initial trust ($it$), the trust gain rate ($tgr$) and the trust erosion rate ($ter$).</td>
</tr>
<tr>
<td>$T(0) = 0.8$</td>
<td>Trust</td>
<td>The initial trust ($it$) in the base case of simulation.</td>
</tr>
<tr>
<td>$tgr(t) = \text{MAX}\left(0, \text{MIN}\left(eft(t),1-T(t)\right)\right)$</td>
<td>Trust/week</td>
<td>The trust gain rate ($tgr$) is determined by the effect of feasibility on trust ($eft$) with the trust gain delay ($tgd$).</td>
</tr>
<tr>
<td>$ter(t) = \text{MAX}\left(0, \text{MIN}\left(T(t),-eft(t) + eut(t)\right)\right)$</td>
<td>Trust/week</td>
<td>The trust erosion rate ($ter$) is determined by the effect of feasibility on trust ($eft$) and the effect of understanding on trust ($eut$) with the trust erosion delay ($ted$).</td>
</tr>
</tbody>
</table>
\(\text{eft}(t) = \text{LOOKUP}(\text{PPF}(t), ((0,0.1), (0.1,0.1), (1,0.2)), ((0.2,-0.1), (0.3,-0.05), (0.4,-0.03), (0.5,-0.02), (0.6,0.03)), (0.7,0.03), (0.8,0.03), (0.9,0.04), (0.917431,0.04895), (0.932722,0.0517544), (0.944954,0.0684211), (0.966361,0.0850877), (1,0.1)))\)

Trust

The effect of feasibility on trust (eft) is influenced by the perceived project feasibility (PPF). As the perceived project feasibility (PPF) increases, the negative effect of feasibility on trust (eft) will turn into the positive one.

\(\text{eut}(t) = \text{LOOKUP}(\text{ueo}(t), ((0,0), (1,1)), (0,0.2), (0.1,0.4), (0.2,0.6), (0.3,0.8), (0.4,1), (0.5,1), (0.6,0.8), (0.7,0.6), (0.8,0.4), (0.9,0.2), (1,0)))\)

Trust

The effect of understanding on trust (eut) is determined positively by the level of understanding each other (ueo).

\(\text{ueo}(t) = \text{LOOKUP}(\text{ecu}(t), ((0,0), (1,1)), (0,0.1), (0.1,0.2), (0.2,0.3), (0.3,0.4), (0.4,0.5), (0.5,0.6), (0.6,0.7), (0.7,0.8), (0.8,0.9), (0.9,1)))\)

Dimensionless

The level of understanding each other (ueo) is driven positively by the effect of communication on understanding (ecu).

\(\text{ecu}(t) = \text{LOOKUP}(\frac{\text{evo}(t)}{\text{rci}(t)}), ((0,0), (10,0.99)), (0,0), (1,0.9), (2,0.9), (3,0.8), (4,0.7), (5,0.6), (6,0.5), (7,0.4), (8,0.3), (9,0.2), (10,0.1)))\)

Dimensionless

The effect of communication on understanding (ecu) is determined positively by the ratio of the emphasis on voicing concerns (evo) over the required communication intensity (rci).

\(\text{evo}(t) = \text{is} \times \text{efcm}(t) + \text{mci}(t)\)

Communication

When the Information sharing (is) is on, the emphasis on voicing concerns (evo) is the sum of the effect of feasibility on communication (efcm) and the minimum communication intensity (mci). Otherwise, it (evo) is equal to minimum communication intensity (mci).

\(\text{rci}(t) = \text{efrc}(t)\)

Communication

The required communication intensity (rci) is equal to the effect of feasibility on required communication (efrc).

\(\text{is} = 0 \text{ or } 1\)

Dimensionless

When Information sharing (is) is equal to 1, the relational strategy is applied in the project. Otherwise it is not.

\(\text{efcm}(t) = \text{LOOKUP}(\text{PPF}(t), ((0,0), (1,1)), (0,0), (0.1,0.9)))\)

Communication

The effect of feasibility on communication (efcm) is determined negatively by the Perceived project feasibility (PPF). However, when the perceived project feasibility
(PPF) is very close to zero, the need to communicate decreases dramatically.

\( efrc(t) = \text{LOOKUP}(PPF(t), ((0,0)-(1,10)),((0,10),(0,1.5,9),
(0,2,4,9),(0,3,3,9),(0,4,2,9),(0,5,1,9),(0,6,1,7),(0,7,1,4),(0,8,1,1),(1,1)) ) \)

Communication

The effect of feasibility on required communication (efrc) is determined negatively by the Perceived project feasibility (PPF).

