INSTITUTO
UNIVERSITÁRIO
DE LISBOA

PPP – A Risk Approach in the Water Sector

Sónia Maria Chin Ah Lima

Doctor in Management, specialization in Strategy and Entrepreneurship

Supervisors:
Doctor Ana Brochado, Assistant Professor with Habilitation, ISCTE - Instituto Universitário de Lisboa

Doctor Rui Marques, Full Professor, Instituto Superior Técnico – Universidade de Lisboa

February 2021

BUSINESS
SCHOOL

Department of Marketing, Operations and General Management

PPP – A Risk Approach in the Water Sector

Sónia Maria Chin Ah Lima

Doctor in Management, specialization in Strategy and Entrepreneurship

Jury:
Doctor Catarina Roseta Palma, Associate Professor, ISCTE - Instituto Universitário de Lisboa (President)
Doctor Maria Rita Martins, Assistant Professor, Universidade de Coimbra
Doctor Rui de Carvalho, Associate Professor, Instituto Superior de Gestão
Doctor Nelson António, Full Professor, ISCTE - Instituto Universitário de Lisboa
Doctor Ana Brochado, Assistant Professor with Habilitation, ISCTE - Instituto Universitário de Lisboa

February 2021

Acknowledgements

I believe that a Doctoral Program is never possible without the help and support of a significant range of people, that marked their presence throughout these years. Their support came in many ways, allowing me to end this journey successfully. In the next paragraphs,' I will mention some of them; nevertheless, it is impossible to cite all their names.

I am grateful to my supervisors Professor Ana Brochado and Professor Rui Cunha Marques, whose rigorous academic style and superb academic competence was an inspiration to me.

My personal thanks to my classmates who I consider to be my friends, for their support throughout all the Doctoral Program. Their honesty, sincerity and open-mindedness allowed me to grow on a personal and academic level.

I would also like to express my deep gratitude to Ana and Vera for their friendship, which profoundly spurred and inspired me. I consider both of them as my friends for many years. Even after moving away during the Doctoral Program, they were always available.

I also have to thank Angela, Nelson, Rui and Paulo, for helping me finding information and sources that support my research.

Last but not least, a special thanks to my family, especially my parents Wi Kim and Julieta, who always believed that I could finish this project.

Resumo

Objectivo: Esta tese tem como objetivo ser uma contribuição teórica para a abordagem de como os contratos de Parcerias Públicas Privadas (PPP) abordam a gestão de risco no sector da água em países em vias de desenvolvimento. Os três objetivos da tese suportam os resultados apresentados. O primeiro identifica as contribuições da literatura, o segundo recai sobre a perceção de especialistas sobre a abordagem do risco e o terceiro capta a abordagem do risco dos contratos do tipo PPP em países em vias de desenvolvimento.

Metodologia: Com o objetivo de responder ao primeiro objetivo da tese, foi aplicada uma metodologia híbrida através da combinação de uma revisão bibliográfica sistemática, semântica e análise narrativa. Os contributos do segundo objetivo da tese, suportaram-se em entrevistas semiestruturadas através do recurso à estatística descritiva e análise de conteúdo. O terceiro e último objetivo teve como base um estudo de caso.

Resultados: A revisão da literatura identificou um total de 122 estudos e a existência de cinco campos relevantes nos contratos do tipo PPP: gestão de risco, contratos, infraestruturas, governança, aspetos financeiros e tarifas. O resultado do segundo estudo identificou vinte e cinco fatores de risco. Os cinco fatores que apresentaram uma maior frequência foram: interferência política, ausência de bases de medição do desempenho, um contexto de investimento desfavorável, o não pagamento das faturas e o desconhecimento do estado de preservação das infraestruturas. Os resultados do terceiro estudo mostraram que o sucesso de um contrato do tipo PPP pode ser comprometido na ausência de uma gestão de risco adequada, onde as gestões de conflitos entre parceiros sejam subestimadas em termos contratuais. A temática gestão de risco nos contratos do tipo PPP tem oportunidades de melhoria. Assim, propõe-se a introdução de indicadores chave de desempenho do risco.

Originalidade: As leis com impacto nos contratos do tipo PPP devem ser continuamente atualizadas e adaptadas às distintas realidades. É proposta uma alteração de paradigma através da introdução dos indicadores chave de desempenho do risco, fornecendo possíveis linhas orientadoras para pesquisa futura.

***Palavras chave*:** PPP, sector da água, países em vias de desenvolvimento, gestão de risco.

JEL: D81, D86

Abstract

Objective: This thesis provides a theoretical and managerial contribution on how PPP can address risk in the water sector in developing countries. Three thesis objectives support the results. The first identifies literature contributions, the second is related to the perception of risk management by different stakeholders, and the third concerns the risk approach in PPP water contracts in developing countries.

Design: A hybrid method combining systematic, semantic network, and narrative analysis review of previous research supported the first objective. To answer the second thesis' objective, a semi-structured interview using quantitative and qualitative analysis identified the perception of risk management in PPP water projects. To support the third objective, a case study provided interesting insights regarding the risk approach in PPP contracts

Findings: From a total of 122 studies, the first objective, identified five main PPP research domains: risk management, contracts, infrastructure, governance, and financing and tariffs. Twenty-five risk factors with high impact were established as a result of the semi-interviews. The top-five critical risk factors are related to political interference, no baselines for performance measurement, unfavourable global private investment climate, non-payment of bills and water asset condition uncertainty. The case study showed how PPP contracts can fail for not having risk management concerns and we have underestimated risks as conflicts between partners. The traditional risk management approach in PPP contracts showed that there is space to improve. The key risk indicators approach was proposed.

Originality: Research outputs showed that PPP laws and sector legislation should be permanently adapted to the local needs. The traditional risk management framework fails to provide a solution. The key risk indicators introduce a paradigm shift, which provides useful guidelines for future studies.

***Keywords*:** PPP, water sector, developing countries, risk management.

JEL: D81, D86

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AdM	Águas de Moçambique, S.A.R.L.
AIAS	Administração de Infra-estruturas de Água e Saneamento
BOOT	Build-Own-Operate-Transfer
BTO	Build-Transfer-Operate
CRA	Conselho de Regulação do Abastecimento de Água
EURAM	European Academy of Management
ISCTE-IUL	Instituto Universitário de Lisboa
ISO	International Organization for Standardization
IPA	Infrastructure and Projects Authority
FDI	Foreign Direct Investment
FIPAG	Fundo de Investimento e Património do Abastecimento de Água
Frelimo	Front for the Liberation of Mozambique
MDM	Mozambique Democratic Movement
MIGA	Multilateral Investment Guarantee Agency
Renamo	Mozambican National Resistance
ROT	Rehabilitate-Operate-Transfer
OECD	Organisation for Economic Co-operation and Development
O&M	Operation and Maintenance
PFI	Private Finance Initiative
PPIAF	Public-Private Infrastructure Advisory Facility
PPP	Public-private partnerships
SJR	SCImago Journal & Country Rank
SDG	Sustainable Development Goal
US$	United States dollars
UTAP	Unidade Técnica de Acompanhamento de Projetos
$\chi 2$	chi-square
VEI	Vitens Evides International

CHAPTER 1: INTRODUCTION

The introduction is structured as follows. The first section presents the research background and purpose. The second and last sections present the research framework and the structure of the thesis.

1.1 Research background and purpose

The thesis's research background and purpose are presented in the current section (see Chapters 1.1.1 and 1.1.2).

1.1.1 Research background

Public-private partnerships (PPP) are a type of strategic alliance that are characterised by being long-term contracts signed between the public sector and a private party (finance and/or industrial contractor), with programmed payments over life as a consequence of the use of the facility by the public sector or the users of the facility (Yescombe, 2007). It can be considered as the vehicle to perform complex infrastructure projects with flexible negotiation, maximizing efficiency and improving monitoring (Yu et al., 2018).

Contract terms can include the design, construction, operation and maintenance of the public infrastructure of the facility by the private-sector party (Yescombe, 2007). PPP can be categorised in three groups: i) the type of asset involved (i.e. with the purpose of building (greenfield) or rehabilitating and upgrading (brownfield) the infrastructure), ii) the type of responsibilities that are allocated to the private party, considering the design, building or rehabilitation, finance, operation and maintenance, and iii) who pays the private party (the private party can be paid by the direct consumer, by the government or a combination of both) (World Bank, 2017a).

The World Bank (2017a) proposes an overview of the infrastructure contract nomenclature (see Table 1-1).

Table 1-1: Infrastructure contracts nomenclature

Contracts	Overview description	Type infrastructure	Functions transferred
DBFOM[a] DBFO[b] DCMF[c]	The maintenance function may be excluded (DBFOM) and the maintenance responsibility is included in operations (DBFO and DCMF)	New	All the functions included in the contract's name.
BOT[d] BOOT[e] BTO[f]	Legal ownership for the new infrastructure until the transfer (BOT). It includes operation before the BOOT type. For last the BTO type predicts the immediate transfer of the asset after construction, before operation starts.	New	Design, build, finance, and maintenance (the two first functions only apply to some cases).
ROT[g]	The private part is responsible for extending, rehabilitating or upgrading the infrastructures.	Existing	Similar to the previous case, changing 'new' to 'existing'.
Concession	It is generally used to the user-pays contracts.	New or existing	Provides the services directly to the users. Can include a combination of the previous cases.
PFI[h]	It is generally focused on how the arrangement of the PPP is set.	New	Design, build, finance and sometimes operations.
O&M[i]	Long term performance-based contracts.	Existing	Operations and maintenance.
Affermage	Similar to concession, where the public part has the responsibility to perform the investments.	Existing	Operations and maintenance.
Management contract	Public partner has the ownership and capital expenditure. The private has the operations and maintenance responsibilities.	Existing	Operations and maintenance.
Franchise	Similar arrangements to concession or *affermage* contracts.	New or existing	It may include a combination of the previous types.

Source: Adapted from *Public-Private Partnerships Reference Guide,* The World Bank, Ed.; 2017, 8-9.

[a] DOFOM: Design-Build-Finance-Operate-Maintain.
[b] DBOFO: Design-Build-Finance-Operate.
[c] DCMF: Design-Construct-Manage-Finance.
[d] BOT: Build-Operate-Transfer.
[e] BOOT: Build-Own-Operate-Transfer.
[f] BTO: Build-Transfer-Operate.
[g] ROT: Rehabilitate-Operate-Transfer.
[h] PFI: Private Finance Initiative.
[i] O&M: Operation and Maintenance.

The contracts' payment mechanism can be added as a defining feature, as previously explained. This characteristic, combined with the overview description, type of infrastructure and main transferred functions, creates a significant range of contract options.

This thesis focuses on the PPP concessions in the water sector in developing countries (low and middle-income countries).

From 2015 until 2019, the investment in PPP arrangements reached a total of United States dollars (US$) 469,82 billion distributed over 1,917 projects. The number of projects permanently increased from 341 in 2015 to 409 in 2019 spread through low and middle-income countries. From an investment perspective, the growth was not permanent. There was a decrease between 2016 and 2015 of around 50% (US$ 58,52 billion from US$ 122 billion), and between 2019 and 2018 of near 3% (US$ 96,7 billion from US$ 99,7 billion). The most significant increase was between 2017 and 2016 of 59% (US$ 92,9 billion from US$ 58,52 billion), followed by a moderate increase of 7% (US$ 99,7 billion from US$ 92,9 billion) throughout the years 2018 and 2017 (World Bank, 2018a, 2020).

The PPP investments in the water sector decreased in 2017, counting with 30 new projects and US$ 1,9 billion in investments, less 7% than in 2016 (US$ 1,84 billion). In 2017 there was an increase of 21% in investments in water-treatment plants, accounting for 84% of sectoral investments (US$ 1,6 billion of US$ 1,9 billion) (World Bank, 2018b).

1.1.2 Research purpose

The thesis research purpose is supported on a literature review connected with the theme 'How PPP address risk management in the water sector'. The search for this answer will be addressed by linking the results of the three thesis' objectives. The results and conclusions presented are the combination of thesis chapters.

The thesis' first objective is the review of studies of PPP in the water sector (see Chapters 2, 3 and 6). The researcher proposes to address the following research questions:

1. What have been the main contributions of different countries and/or regions and researchers to studies on PPP in the water sector?
2. What have been the main research designs used to study PPP in the water sector?

3. What insights (i.e. themes) does literature offer regarding PPP in the water sector?
4. What needs to be addressed by future studies?

The thesis' second objective is to study the perception of risk management by different stakeholders such as governments, sector regulators and utilities managers in PPP contracts in developing countries (see Chapters 2, 3, 4 and 6). The researcher proposes to address the following research questions:

1. What are the most relevant risk categories in PPP contracts, based on experts' opinions?
2. What are the critical risk factors within each risk category?
3. How to mitigate the critical risk factors?
4. How can the key risk indicators concept improve the current risk management framework of the contracts?

The thesis' third and last objective is related to the research context, the risk approach in PPP water contracts in developing countries (see Chapters 2, 3, 5 and 6). The researcher proposes to address the following research questions:

1. How are the PPP water contracts in developing countries designed to address risk?
2. Is there room to improve PPP water contracts in developing countries?

1.2 Research framework

The thesis is divided into six chapters. The structure is organised as follows:

Chapter 1 – Introduction. This chapter focuses on the introduction of the research topic, background and research framework.

Chapter 2 – Literature review. This chapter focuses on presenting the state of the art regarding the topic, including the review of scholars' contributions to identify the key topics and the research gap.

The results presented are supported by the application of a systemic quantitative review, development and connection of the key topics and narrative analysis.

The outcomes offer a theoretical support for content of the thesis and the research topic (see Chapter 2.8).

Chapter 3 – Research design and methodology. This chapter focuses on presenting the research design, data types and sources, tools and methods to address the research's objectives and to answer the research's questions.

The first objective, review and identification of the major insides of PPP studies in the water sector, were supported by narrative, systematic and semantic network analyses (i.e. Leximancer and Word Cloud).

The second objective, the identification of critical risk factors based on international experts in developing countries, was supported by the use of quantitative (i.e. descriptive statistics) and qualitative analyses (i.e. Gioia methodology and systematic inductive and deductive approach).

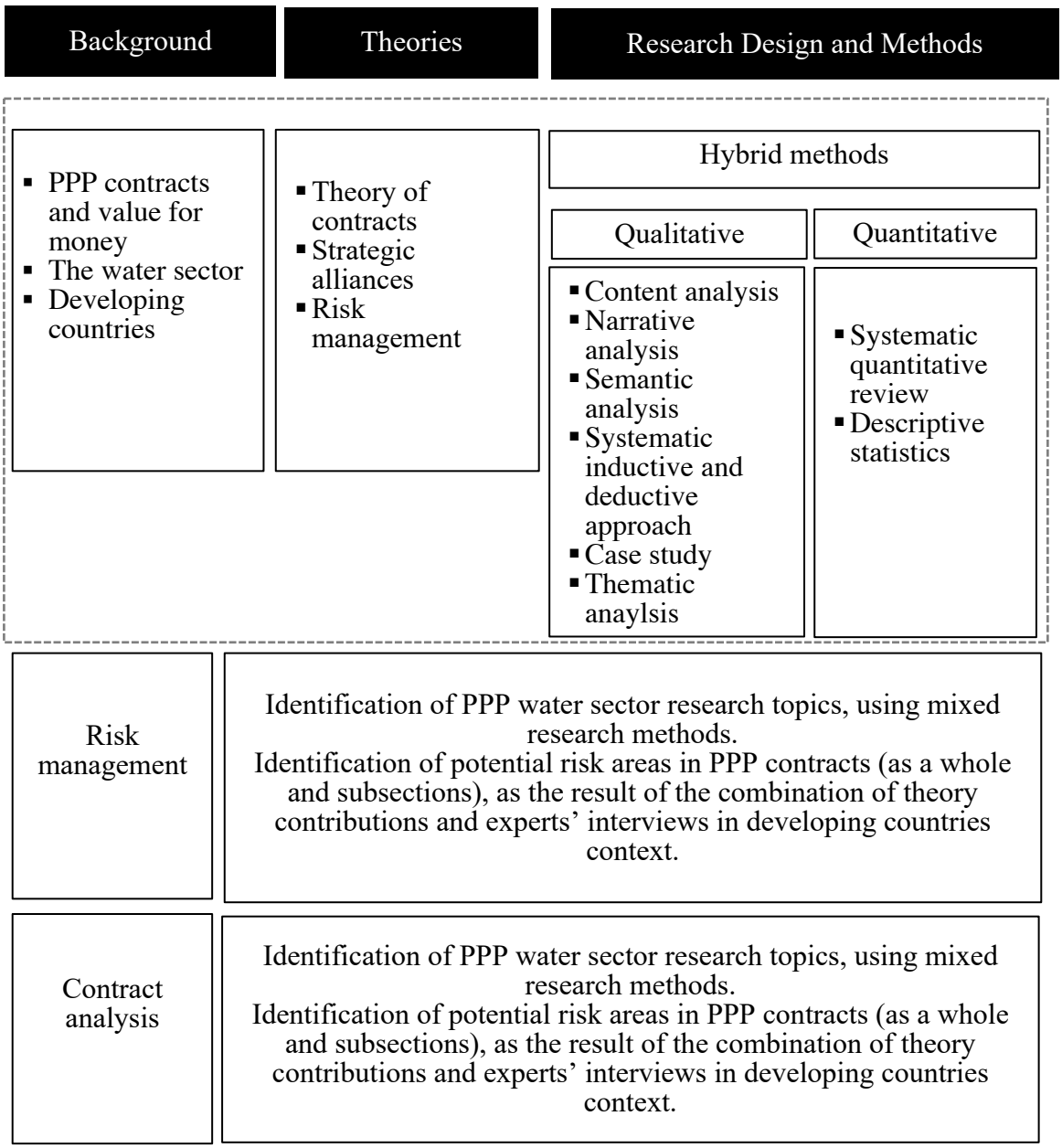


Figure 1-1: Research Framework

The third and last objective, the risk approach in PPP water contracts, in developing countries, was based on a case study (Mozambique) on desk research methods and

qualitative analysis (i.e. triangulation technique using content analysis and thematic analysis).

The research framework (see Figure 1-1) supports the thesis' results and conclusions.

Chapter 4 – Risk management in PPP contracts. This chapter presents the results of the interviews (semi-structured) conducted to experts of PPP contracts in developing countries, described in Chapter 3, based on the results previously obtained in Chapter 2.

Chapter 5 – Risk approach in PPP water contracts in developing countries. This chapter's focus is on testing the existence of a learning curve in PPP water contracts in developing countries using a case study.

Chapter 6 – Conclusions. This chapter resumes the results obtained from the previous chapters and discusses possible further research directions.

1.3 Research outcomes

Regarding the research outcomes, the researcher performed two international conferences, published one study and submitted a second.

The project results from the thesis' first objective were presented in the international management conference European Academy of Management (EURAM), submitted to the theme – exploring the future of management, hosted by Instituto Universitario de Lisboa (ISCTE-IUL) (see Appendix A) on 26th to 28th June 2019. The researcher presented the study 'The tariff systems in PPP water contracts: is this the solution to save this marriage?' in the sustainable tariffs for water services conference 2019 (see Appendix B).

The study 'Public-Private Partnerships in the Water Sector: A Review' was accepted on 25th January for publication in the Journal Utilities Policy (classified in Q1 quartile for Management, Monitoring, Policy and Law) (see Appendix C). The study 'A paradigm shift in risk approach in public-private partnerships arrangements' was submitted for publication equally in the Journal Utilities Policy (see Appendix D).

CHAPTER 2: LITERATURE REVIEW–THESIS' FIRST OBJECTIVE

The literature review is structured as follows. The next sections present the concepts and theory of strategic alliances and incomplete contracts, introducing the PPP contracts as an alternative solution. Section three introduces the concepts of public infrastructure (economic and social) and the water sector. Section four, five and six were developed based on a literature review protocol (using and systematic, semantic and narrative analyses) with the purpose of accessing the main scholar's contributions of PPP in the water sector to provide and support the research gap that will be the basis of the next thesis chapters. Seven section propose the template work basis to identify the risk approach used on the second and third thesis' objectives. The thesis' first objectives – 'Review of studies of Public Private Partnerships in the water sector' – are (see Chapters 2, 3 and 6):

1. What have been the main contributions of different countries and/or regions and researchers to studies on PPP in the water sector?
2. What have been the main research designs used to study PPP in the water sector?
3. What insights (i.e. themes) does literature offer regarding PPP in the water sector?
4. What needs to be addressed by future studies?