### Resources available

<table>
<thead>
<tr>
<th>Formulations</th>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( RA(t) = RA(0) + \int_{0}^{t} rcr(s) ds )</td>
<td>Resource</td>
<td>The resource available (RA) is determined by the initial resource (ir) and the resource change rate (rcr).</td>
</tr>
<tr>
<td>( RA(0) = 20 )</td>
<td>Resource</td>
<td>The initial resource (ir) of the base case in the simulation.</td>
</tr>
<tr>
<td>( rcr(t) ) = ( \text{MAX} \left( \text{minra} - RA(t), \text{MIN} \left( \text{maxra} - RA(t), eir(t) \right) \right) )</td>
<td>Resource/week</td>
<td>The resource change rate (rcr) is constrained by the minimum resource available (minra) and the maximum resource available (maxra). And it is determined positively also by the effect of investment on resource (eir) with the resources change delay (rcd).</td>
</tr>
<tr>
<td>( \text{minra} = 10 )</td>
<td>Resource</td>
<td>The minimum resource available (minra) of the base case in the simulation model.</td>
</tr>
<tr>
<td>( \text{maxra} = 40 )</td>
<td>Resource</td>
<td>The maximum resource available (maxra) of the base case in the simulation model.</td>
</tr>
</tbody>
</table>
| \( eir(t) = \text{LOOKUP}(rsi(t), ((-1,-10),(-1,10)),(-1,-0.5),(-0.9,-0.45),(-0.8,-0.35),(-0.7,-0.25),(-0.6,-0.2),(-0.5,-0.15),(-0.4,-0.075),(-0.1,-0.05),(-0,0),(0,0.1),(0.4,1.1),(0.5,1.6),(0.6,3.2),
(0.7,4.2),(0.8,5.2),(0.9,6.2),(1,9.8)) \) | Resource | The effect of investment on resource (eir) is determined positively by the relation specific investment (rsi). |
| \( rsi(t) = -nm * eppf(t) + im * eppf(t) + ecl(t) \) | Investment | The relation specific investment (rsi) is the difference between the effect of perceived project feasibility on
investments \( (eppf(t)) \) and the effect of commitment on investments \( (eci) \), when Self-serving response is on. Otherwise, it is the sum of these two.

\[
sr = 0 \text{ or } 1
\]

Dimensionless

When Self-serving response \( (sr) \) is equal to 1, the contractual strategy is applied in the project. Otherwise it is not.

\[
ar = 0 \text{ or } 1
\]

Dimensionless

When Accommodative response \( (ar) \) is equal to 1, the relational strategy is applied in the project. Otherwise it is not.

\[
eppf(t) = \text{LOOKUP}(PPF(t), ((0,0)-\text{[(0,0) - (1,1)]}),(0.1,0.099), (0.4,0.09),(0.5,0.07),(0.6,0.03),(0.7,0.02),(0.8,0.015),(0.9,0.01),(1,0)))
\]

Investment

The effect of perceived project feasibility on investments \( (eppf(t)) \) is determined negatively by the Perceived project feasibility \( (PPF) \).

\[
eci(t) = \text{LOOKUP}(c(t), ((0,-0.03)-\text{[(0,0) - (10,1)]}),(0.0917431,-0.03), (1.49847,-0.0260088),(4.37309,0.0180263),(4.98471,0.0025),(6.63609,0.0104825),(8,0.0407018),(9,0.0635088),(9.69419,0.0800439),(10,0.1)))
\]

Investment

The effect of commitment on investments \( (eci) \) is positively determined by the level of commitment \( (c) \).

\[
c(t) = etc(t)
\]

Commitment

The level of commitment is equal to the effect of trust on commitment \( (etc) \).

\[
etc(t) = 9.4 \times T(t)
\]

Commitment

The effect of trust on commitment is positively driven by the trust on both sides \( (T) \).