The last section presents the literature review results and thesis objectives contribution. The results should provide and support answers to the research questions.

2.1 Strategic alliances and incomplete contracts

Strategic alliances are becoming more prominent due to the global economy. They are broadly used to characterise an agreement between future partners in ways that go beyond a regular company-to-company transaction, without having to merge (Elmuti & Kathawala, 2001). In fact, a strategic alliance should be based on a partnership with mutual strategic objectives. The reasons to create strategic alliances can go from growth strategies and entering new markets to obtaining new technology, improving quality, low costs, reducing financial risks, sharing costs of research, and developing, achieving or ensuring competitive advantages. They can take several forms, informal or formal

agreements, the latter being formalised by a written contract between the parts (Elmuti & Kathawala, 2001).

In this context, contracts provide the foundation for a significant part of economic analysis as any trade should be mediated by some sort of contract (Hart & Holmstrom, 1986). They can be implicit or explicit, short or long-term relationships. Researchers are particularly interested in the long-term ones and how they should mediate the relationship between two or more partners. Asymmetrical information and incomplete contracts are a natural concern which have been addressed in literature over the years. Applied to public versus private ownership, the existence of residual control rights is important. They can be crucial to the lack and poor delivery of the contract service or infrastructure (Hart, 2017).

Therefore, we observe the emergence of PPP that are characterised by contracts. These, combined with the long-term legal obligations, are incomplete due to their high degree of complexity (D'Alessandro et al., 2014).

2.2 Public-private partnerships

The Sustainable Development Goal (SDG) 6 defines the targets that ensure the availability and sustainable management of water and sanitation services for all until 2030. In 2017 water services reached nearly 70% of the world population whereas sanitation covering 45% (JMP, 2020). Access to water and sanitation services is a core issue that presents major social, economic and environmental challenges, as well as an essential component of human development (Tortajada, 2014). Moreover, urban water utilities are often inadequately managed, and many customers' quality of life is diminished due to poor or even non-existent services (Vedachalam et al., 2016). To circumvent this status-quo, massive investments are required and the private sector can have an important and decisive role here through public-private partnership (PPP) projects.

A PPP arrangement is a type of strategic alliance characterised by long-term contracts between public and private partners where the private partner usually designs, finances, builds and operates the infrastructure or the service (Yescombe, 2007).

Over the last two decades, the literature on PPP has been growing, including in terms of the number of published articles and variety of research methods and topics (Cui et al.,

2018). In 2019, investment in PPP arrangements reached a total of US$ 96,7 billion allocated to 409 projects in 62 low and middle-income countries. (World Bank, 2020). PPP are strategic alliances characterised by long-term contracts between two types of partners: public and private (Yescombe, 2007). In addition, PPP can be considered a vehicle with which to develop complex infrastructure projects that allow flexible negotiations, maximise efficiency and improve monitoring processes (Yu et al., 2018). This type of strategic alliance has emerged as an attractive solution to achieve these objectives especially in developing countries (Idelovitch & Ringskog, 1995).

Contract terms may include the design, construction, maintenance and operation of facilities' public infrastructure by private-sector parties (Yescombe, 2007). Overall, PPP can be categorised into three groups. The first is based on the assets involved, namely, projects involving building (i.e. greenfield) or rehabilitating and upgrading (i.e. brownfield) infrastructures. The second group is focused on the responsibilities allocated to private parties with regards to design, construction or rehabilitation, finance, maintenance and operation. The last group focuses on the way the private partners are paid: by direct consumers, by the government or a combination of both (World Bank, 2017a).

Previous researchers have performed systematic literature reviews focusing on PPP studies (Cui et al., 2018; Ke et al., 2009; Marsilio et al., 2011). For example, Marsilio et al. (2011) conducted bibliometric analysis covering the 1990–2007 period and identified four main fields within PPP research's intellectual structure. These included government and intergovernmental organisations, public administration, public policy academics, new institutional economics scholars, strategy theory and network theory of alliance scholars.

Ke et al. (2009) in turn, carried out a systematic literature review related to PPP arrangements between 1998 and 2008. The cited authors expanded the three traditional topics of risk procurement and financial issues to seven categories: investment environments, procurement, economic viability, financial packages, risk management, governance issues and integration research. In addition, Andon (2012) used literature-based analysis of the relevant PPP studies published up to December 2010. The results suggest the need to look beyond the 'technicalities' of these partnerships to question critical explanations, internalise knowledge and consider post-procurement implications and existing regulation and guidelines.

Neto et al. (2016) also conducted bibliometric analysis of studies completed between 1990 and 2014 and concluded that researchers focused mainly on contract design, performance, risk sharing, and less on areas such as contract termination and renegotiation. Chen et al. (2016) study targeted empirical studies published between 2002 and 2014 and categorised research into five main domains: performance, contract, risk, value for money and institutional issues.

Cui et al. (2018) carried out a study of the literature dated from 1990 until 2016 and identified six topics. The most prominent was performance management, followed by governance, regulation, economic viability and value for money. The fourth topic was risk management and success factors, while the fifth was procurement, contract management, and the last was financial packages and PPP applications. The cited authors highlight that the water sector is one of the most important topics in PPP studies. Cui et al. (2018) research included 754 peer-reviewed studies from six continents and 56 different countries and regions. These authors observed that 379 studies focused on infrastructure projects. Transport projects were at the top of the list (111 studies), followed by health and hospital (39) and water supply (37).

2.3 Public infrastructure – economic and social

The utilities sector and the water sector in particular are both related to the definition of public infrastructure. Yescombe (2007) claims that a public infrastructure is defined as the necessary facilities to perform a function. These can be classified as economic (where transportation facilities and utilities network are included) or social infrastructures (such as schools, hospitals, libraries or prisons).

Taking into account the scope of the present work, the concept of economic infrastructure that is directly connected to the utilities network concept is considered.

2.3.1 Water sector

The results from 'Review of studies for PPP in the water sector' (see Chapters 2, 3 and 6) identified 122 studies that fulfil the criteria set by the investigator (see Appendix E). Considering that in this particular case the results obtained are connected to the search engine's criteria and are therefore highly biased, this theme was removed from the results

as an emerging theme. However, it is necessary to have a clear understanding of the water sector before presenting the emerging themes.

This subsection provides a brief description of these PPP and their key characteristics. Satisfying populations' basic water needs and improving their quality of life is on policymakers' agenda both in developed and developing countries. Poor water services can generate (Tortajada, 2014) economic (e.g. slower economic development), social (e.g. illness, morbidity and premature mortality) and environmental (e.g. pollution) costs. The water sector is traditionally characterised by a horizontal fragmentation and an intense exposure to political and institutional factors (Asian Development Bank [ADB], 2009). In addition, this sector is highly vulnerable to various economic externalities, climate change, calamities and factors affecting the stability of the country or region, which can influence the costs of service provision that are not directly transferable to customers' final tariffs (Ameyaw & Chan, 2013).

The privatisation of water companies in the United Kingdom (Chong et al., 2006) helped to strengthened the dissemination of PPP in the water sector as a possible business model, influenced by the bilateral and multilateral involvement of financial institutions (Zhong et al., 2008). PPP water contracts are generally characterised by a medium or long-term duration (Grimsey & Lewis, 2002).

Idelovitch and Ringskog (1995) argue that when this type of strategic alliance is applied to the water sector, especially in a developing country, this strategy can help partners to overcome obstacles such as poor performance and productivity.

Given the aforementioned points, a review of the various vectors that can produce good or bad relationships during the life cycle of the contracts needs to be carried out. Conflicts can arise because public partners do not prepare adequately for projects nor develop an effective monitoring plan (Guasch et al., 2014). In combination with incomplete contracts and an inadequate internalisation of structural, social and economic changes, information asymmetries between partners can mean that terms need to be renegotiated (Marques, 2018).

Marin (2009) also proposed four broad categories of factors that can influence performance levels: access to water and wastewater services, quality of service, operational efficiency, and impacts on tariffs. Regardless of the contract model chosen, PPP main purpose is to transfer design, construction or maintenance, and to share the risks associated with systems' operations (Ameyaw & Chan, 2013).

According to the Global Water Intelligence (2016), the global water market that includes industrial water and wastewater was estimated to be worth US$ 174 billion in 2016, with an expected annual growth of 3.8% until 2020. The same source reports five trends in the water sector: the first is the improvement of water efficiency in response to water supply pressures; the second is the growing importance given to adequate wastewater treatment through the construction of proper infrastructure, especially in regions with rapid economic growth; the third trend is the use of technology as a driver of performance; and the fourth is the existence of adequate mechanisms to secure the economic viability of the water sector. The last trend is private finance as a validated form of securing the water-related investment needed.

The present thesis' objective sought to provide an objective overview of how researchers have investigated PPP as a business model that can potentially be used to address identified challenges, as well as defining and exploring potential research gaps and future directions. The water sector has adopted the PPP model with lack of adequate infrastructure, especially in developing countries (Ameyaw & Chan, 2016). Researchers have suggested that this sector's use of PPP has produced advantages, such as cost reduction and improvement of the quality of life of locals, and worker productivity (Ameyaw & Chan, 2015b; Davis, 2005).

The current thesis' objective was thus to provide a comprehensive and holistic review of PPP research in water sector journals and provide the main insights offered by the literature.

To address these questions, this review used a hybrid method including systematic quantitative review methods, semantic network and narrative analysis (Jin & Wang, 2014).

2.4 Systematic quantitative review

This section shows the systematic quantitative review results that include the publications distribution (i.e. region and time, the number of publications, journal, author and institution), the geographical distribution of studies and methodologies (see Chapters 2.4.1 to 2.4.4).

2.4.1 Publications distribution by regions and time

The number of PPP studies related to the water sector has increased in recent years. The research published from 2010 to 2018 includes 86 (70%) of the studies analysed. The next most prolific periods were from 2000 to 2010, which covered 30 (25%) documents, and 1990 to 2000 with six (5%) studies (see Figure 2-1).

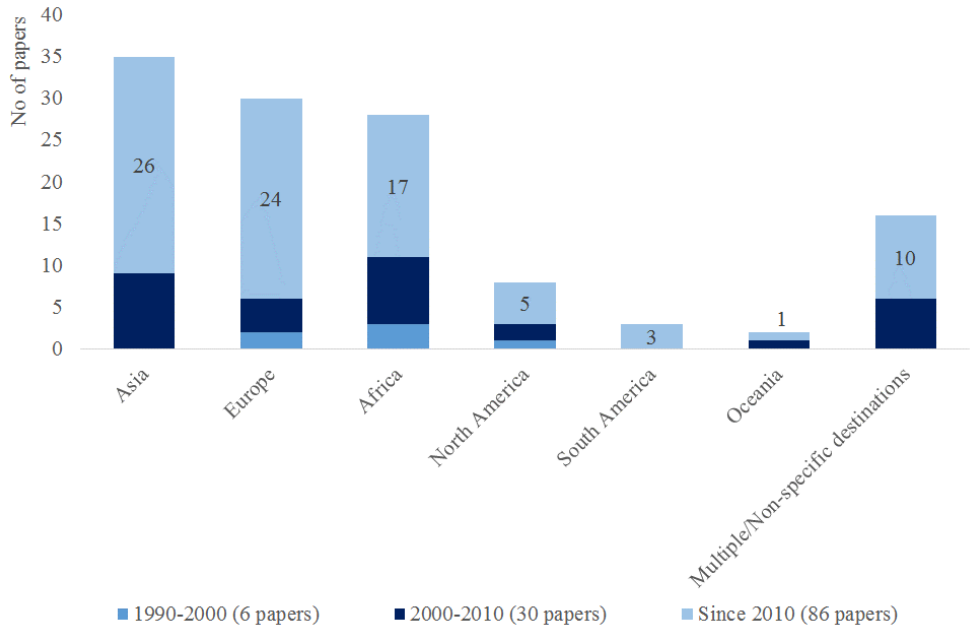


Figure 2-1: Publications distributed by region and year of publication

The research showed variations in PPP implementation models between developed and developing countries. Developing countries are seen as an opportunity to access capital, utilise innovative techniques and take advantage of expertise and know-how (Siemiatycki, 2013; Willoughby, 2013). When ranked by regional institutions Asia leads, followed by Europe and Africa in the three periods considered in this study, namely, 2010–2018, 2000–2010 and 1990–2000, as well as for the entire time (see Figure 2-1 above).

2.4.2 Number of publications by journal, author and institution

The 122 studies reviewed were published in 74 journals. The leading journals in the publication of PPP research in the water sector are the *International Journal of Water Resources Development*, the *Public Works Management and Policy* and the *Utilities Policy* (see Table 2-1).

Table 2-1: Leading journals

Journal	Number of Studies
International Journal of Water Resources Development	10
Public Works Management and Policy	6
Utilities Policy	6
Local Government Studies	4
Water S.A.	4
Journal of Facilities Management	4
Water Resources Management	4
Public Administration	3
Water Policy	3
Journal of Construction Engineering and Management	3
Others	27
Total Number of Journals out of 122 Studies	**74**

The most productive authors are A. Chan with 10 studies, followed by E. Ameyaw with 7 and R. Marques with 6 (see Table 2-2).

Table 2-2: Leading authors in number of publications

Authors	Number of Studies
A. Chan	10
E. Ameyaw	7
R. Marques	6
S. Porcher	3
C. Ruiters	3
Y. Xu	3
J. Yeung	3
Others	228[a]

Note: [a] As multiple authorships and institutions are considered, the total is higher than 122.

Table 2-3 presents the data on the most productive institutions. The Hong Kong Polytechnic University leads with 20 publications, followed by the Technical University of Lisbon – currently known only as the University of Lisbon – with 11 publications and

Cornell University and the University of Science and Technology Beijing, with six publications each. Combining the institutions and countries, China comes first with 30 studies, followed by Portugal with 11 studies and the US with 10 studies (see Table 2-3).

Table 2-3 : Leading institutions with most publications

Institution	Country	Number of Studies
Hong Kong Polytechnic University	China	20
Technical University of Lisbon (University of Lisbon)	Portugal	11
Cornell University	US	6
University of Science and Technology Beijing	China	6
The University of Arizona	US	4
Charles Sturt University	France	4
Tsinghua University	China	4
Other Institutions	N/A	208 [a]

Note: [a] As multiple authorships and institutions are considered, the total is higher than 122.

2.4.3 Geographical distribution of studies

The sample included research studies from around the world. Power BI tools were used to perform geographical analysis, facilitating the visualisation of quantitative data (see Figure 2-2) (Krishnan et al., 2017). The result is a heat map, which is a graphical representation of the sample's frequency and geographical distribution.

The results presented in Figure 2-2 are not completely aligned with the frequency of the PPP projects registered. For example, the Word Bank ranks the East Asia and Pacific countries first with 587 projects and US$ 28 billion in investments, and China leads those countries with 510 PPP projects valued at US$ 16 billion. According to Figure 2-2, the area showing the highest frequency of projects studied is Europe, and Central Asia shows up in third place with 64 projects and US$ 5 billion in investments. The Russian Federation ranks first in the latter group with 27 projects worth US$ 3 billion.

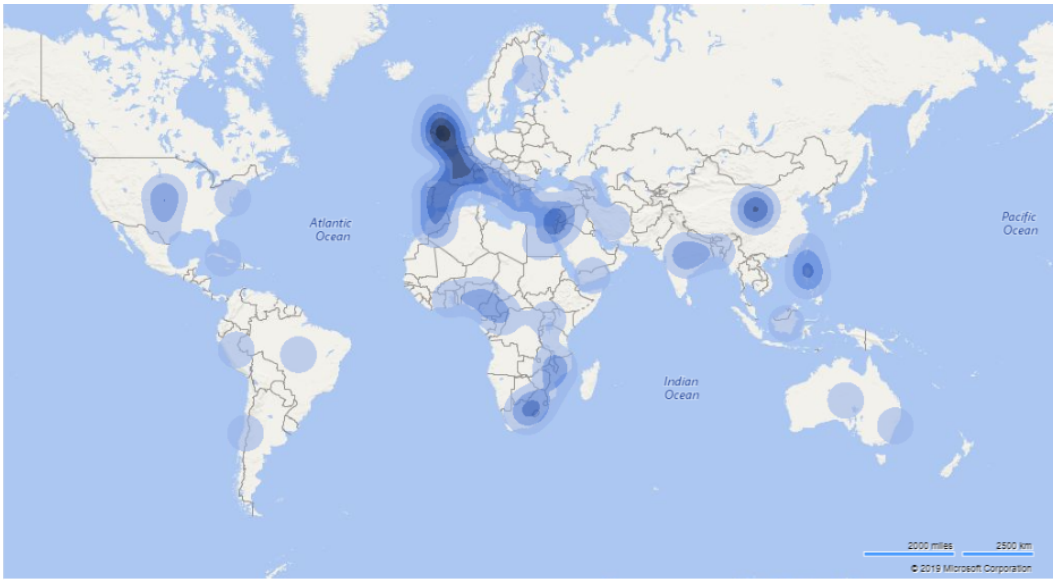


Figure 2-2: Sample's frequency and geographical distribution

The results show that developing regions can be interesting, productive areas for future research on PPP water contracts. These contracts facilitate higher levels of private investment in water infrastructure, thereby contributing to the relevant populations' increased wellbeing. These benefits can have a significant impact on developing countries.

2.4.4 Studies' methodologies

The studies' methodology include qualitative, with 54 (44%) studies (e.g. Cruz & Marques, 2012; Gopakumar, 2014); quantitative, with 42 (34%) (e.g. Owen, 2016; Vedachalam et al., 2016); and mixed methods, with 26 (21%) (e.g. Breytenbach & Manning, 1999; Loë & Mitchell, 1993). Table 2-4 provides an overview of how the different methodologies were applied in studies. Another interesting perspective was to assess the studies' research design.

The most frequently applied design are case studies with 63 examples (e.g. Cruz & Marques, 2013a; Williams, 2018), confirming the tendency found in previous literature reviews of PPP research (Yu et al., 2018). This research design can be a useful tool for researchers seeking to understand detailed data and information about a certain topic (Cavaye, 1996). Research designs based on interviews ranked second with 26 studies (e.g. Carvalho et al., 2018; Chan & Cheung, 2011), followed by surveys in third place with 17 publications (e.g. Ameyaw et al., 2017; Wibowo & Mohamed, 2010).

Table 2-4: Methodologies adopted by studies

		Research Design					
Methodology	**Number of studies**	**Descriptive**	**Content analysis**	**Case study**	**Longitudinal**	**Interview**	**Survey**
Qualitative	54	3	8	36	5	14	0
Quantitative	41	2	2	9	2	4	9
Mixed methods	26	1	4	18	2	8	8
Total[a]	**122**	**6**	**14**	**63**	**9**	**26**	**17**

Note: [a] As multiple authorships and institutions are considered, the total is higher than 122.

2.5 Development and connections of key topics (semantic analysis)

Word Cloud frequency analysis facilitated the classification of research topics through high-frequency keywords (see Figure 2-3). This analysis highlighted the words 'water', 'public-private', 'partnerships' and 'risk'. The word connections stressed suggested that risk management, financial package and governance are popular topics.

Figure 2-3: Word Cloud of research topics

Leximancer's results revealed eight themes (see Figure 2-4). The highest ranked concepts were 'public-private' with 65 hits (84%), 'risk' with 19 (25%) and 'public' with 11 (14%), while the remaining themes added up to 14 (18%). Visual observations produced similar results.