### Alphabetical list of model variables

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Variable name</th>
<th>value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td>Commitment</td>
<td></td>
<td>Commitment</td>
</tr>
<tr>
<td>ct</td>
<td>Contract targets</td>
<td></td>
<td>Performance</td>
</tr>
<tr>
<td>CRP</td>
<td>Contractually required performance</td>
<td>Performance</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------------------------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>cp</td>
<td>Current performance</td>
<td>Performance</td>
<td></td>
</tr>
<tr>
<td>epsf</td>
<td>Effect of performance shortfall on feasibility</td>
<td>Feasibility</td>
<td></td>
</tr>
<tr>
<td>eci</td>
<td>Effect of commitment on investments</td>
<td>Investment</td>
<td></td>
</tr>
<tr>
<td>ecu</td>
<td>Effect of communication on understanding</td>
<td>Dimensionless</td>
<td></td>
</tr>
<tr>
<td>ecct</td>
<td>Effect of controls on contract targets</td>
<td>Performance</td>
<td></td>
</tr>
<tr>
<td>efcm</td>
<td>Effect of feasibility on communication</td>
<td>Communication</td>
<td></td>
</tr>
<tr>
<td>efc</td>
<td>Effect of feasibility on control</td>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>efrc</td>
<td>Effect of feasibility on required communication</td>
<td>Communication</td>
<td></td>
</tr>
<tr>
<td>eft</td>
<td>Effect of feasibility on trust</td>
<td>Trust</td>
<td></td>
</tr>
<tr>
<td>err</td>
<td>Effect of investment on resources</td>
<td>Resource</td>
<td></td>
</tr>
<tr>
<td>eppfi</td>
<td>Effect of perceived project feasibility on investments</td>
<td>Investment</td>
<td></td>
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<tr>
<td>etc</td>
<td>Effect of trust on commitment</td>
<td>Commitment</td>
<td></td>
</tr>
<tr>
<td>eut</td>
<td>Effect of understanding on trust</td>
<td>Trust</td>
<td></td>
</tr>
<tr>
<td>ecc</td>
<td>Emphasis on contractual controls</td>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>evc</td>
<td>Emphasis on voicing concerns</td>
<td>Communication</td>
<td></td>
</tr>
<tr>
<td>cc</td>
<td>Contractual control</td>
<td>0,1</td>
<td>Dimensionless</td>
</tr>
<tr>
<td>it</td>
<td>Initial trust</td>
<td>0.8</td>
<td>Trust</td>
</tr>
<tr>
<td>icrp</td>
<td>Initial contractually required performance</td>
<td>1</td>
<td>Performance</td>
</tr>
<tr>
<td>ippf</td>
<td>Initial perceived project feasibility</td>
<td>1</td>
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Appendix 12 Sensitivity analysis report

The sensitivity analyses check the robustness of the model to the changes in values of fifteen parameters. The study investigates the sensitivity of the variable “Trust on both sides” to high, medium and low values of the fifteen variables under both the relational response and the contractual response. The overall results show the model is robust under the changing parameter values, with the exception of extreme conditions that are inconsistent with the empirical reality. The sensitivity analysis shows that under one of the following conditions, a relational strategy still fails to solve the performance shortfall and results in the breakup of relationship: small “maximum resources available”, high level of “minimum resources required”, long “resource change delay” and high “initial contractual requirements”. There are situations where a contractual strategy might lead to good results. These situations are under one of the following conditions: high “initial resources”, high “initial performance”, high “minimum resources available”, short “resource change delay” low “minimum resources required”, and short “performance change delay”.

The following shows the results for each variable.

1. Initial trust (units: trust): the value of initial trust may vary between 0 and 1.

Tests and values:

Relational response (see the figure below left): base case (0.8), test 1 (1), test 2 (0.5), test 3 (0)

Contractual response (see the figure below right): base case (0.8), test 1 (1), test 2 (0.5), test 3 (0)
As shown in the graphs above, the model is robust to changes in initial trust, since changes to the initial values of trust do not affect the behaviors of trust over time. Note that this result enables us to, for all further analyses, set the level of trust in the base case to the same level (0.8) for both cases to facilitate comparison of the simulation results.

2. Initial performance (units: performance): the value of initial performance may vary between 0 and 2.

Tests and values:

Relational response (see the figure below left): base case (1), test 1 (1.3), test 2 (0.8), test 3 (0)

Contractual response (see the figure below right): base case (1), test 1 (2), test 2 (0.5), test 3 (0), test 4 (1.5)

With a relational response, the model is robust for values of initial performance on or below 1.3. When the value of initial performance exceeds 1.3, the level of trust immediately starts and continues to increase. With a contractual response, the model is robust for values of initial performance below 1.5. An initial performance value of 1.5, trust will decline initially but recover in the end. When the value of initial performance exceeds 1.5, the level of trust immediately starts and continues to increase. This result shows that when initial performance is high enough, successful project behavior may be generated even when a contractual response is active. However, sufficient resources
at the start of the project are necessary for a high level of initial performance, and this was not true for the two cases studied.