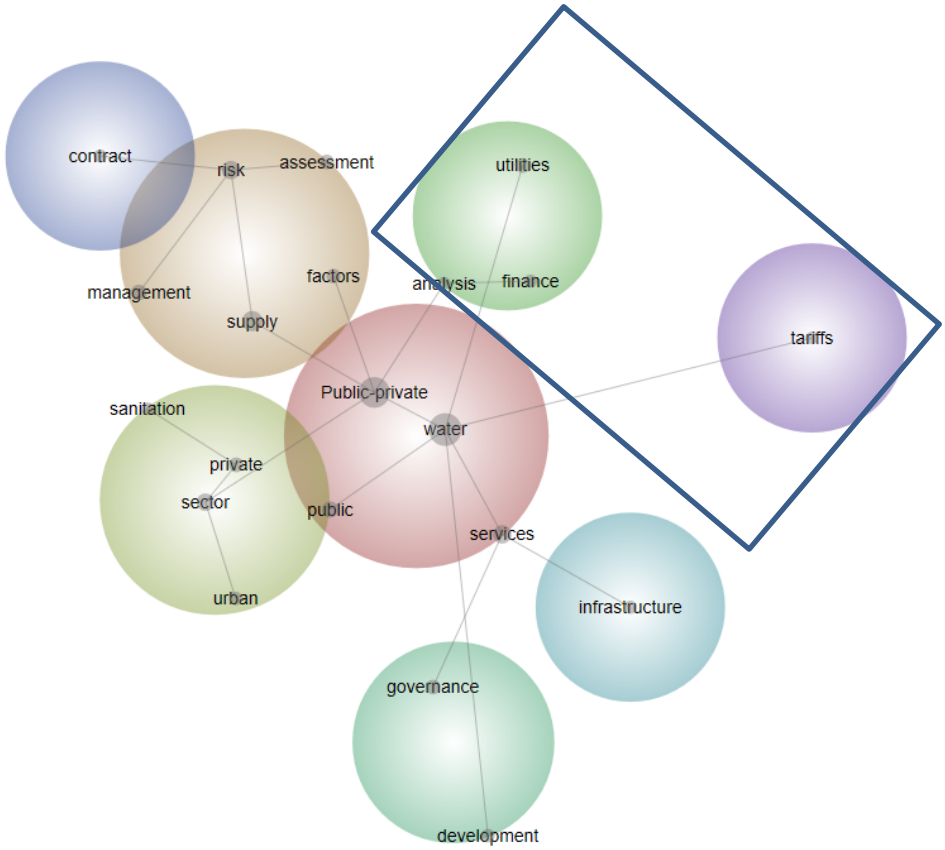


Figure 2-4: Concept map of PPP themes by Leximancer

The analysed studies' main domains included PPP in 122 studies (100%), risk management in 37 (30%), PPP contractual arrangement in 23 (19%), financing and tariffs in 22 (18%), infrastructure in 16 (13%) and governance in 7 (6%).

As shown by the main domains, risk management in PPP contracts is a compelling concern. Research by Cui et al. (2018) also confirmed that this is a hot topic since risk management and success factors came in fourth place, and 18% of studies' main domain was PPP contracts. Risk management in PPP contracts comprises the process of risk identification, assessment and allocation, as well as management strategies (Cui et al., 2018).

The public-private theme included the concepts of water (77, 100%), public (11, 14%) and services (8, 10%). The risk management theme covered the concepts of management (11, 14%), supply (11, 14%), factors (6, 0.8%) and assessment (6, 0.8%). The theme of contracts was a single concept (3, 0.4 %). The financing and tariffs themes are closely connected, which comprised together the concepts of utilities (9, 12%) and analysis (3, 0.2 %). The theme of infrastructure contained a single concept (20, 26%), and the last theme, governance, included the concept of development (4, 5%).

2.6 Narrative analysis

This section shows the narrative analysis results that include the themes: risk management, PPP contractual arrangement, financing and tariffs, infrastructure, and for last governance (see Chapters 2.6.1 to 2.6.5).

2.6.1 Theme one: risk management

Risk management in the water sector was the focus on 37 studies (30%). As previously mentioned, risk management in PPP contracts is a compelling concern in the field. Cui et al. (2018) research provides evidence that this theme is an important topic in PPP research since risk management and success factors ranked fourth and 18% of studies' main domains included PPP contracts.

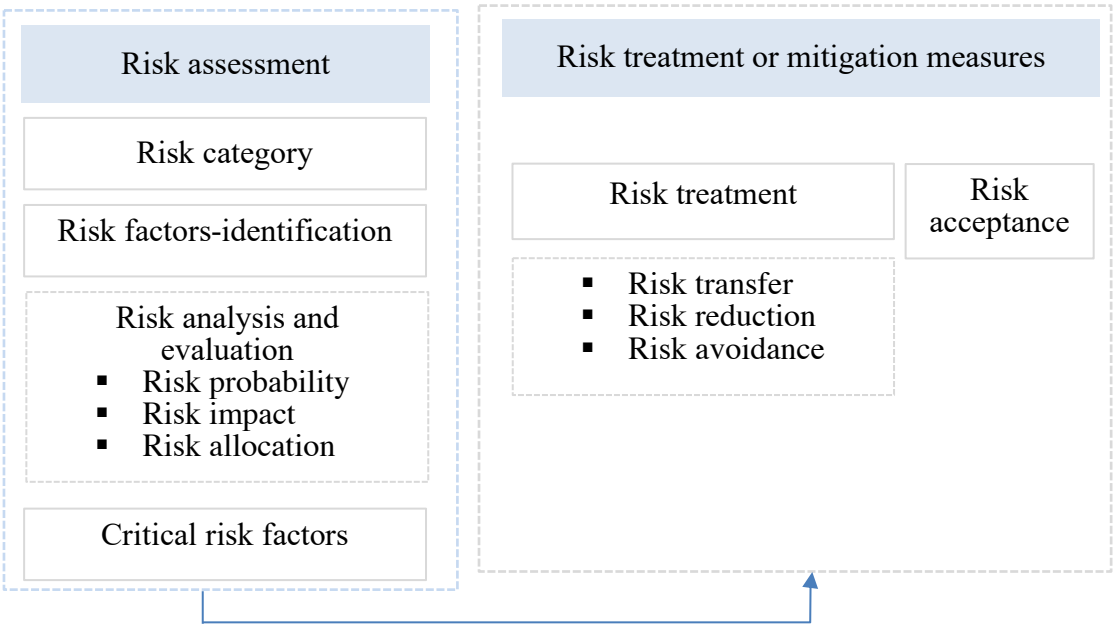


Figure 2-5: Risk management framework

The first step before designing the risk management process of projects is to define the appropriate risk management strategies. This process comprises two important phases (see Figure 2-5). The first phase is the risk assessment that includes risk identification, analysis and evaluation. The final outputs should provide a list of critical risk factors. The second is the risk treatment or mitigation measures and management strategy that include the quantification of impacts and minimization measures (Ameyaw & Chan, 2015a; Cui et al., 2018; International Organization for Standardization [ISO], 2018a).

The risk assessment phase is thus an evaluation of how the identified risks that belong to risk categories or types that can have an impact on the contract's performance and objectives. The appraisal is performed through risk analysis and evaluation.

The risk assessment phase is thus an evaluation of how the identified risks that belong to risk categories or types can have an impact on the contract's performance and objectives. The appraisal is performed through risk analysis and evaluation.

According to the international standards, risks can be empirically classified in groups or categories, connected to their type (ISO, 2018a). However, grouping risk into category types can be a useful tool to facilitate the discrimination and identification of these factors. For example, Unkovski and Pienaar (2009) proposed that risks can be categorised as financial, legal and technical. Based on Prince2 and standard methodologies, risk factors are identified (Esteki et al., 2020).

Risk identification is associated with systematic observations conducted to classify specific potential risks of projects.

Risk factors can be easily affected by external forces, such as social and cultural diversity or projects' location in developed or developing regions. Therefore, risk factors can easily change due to the substantial influence of the socio-economic context.

Risk evaluation is related to the likelihood of a particular event occurring multiplied by the corresponding impact quantification (Marques & Berg, 2011a). Risk allocation is also crucial for researchers to understand which partner (i.e. private or public) is responsible for addressing the identified risks (i.e. the risk owner) (Ameyaw & Chan, 2013; Wibowo & Mohamed, 2010). According to the literature on the water sector, the biggest risk factors are non-economically viable water tariffs, water pricing uncertainty, financing, tax policy changes, interest rates and volatility, and unstable water resource prices. Other factors are governmental instability and breach of contract, the weak

capacity of national financial institutions, and the resistance of public opinion (Ameyaw & Chan, 2015c).

The process of ranking risk factors leads to another relevant category: critical risk factors (Ameyaw et al., 2017).

Risk evaluation and ranking have attracted scholars' attention in recent years (Ameyaw et al., 2017; Zhang et al., 2018). Given the water sector characteristics, risk factor rankings cannot be generalised to all settings (Ameyaw & Chan, 2015c). For example, from a chronological point of view and depending on the range of the contract, it is expected to have associated risks that are directly related to the design and to the construction phase (e.g. planning risk and technology, delays or low plant performance, total costs over the initial planning), while others are just related to operational and maintenance risks (e.g. market demand risk, operational risks and supply risks). Finally, there are a group of risks that are common to both phases (e.g. economic externalities, natural disasters risks, environmental risks and macroeconomic variables as inflation, interest rate risk, currency risk).

Nonetheless, critical risk factors were ranked by researchers in all the 37 studies connected to risk management in PPP water contracts. These results are not consensual due to the diversity, the type and the external environment of the project, among other direct or indirect factors.

The most frequently mentioned risks (Ameyaw & Chan, 2013; ADB, 2009; Marin, 2009) are: economic externalities, political and institutional factors (including governments' breach of contract and interference), natural disasters such as climate changes and calamities, financing (including capital investments), water pricing uncertainty, water tariffs, water resources, price instability, and poor performance and productivity. According to the literature, it is still possible to add other risks, such as risks related to the foreign exchange rate, corruption, water theft, non-payment of bills, political interference, high operational costs, pipeline failures, lack of PPP experience, inflation rate volatility, construction time and cost overrun, poor contract design, interest rate, political discontent, early contract ending, poor design and construction problems, conflicts between the partners, financing, land acquisition issues and public resistance to PPP contracts (Ameyaw & Chan, 2015a). The second and last phase of the risk management framework is based on the critical risk factors identified in the assessment phase: risk treatment or mitigation measures, including a management strategy.

The literature identified two main groups of possible solutions for risk treatment or mitigation measures: acceptance, and treatment or mitigation measures. Accepting risks occurs when the public partner evaluates the potential risk responses and rationalises this economic and social advantage when the risk materialises itself (e.g. risk of social instability in the European Union resulting from the coronavirus COVID-19 impact in 2020 (European Commission, 2020)). Risk treatment or mitigation measures include a range of options (AXELOS, 2018; Nigel et al., 2017; Office of Government Commerce [OGC], 2009). Risk transfer (e.g. thought contracting insurance policies) is a valid instrument to achieve value for money (Bing et al., 2005; Roehrich et al., 2014).

Through the awareness of the project's level of risk, risk reduction allows partners to take action (e.g. revise the project's dimension and scope to reduce risk exposure and to attract private participation (Ameyaw & Chan, 2015b).

Risk allocation should be revised to ensure that all identified risks have at least an owner and if each PPP contract risk is allocated to the partner who is best able to manage it (share risk options) (Välilä, 2020).

The risk management topic leads to the introduction of tools to support the control of critical risk factors and future threats (Moeller, 2007). The concept of key risk indicators emerges in this context. Traditionally, key risk indicators provide statistics or metrics to support the organisations' risk position (Peček & Kovačič, 2019). The objective of key risk indicators is to provide relevant metrics to access critical risk factors and include potential risks (Beasley et al., 2010). This concept introduces another fundamental term: the need to measure and monitor risk (Timmermans et al., 2016). The key risk indicators as a potential monitorization tool were not identified in the 13 studies analysed. The adaptation of this concept to PPP water contracts can present advantages in providing a useful tool for monitoring risk and bring originality and scientific contribution to this thesis.

The results from Table 2-5 show that 13 out of 37 studies were considered relevant regarding the approach of the risk process of PPP in the water sector. Table 2-5 also shows that from the considered studies, 11 were focused on developing countries, and two on developed countries.

From the perspective of risk assessment, these studies provided contributions. However, we observed and concluded that there was no consensual methodology and terminology between scholars with regards to risk assessment.

Table 2-5: Literature risk approach – relevant studies from the 37 selected studies

Authors	Study title	Risk assessment	Risk treatment or mitigation measures	Location
Ameyaw and Chan (2015a)	Evaluating key risk factors for PPP water projects in Ghana: a Delphi study	Suggest a list of risk factors connected to contracts in PPP in the water sector. Includes the identification phase of analysis using a Delphi study.	Discuss the critical risk factors (top 20), including the discussion about the way these factors emerge as critical. *[There is no information about risk treatment or mitigation measures.]*	Developing countries
Ameyaw and Chan (2015c)	Risk allocation in Public-private partnership water supply projects in Ghana.	The study is connected to the risk allocation between the private and public sector and the implications on risk management, using a Delphi study.	The results are focused in proposing a balance in risk allocation between partners.	Developing countries
Ameyaw and Chan (2016)	A fuzzy approach for the allocation of risks in Public-private partnership water-infrastructure projects in developing countries	This study is focused on risk allocation between the public sector and private sector. It is proposed a risk-allocation criterion of five critical risk factors related to PPP projects in water sector, using a Delphi study.	The results support that risk sharing is the answer to true partnerships. The study produced good insights about how risk sharing and allocation can be useful tools to improve PPP contracts in the water sector.	Developing countries

Authors	Study title	Risk assessment	Risk treatment or mitigation measures	Location
Braadbaart et al. (2009)	Managing urban wastewater in China: A survey of build-operate-transfer contracts	Five BOT[a] contract documents were examined, identifying gaps in contract specifications including clauses allocating to commercial specification.	*[There is no information about risk treatment or mitigation measures.]*	Developing countries
Carpintero and Petersen (2016)	Public-private partnerships (PPPs) in local services: risk-sharing and private delivery of water services in Spain.	This study is focused on assessing the associated risks to construction delays in the water sector and the risk sharing on local services.	This study is focused in possible alternatives to address the risk transfer topic.	Developed countries
Cheung and Chan (2011)	Risk Factors of Public-private Partnership Projects in China: Comparison between the Water, Power, and Transportation Sectors	Identification of the top five most severe risk factors indicating that the most severe risks are government related.	*[There is no information about risk treatment or mitigation measures.]*	Developing countries
Grimsey and Lewis (2002)	Evaluating the risks of Public-private partnerships for infrastructure projects	This paper presents a framework for assessing the risks and uses a case study of a wastewater treatment facility in Scotland.	*[There is no information about risk treatment or mitigation measures.]*	Developed countries
Lee and Yu (2012)	Characteristics of Public-private partnerships for	Three projects highlighting the characteristics of risk allocation.	The study recommends measures to reduce contracts risk and renegotiation.	Developing countries

Authors	Study title	Risk assessment	Risk treatment or mitigation measures	Location
	municipal wastewater treatment in Taiwan			
Mahalingam et al. (2011)	A Comparative Analysis of Public- Private Partnership (PPP) Coordination Agencies in India: What Works and What Doesn't	A study about the coordination agencies involved in projects in the water and sanitation sector in India, commercial risk management and relational risk management.	*[There is no information about risk treatment or mitigation measures.]*	Developing countries
Marques (2016)	PPP arrangements in the Brazilian water sector: A double-edged sword	The study concluded that the risk matrix is unbalanced and that most of the risks will be retained in the public sector.	*[There is no information about risk treatment or mitigation measures.]*	Developing countries
Nakhla (2016)	Innovative regulations, incomplete contracts and ownership structure in the water utilities	The study approaches the financial risks factors.	*[There is no information about risk treatment or mitigation measures.]*	Developing countries
Wibowo and Mohamed (2010)	Risk criticality and allocation in privatised water supply projects in Indonesia	This study is focused in risk allocation within Indonesia water supply projects. It is proposed a rank of risks associated to the water projects	*[There is no information about risk treatment or mitigation measures.]*	Developing countries

Authors	Study title	Risk assessment	Risk treatment or mitigation measures	Location
Xu et al. (2010)	Developing a risk assessment model for PPP projects in China-A fuzzy synthetic evaluation approach	The study is focused in risk factors identification using a Delphi study. The results allow to identify the critical risk factors regarding risk exposure (probability x severity)	*[There is no information about risk treatment or mitigation measures.]*	Developing countries

Note: [a]BOT- Build-Operate-Transfer model (World Bank, 2016).

Scholars based their results mainly on experts' opinions to identify risk factors and critical risks (e.g. Ameyaw & Chan, 2016; Wibowo & Mohamed, 2010). Marques (2016) successfully performed a study of PPP arrangements in the Brazilian sector, concluding that the risk matrix was unbalanced and that most of the risks would be retained by the public sector.

Researcher observed that scholars failed to propose and evaluate solutions regarding risk treatment or mitigations measures. From the 13 identified studies, nine (70%) did not address the risk treatment or mitigation measures' issues as part of the study, but as recommendations and possibilities for future research. Taking into account the characteristics of the water sector, risk factors and critical risk factors cannot be generalized (see Chapter 2.3.2). The water sector is complex and can present a considerable diversity, type of the project, external environment, among other direct or indirect factors.

The combination of experts' opinion and contracts verification as part of the validation of the risk management framework model demonstrated the valuable contribution and originality of this study (see Chapters 4 and 5).

2.6.2 Theme two: PPP contractual arrangement

PPP contract types were the focus in 23 studies (19%). According to Yescombe (2007), PPP are one possible type of long-term strategic alliance between two partners. The options available basically depend on the type of assets involved, namely, greenfield projects for new assets or brownfield projects for significant infrastructure removal. Options also vary according to the shared level of responsibility of the business partners, that is, private partners can experience a significant increase in their responsibilities in contracts including the design, construction, rehabilitation, financing, maintenance and operation of public facilities' infrastructure. In addition, the available options depend on how private partners are to be paid: totally via service users' fees or via public partners – or a combination of both sources (Guerrini & Romano, 2017; World Bank, 2017a).

A closer look at the literature related to the water sector provided various options regarding contractual arrangements involving water services providers (Guerrini & Romano, 2017; Reynaud, 2015).

Service contracts assign a lower level of shared responsibility to providers. In this option, a company owned or controlled by the government (i.e. the public party) decides to outsource a segment of its business based on the existing infrastructure to a private company (i.e. the private party). Services can be provided using exclusively internal resources (i.e. operation and maintenance contracts), and the private partner is paid by the public.

According to the (World Bank, 2017a), there are two major types of contracts. The first is the concession in which users pay the PPP parties and new or existing infrastructure requires that the functions transferred include design, construction, finances, operations and maintenance. The private partner provides services directly to the users, and the latter are entirely or partially responsible for payment. The second is related to the fact that some contracts require a higher level of involvement between the public and private partners who implicitly share responsibilities, such as management decisions about operations and maintenance of infrastructure to provide an adequate level of services. These contracts ask private companies to manage and maintain significant components of water services.

PPP contracts are generally characterised by being medium or long term. Thus, researchers have closely examined the various vectors that can create good or bad relationships during the life cycle of the contracts. Conflicts can arise when public partners fail to adequately prepare for projects, design contracts and neglect to develop effective monitoring plans (Ameyaw & Chan, 2015c; Guasch et al., 2014). In addition, incomplete contracts and a poor capacity to internalise structural, social and economic changes can be combined with information asymmetries between partners to force them to renegotiate their terms (Marques, 2018). The theory of incomplete contracts can provide a different approach to renegotiation so that the contracts' revision may involve updating terms as a result of the emergence of new information that was unavailable when the initial contracts were created (Grossman & Hart, 1986).

2.6.3 Theme three: financing and tariffs

The theme of financing and tariffs in the water sector was present in 22 studies (18%). PPP financial evaluation continues to attract scholars attention (Roehrich et al., 2014).

This topic can be separated into different perspectives. The first one focuses on how PPP contracts can be crucial to attract investment to develop the necessary infrastructure

and provide services to the public. The second perspective is related to how public partners' contracts ensure that private payments are made (i.e. user fees, payment by public partners or both).

Infrastructure's large-scale investments tend to present challenges. Investors are strongly influenced by various internal and external factors that can individually or together influence decisions against or for financing water infrastructure, which is overall an important cause for concern (Marques & Berg, 2011b). The level of development of regions and countries can be decisive regarding their access to credit and long-term international loans provided by local and national banks (Yu et al., 2018). Financing problems can be related to the macroeconomic environment, the financial system's instability, and local and/or national banks' weak institutional capacity, all of which can determine financing accessibility and availability and thus influence projects' attractiveness (Chou & Pramudawardhani, 2015). Water supply projects tend to be capital intensive, and an additional effort may be needed to secure an adequate level of financing to ensure projects are sustainable in the medium or long term.