3. Initial resources (units: resource): the value of initial resource may vary between 0 and 40.

Tests and values:

Relational response (see the figure below left): base case (20), test 1 (26), test 2 (21), test 3 (0)

Contractual response (see the figure below right): base case (20), test 1 (40), test 2 (21), test 3 (0), test 4 (25)

With a relational response, the model is robust for values of initial resources on or below 26. When the value of initial resources exceeds 26, the level of trust immediately starts and continues to increase. With a contractual response, the model is robust for values of initial resources below 25. An extremely high initial resources value (e.g. 40), the level of trust immediately starts and continues to increase. When the value of initial resources exceeds 25, trust will decline initially but recover in the end. This result shows that when initial resources is high enough, successful project behavior may be generated even when a contractual response is active. However, this condition of high initial resources is not met in the two cases studied.

4. Maximum resources available: the value of the maximum level of resources available may vary between 20 and 80.
Tests and values:

Relational response (see the figure below left): base case (40), test 1 (80), test 2 (23), test 3 (20)

Contractual response (see the figure below right): base case (40), test 1 (40), test 2 (23), test 3 (20)

The model is robust, with one exception. When the maximum level of resources is smaller than 23, using a relational response inhibits the recovery of trust after an initial decline. The results also show that when the maximum level of resources is very small, using a relational response may still result in a failed project, but only when project resources remain insufficient. This was however not true for the two cases studied.

5. Minimum communication intensity (units: communication): the value of the minimum level of communication intensity may vary between 0 and 10.

Tests and values:

Relational response (see the figure below left): base case (1), test 1 (10), test 2 (5), test 3 (0)

Contractual response (see the figure below right): base case (1), test 1 (10), test 2 (5), test 3 (0)
The model is robust to changes in the minimum level of communication intensity, since changes to the initial values of communication intensity do not affect the behaviors of trust over time.

6. Minimum resources available (units: resources): the value of the minimum level of resources required may vary between 1 and 40

Tests and values:

Relational response (see the figure below left): base case (10), test 1 (40), test 2 (28), test 3 (0)

Contractual response (see the figure below right): base case (10), test 1 (40), test 2 (28), test 3 (0), test 4 (25)

With a relational response, the model is robust for values of minimum resources on or below 28; with a contractual response, the model is robust for values of minimum
resources on or below 25. When the value of initial resources exceeds 26, the level of trust immediately starts and continues to increase. With a contractual response, the model is robust for values of initial resources below 25. An extremely high minimum resources value (e.g. 40), the level of trust immediately starts and continues to increase under both responses. With a contractual response, when the value of minimum resources is set at 25 or higher, trust will decline initially but recover in the end. This result shows that when minimum resources is high enough, successful project behavior may be generated even when a contractual response is active. However, this condition of a high minimum level of resources is not met in the two cases studied.

7. Minimum resources required (units: resources/performance): the value of the minimum level of resources required may vary between 1 and 40.

Tests and values:

Relational response (see the figure below left): base case (20), test 1 (40), test 2 (30), test 3 (1), test 4 (14)

Contractual response (see the figure below right): base case (20), test 1 (40), test 2 (16), test 3 (0), test 4 (9)

With a relational response, the model is robust when the value of the minimum level of resources required is between 30 and 14. When this value exceeds 30, trust ultimately collapses. For values below 14, trust immediately start and continues to increase. With
a contractual response, the model is robust for values of the minimum level of resources required exceeding 16. For values in the range of 9 to 16, trust will decline initially but recover in the end. For values below 9, trust immediately starts and continues to increase. These results show that when the minimum level of required resources is high, using a relational response may still lead projects to fail. In contrast, when the minimum level of required resources is low, using a contractual response may still generate successful project behavior. However, extremely high or extremely low levels of project complexity were not observed in the cases studied.

8. Normal contractual control (units: control): the value of normal contractual control may vary between 0 and 10.

Tests and values:

Relational response (see the figure below left): base case (3), test 1 (10), test 2 (5), test 3 (0)

Contractual response (see the figure below right): base case (3), test 1 (10), test 2 (5), test 3 (0)

The graphs above show that for both responses, the behavior of trust is not sensitive to changes to normal contractual control.
9. Initial contractual requirements (units: performance): the value of initial contractual requirements (i.e., original targets) may vary between 0.1 and 6.