Various options are available in terms of the method chosen to secure the private partners' payment for providing services to users. The necessary funds can come totally from users' fees, be provided by public partners only, or these two options combined (World Bank, 2017a). In this context, the system selected for setting water tariffs is of particular importance.

For example, in 2011, the Italian national water authority observed a gradual paradigm shift in the revenue cap regulations. The first type was called '*metodo tariffario normalizzato*', which changed to the '*metodo tariffario transitorio*' from 2012 to 2013. Then, from 2014 to 2015 it changed to the '*metodo tariffario idrico*' and, finally, to the MTI2 from 2016 to 2019. According to Guerrini and Romano (2017), the MTI tariff system was designed to transfer costs to users based on the principles of 'full cost recovery' and 'the polluter pays'. Italy's tariff system now recognises the need to include the costs of financing and investment (including interest and taxes), recovery operations and maintenance costs, and to make the necessary adjustments based on the previous year's tariffs.

2.6.4 Theme four: infrastructure

The theme of infrastructure in the water sector was present in 16 studies (13%). This sector is characterised by the need for extensive investment in projects, and the construction and maintenance of infrastructures (An et al., 2018). Topics such as lack or excess of infrastructure capacity are common issues in the water sector, which have a major impact on business activities during PPP water contracts' lifetime. Construction time and cost overruns are among the most critical risks in water-related PPP (Shen et al., 2006). Overall, the water infrastructure is complex to design, build and maintain. The nature of problems ranges from lack of adequate projects to weak institutional support in the sector, inconsistency in the investment plans approved and lack of coordination between construction firms (Ameyaw & Chan, 2015c).

The ISO's ISO/CD 55011.2 was developed in response to the problems connected to asset management, and guidelines for public policymakers are also being prepared. This useful tool helps national governments to achieve a balance between investing in new infrastructures (i.e. greenfield projects) or choosing to repair and replace existing assets (i.e. brownfield projects). The ISO/55002's principles include planning company asset management, executing asset management objectives and risk management, monitoring operations, analysing asset management systems and making decisions based on continuous improvement (ISO, 2018a, 2018b).

2.6.5 Theme five: governance

The theme of governance in the water sector appears in seven studies (6%). This theme focuses on project governance and it is connected to government policymakers' interference in PPP water contracts. Researchers regularly observe that projects reveal a mismatch between the governance approach applied and the reason why projects are developed (Cui et al., 2018). When the institutional design fails to match (and allows integration) the water sector's national policies and local contexts, problems connected to lack of transparency, engagement and accountability can arise (Beisheim & Campe, 2012).

Some of the controversy surrounding PPP water contracts' institutional design is due to the conceptualisation of water classification in specific national policies. Water is sometimes seen as a 'collective good' and/or as an economic good, specifically in the

case of developing countries that choose private partners connected to non-profit organisations (Wibowo & Mohamed, 2010). In addition to depending on internal policies, the water sector can often be considered a national priority and thus be more focused on obtaining access and adequate levels of service for all populations – including ensuring water quality standards. This may mean that the sector is forced to neglect the water systems' economic sustainability. Evidence that the existence of an adequate regulatory framework and strategic approach can help mitigate these issues has been found (Abednego & Ogunlana, 2006; Sabry, 2015).

Finally, PPP's governance performance can be compromised by instability in the tariff systems' definition, lack of opportunities for private infrastructure ownership and misguidance due to inadequate governmental regulations (Mouraviev & Kakabadse, 2015). To deal with these issues, national and local institutions must apply a clearly defined strategic approach to the water sector in order to ensure stability and attract and retain private partners.

2.7 Risk approach and PPP water contracts

The conclusions from previous sections allowed the identification of the risk theme as a hot topic among scholars. The risk management framework in a PPP context was equally described in Chapter 2.6.1.

Nevertheless, it was observed that the risk management framework in PPP contracts context is flexible, and it can present a subjective perception according to each project's objectives. The PPP contract risk can be based on and assessed by recurring to quantitative or qualitative criteria (World Bank, 2017a).

However, it is necessary to clarify the concepts that will be used to avoid misperceptions.

Risk, by definition, is the effect of uncertainty on objectives (ISO, 2018a). This effect can be positive, negative or both, and it can result from opportunities or threats to the project's objectives (ISO, 2018a; Irwin, 2007). Risk can be defined as an unpredictable variation in value, where the total-project-value is the result of an unpredictable variation in the total value of the project (Irwin, 2007).

Risk can have many sources. Irwin (2007) defines risk as the unpredictable variation (in value) caused by the variation of a risk factor, which will affect the total project-value.

Risks and risk factors can be aggregated into risk categories, according to the needs of the project and the type of available data (see Figure 2-6). For this thesis, these definitions were considered.

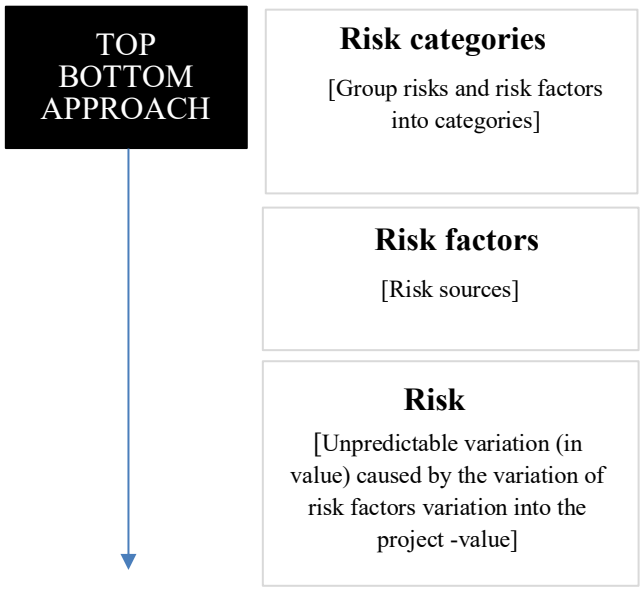


Figure 2-6: Thesis risk approach

There was some flexibility when applying these concepts, considering the environment, type of available data and evaluation purpose.

Chapter 4.2 uses a top-bottom approach, for example. The literature provides insides regarding the risk categories that served as support to the interviewee's opinion regarding potential risk factors in PPP utilities contracts in developing countries. In this case, the risk concept was not applicable because there was not a project-value that could be evaluated.

Results of risk approach based on the systemic literature results

The researcher performed a visual observation of how scholars put the risk management framework into practice. Results from the systematic literature review allowed the identification of 37 potential studies that could support a suitable approach to risk in PPP water contracts. Table 2-6 shows that most of the studies considered risk factors as the basis of the risk management framework.

Table 2-6: The risk classification – literature contribution

Classification	Nº studies[a]	Nº identified items
Risk categories	5	30
Risk factors	13	365
Risk	5	84

Note: [a] The researcher only considered the studies that classified the risk theme, from the total of the 37 studies.

Risk categories resulting from the literature

PPP risks can be grouped into categories according to the nature of the projects, assets, services involved or where the project is going to be implemented (World Bank, 2017a).

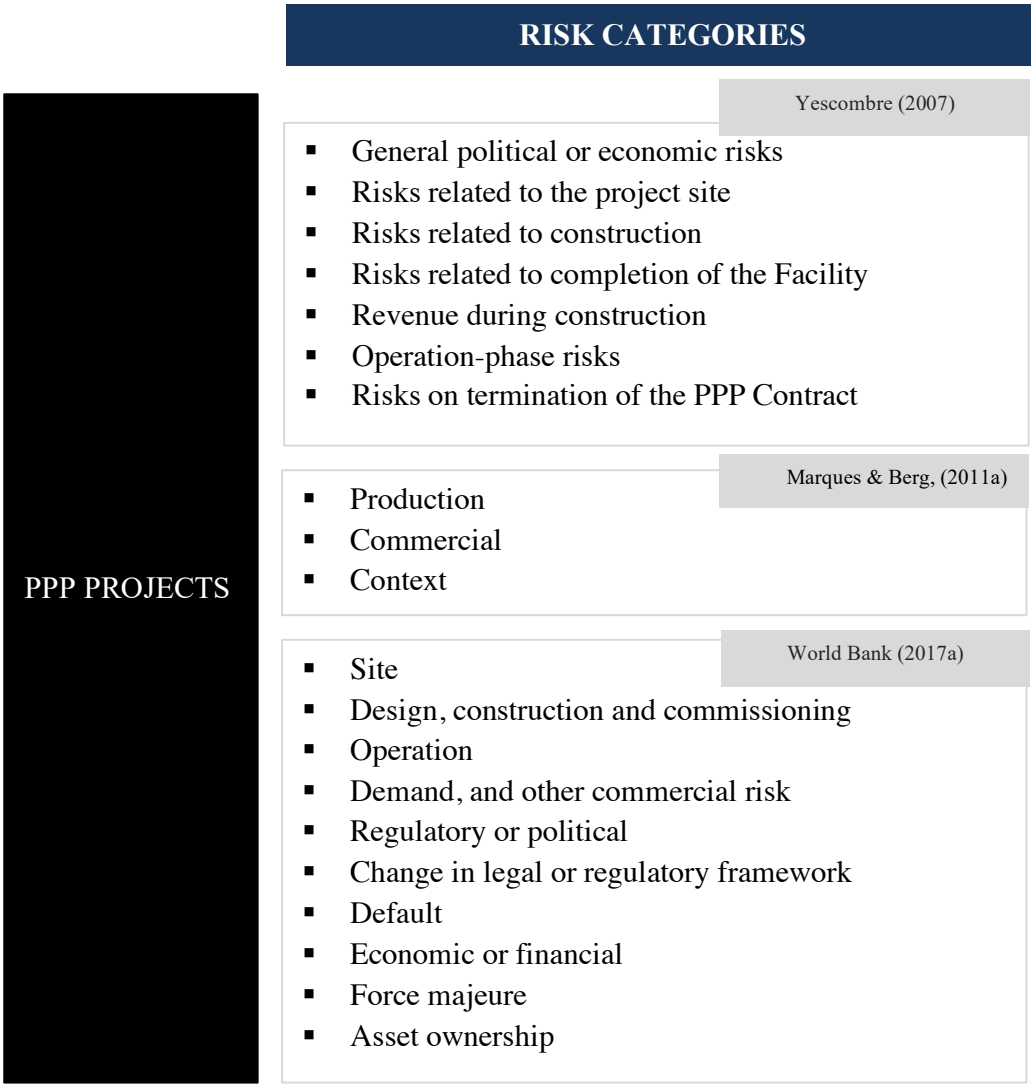


Figure 2-7: Risk categories resulting from the literature

The literature proposes several options for the classification of risk categories, which allows the adequacy of the content to the needs of each project and sector.