Tests and values:

Relational response (see the figure below left): base case (1), test 1 (4.4), test 2 (2), test 3 (0.6)

Contractual response (see the figure below right): base case (1), test 1 (4.4), test 2 (2), test 3 (0.4)

With a relational response, the model is robust for values of initial contractual requirements between 4.4 and 0.6. For values exceeding 4.4, trust ultimately collapses. For values below 0.6, trust immediately starts and continues to increase. With a contractual response, the model is robust for values of initial contractual requirements above 0.4. When the value of initial contractual requirements on or below 0.4, trust immediately starts and continues to increase. The results show that when the level of initial contractual requirements is high, using a relational response may lead to a failed project, while in case of low values of initial contractual requirements successful project behavior may be generated even when a contractual response is active. However, extremely high or extremely low levels of initial contractual requirements were not observed in the cases studied.

10. Delay in changes to perceived project feasibility (units: week): the value of the delay may vary between 1 and 250.
Tests and values:

Relational response (see the figure below left): base case (15), test 1 (35), test 2 (18), test 3 (1)

Contractual response (see the figure below right): base case (15), test 1 (250), test 2 (88), test 3 (3), test 4 (40)

With a relational response, the model is robust for values of the delay below 35. For values exceeding 35, trust immediately starts and continues to increase. With a contractual response, the model is robust for values of the delay between 3 and 88. Outside this range, trust will decline initially but recover in the end. The results show that when the people are extremely sensitive or insensitive regarding perceived project feasibility, successful project behavior may be generated even when a contractual response is active. However, such extreme values of delays were not observed in the cases studied.

11. Delays in changes to performance (units: week): the value of the delay may between 1 and 250.

Tests and values:

Relational response (see the figure below left): base case (25), test 1 (129), test 2 (61), test 3 (6)
Contractual response (see the figure below right): base case (25), test 1 (250), test 2 (122), test 3 (4),

With a relational response, the model is robust for values of the delay between 6 and 129. Outside this range, trust immediately starts and continues to increase. With a contractual response, the model is robust for values of the delay exceeding 4. Below 4, trust will decline initially but recover in the end. The results show that when performance can quickly be improved (i.e., in a very short time period), it is possible to turn a troubled project into a successful one, even when using a contractual response. This situation however does not match with the reality in the cases.

12. Delays in changes to required performance (units: week): the value of the delay may between 1 and 250.

Tests and values:

Relational response (see the figure below left): base case (8), test 1 (250), test 2 (125), test 3 (1)

Contractual response (see the figure below right): base case (8), test 1 (250), test 2 (125), test 3 (1)

The graphs above show that for both responses, the behavior of trust is not sensitive to changes to delays in changes to required performance.
13. Delays in changes to resources (units: week): the value of the delay may between 1 and 250.

Tests and values:

Relational response (see the figure below left): base case (8.5), test 1 (169), test 2 (85), test 3 (1)

Contractual response (see the figure below right): base case (8.5), test 1 (250), test 2 (125), test 3 (1),

With a relational response, the model is robust for values of the delay between 1 and 169. When the delay is equal to or exceeds 169, trust ultimately collapses. With a contractual response, the model is robust, unless the delay is set to an extremely value (e.g. 1). Then, trust will decline initially but recover in the end. The results show that when it takes extremely long for resources to be increased, using a relational response may still lead to project failure. In contrast, when resources can quickly be increased, it is feasible to turn a troubled project into a successful one even when using a contractual response. This situations however do not match with the reality in the cases.
14. Delays to trust erosion (units: week): the value of the delay may vary between 1 and 250.

Tests and values:

Relational response (see the figure below left): base case (25), test 1 (250), test 2 (125), test 3 (1)

Contractual response (see the figure below right): base case (25), test 1 (250), test 2 (125), test 3 (1)

The graphs above show that for both responses, the behavior of trust is not sensitive to changes to delays in trust erosion.

15. Delays in gains in trust (units: week): the value of the delay may vary between 1 and 250

Tests and values:

Relational response (see the figure below left): base case (30), test 1 (250), test 2 (125), test 3 (1)

Contractual (see the figure below right): base case (30), test 1 (250), test 2 (125), test 3 (1)
The graphs above show that for both responses, the behavior of trust is not sensitive to changes to delays in gaining trust.