Figure 2-7 shows some possible classification of risk categories (Marques & Berg, 2011a; World Bank, 2017a; Yescombe, 2007).

The risk categories' results from the 37 PPP studies (see Table 2-6) are were in line with the literature (see Figure 2-6). They added risk categories, such as political/legal, environment, construction, market, financial and social (Ameyaw & Chan, 2013; Lee & Yu, 2012) as variants of the previous risk categories. The results sustained the researcher's proposal for five risk categories (see Chapter 3.2.1). The five risk categories identified were: i) financial risks, ii) context risks, iii) technical and operational risks, iv) commercial risks, and v) infrastructure risks. For this thesis, the following definitions were considered:

- Financial risk category is associated to the ability (or not) to secure the necessary funds from both partners for the success of the PPP projects.
- Context risk category is related to the background, political and social-cultural and economic background elements that can have an impact or constrain the PPP projects.
- Technical and operational risk category is connected to technical risks and operational issues that can affect (positively or negatively) the project's success. It is connected to the PPP performance and its ability to provide the service in a timely and efficient way.
- Commercial risk category is linked to the commercial provision of water supply services to customers, including the collection capacity in PPP projects.
- The infrastructure risk category is related to the impact that a good or bad preservation and awareness of PPP assets can have in the success of the project's outcomes.

Identification of risk factors based on the literature

The identification of risk factors in the PPP projects' context should be tailored to each project and consider the sector and the surrounding environment. Analysing the contributes of the 37 studies previously identified on systematic literature review, a vast number of possibilities regarding risk and the identification of risk factors connected to PPP in the water sector were identified. Visual observation allowed the identification of 365 entries. After removing duplicates and similar wording and meaning, the researcher

was able to identify 122 risk factors which are presented in alphabetic order (see Table 2-7).

Table 2-7: PPP risks factors in the water sector – literature contribution

List of identified risk factors	List of identified risk factors
Absence of policy and legal frameworks	High operational cost
Abuse of power by government officials	High tendering cost
Acceptability risk (aesthetics)	Imperfect law and supervision system
Advancements and innovations in water technology	Inability of concessionaire
Alternative cheaper water sources	Inaccurate market forecast
Basic studies and experiments	Inadequate competition for tender
Breach of contract by government or the operator	Inadequate law and supervision system
Capital availability problems	Inconsistency in weather patterns
Change in tax regulation	Increasing population and expansion of urban settlement
Climate change	Inexperience in PPPs
Coherent rulings	Inflation
Competence of private consortium	Insufficient project finance supervision
Competitive financial offers	Interest rate
Completion delay	Labour strike
Concessionaire change	Lack of support for infrastructure
Conflicts between partners	Land acquisition
Construction cost escalation and overrun	Leadership and handling by officials
Continuation of traditional	Long approval time for the projects
Continuous monitoring	Low operation productivity
Corruption	Low quality of raw water
Currency convertibility/ transferability	Low residual value
Delayed process	Macro-economy consistency situation
Delivery or assurance of service	Man-made disaster
Design and construction deficiencies	Market demands change
Design flexibility	Material/labour non-availability
Employee theft	Nationalization/expropriation
Employment of expert consultants	Natural disaster
Entry of new competitors	No baselines for performance
Environment damage	No pro-poor measures
Exclusivity negation	No risk allocation mechanism
Expense payment	Non-payment of bills
Expropriation/nationalization	Non-transparent and accountable process
Failure in financial closure	Non-availability of raw water
Failure in refinancing	Obsolete technology
Financial availability	Operation & maintenance cost escalation
Fluctuation's demand	Operation safety
Force majeure	Organization and coordination
General changes in legislation	Pipeline failures during distribution
Government credit	Planning deficiency
Government intervention	Political discontent & early termination

List of identified risk factors	List of identified risk factors
Political interference	Sovereign and contractual risk
Poor commitment from private party	Specific changes in legislation
Poor contract design	Strong warranty from both of the performing parties
Poor performance	
Poor public decision-making process	Subjective project evaluation method
Premature termination by government or operator	Support utility
Price change	Technical leakage during distribution
Private partners' performance record	Termination of contract by government
Problems with cultural understanding of water protection	The management, control and exploitation of water resources
Problems with water recovery technology	Third party delay/violation
Procurement	Transfer failure
Product price	Unfavourable global private
Project/operation changes	Unfavourable local/ global economy
Protected negotiation on land price	Unforeseen weather/geotechnical conditions
Public opposition	Unproven engineering techniques
Qualitative and quantitative security of	Unsuitable PPP model
Regional political instability	War
Regulatory risk (weak regulation)	Water asset condition uncertainty
Reliability of service/water quality	Water pricing and tariff review uncertainty
Residual risk	Water theft
Safety	Weak capacity of public and private partners
Social-public support	

The visual observation of the studies concluded that risk factors are generally the starting point. After being ranked, it was possible to identify the critical risk factors (Ameyaw & Chan, 2015a, 2016; Osei-Kyei et al., 2017).

The listed risk factors were considered as a template work basis for the identification of the risk factors of the second and third thesis' objectives (see Chapters 4 and 5).

Risk and risk allocation

As previously mentioned, risk can be defined as the result of the evaluation of risk factors. Considering the research context and the available data, the researcher's focus was on the identification of risk factors and their rank.

The risk allocation principle is directly connected to the previous definitions. Risk should be primally allocated to the party which can more effectively influence:

- The identified risk factor – the party is available to support the costs and get the benefit from improving the risk factor outcome.
- The total-project-value by anticipating or responding to the risk factor – the party is able to influence the sensitivity of total total-project-value by

mitigating, reducing and exploiting the upside risk (e.g. choose the location of an infrastructure where the probability of an earthquake occurs).

- Risk – parties are not neutral to risk and this concept is connected to their ability to accommodate risk.

2.8 Literature review results and thesis objectives contribution

This chapter conducted a detailed review of research on PPP connected to the water sector in order to identify the field's tendencies. Water sector PPP projects have been given increasing importance in the literature, and these are among the top five most researched PPP infrastructure schemes (Cui et al., 2018). The research involved the application of a hybrid method that included a systematic quantitative review and both semantic and narrative analysis to highlight the results (i.e. themes) identified throughout the studies in question. These results provided answers to the research questions identified in this chapter introduction. The four main research questions and insights are highlighted again.

1. What have been the main contributions of different countries and/or regions and researchers to studies of PPP in the water sector?

The number of studies related to PPP in the water sector has increased, especially over the last decade, as this theme was identified in 86 (70%) of the 122 publications. The most productive institutions are located in Asia with 26 (21%), followed by Europe with 24 (20%) and Africa with 17 (14%). The results proved to be quite similar in terms of the distribution of the authors and countries and/or regions included in the present study's sample.

2. What have been the main research designs used to study PPP in the water sector?

The publications in question are not concentrated in specific journals. The results showed that the publications were distributed by 74 journals. Regarding the research design used, the findings included an absence of any clear tendency regarding which methodologies were chosen: 54 qualitative studies (44%), 42 quantitative studies (34%) and 26 mixed methods (21%).

3. What insights (i.e. themes) does literature offer regarding PPP in the water sector?

The five themes identified during the semantic analysis that were not included in the initial keywords search were risk management, PPP contractual arrangements, financing and tariffs, infrastructure and governance.

The risk management theme came first with 37 studies (30%). This theme had already been identified in previous studies related to PPP (e.g. Cui et al., 2018; Ke et al., 2009), and it included subtopics such as risk assessment, identification and factors, as well as the way to choose the best model to ensure adequate analyses, evaluations and risk treatment measures (Ameyaw & Chan, 2015a; Cui et al., 2018; ISO, 2018a).

The second most prominent theme was PPP contractual arrangements in which poor design and a frequent presence of multiple possibilities can lead to future problems between PPP partners and to the need to renegotiate the terms that regulate partnerships.

The financing and tariffs theme ranked third with 22 studies (18%). This included the need to improve contracts to attract the necessary investment to develop infrastructure, including finding a balance between financial and economical sustainability, which will ensure that payments are made (i.e. user fees and public partners' payments or both). This approach respects the water sector's social and economic characteristics.

The next identified theme, infrastructure, was found in 16 studies (13%). As previous mentioned, the sector typically shows a need for extensive investments in the construction, rehabilitation and maintenance of infrastructure since poor project design and a lack of suitability and institutional support can compromise partnerships' success.

The absence of – and an inadequate – governance structure regarding public partners was the last theme identified through narrative analyses, which was present in seven studies (6%). Researchers have observed that government policymakers' interference in PPP water contracts can lead to a mismatch between the initial purpose of the projects and their final design (Beisheim & Campe, 2012; Cui et al., 2018).

4. What needs to be addressed by future studies?

The research results supported that risk management emerged as the most relevant topic to be addressed. Various paths that address the theme risk management were identified, but the review conducted for the present study did not find a consensus about which risk matrix can be used in PPP contracts, especially in the water sector. Marques (2016) showed that an unbalanced risk matrix can result in the allocation of most of the risks to the public sector. This topic needs to be investigated to provide a solid guidance for the public entities regarding risk management issues, improving the PPP contract

design and risk allocation. Unbalanced risk allocation between the public and private emerges as a crucial issue to ensure the partnership's stability (Wibowo & Mohamed, 2010). Marques (2018) showed that these weaknesses can be used as an argument in legal disputes when there is renegotiation of the contract terms. Ameyaw and Chan (2015b) successfully used the fuzzy methodology to support the adequate level of risk allocation to decision-makers; however, they recognised that the method presented limitations. It could be interesting to develop further research on the establishment of a computerised system with focus on the results of the fuzzy methodology.

The authors identified room for improving the PPP contractual arrangement models and that they must be revised in order to meet the expectations of both private and public partners.

An unbalanced PPP project's finance reflects the partnership's capacity to attract investment to provide the necessary water infrastructure. This is a hot topic to consider for further research.

PPP institutional support and governance structure have emerged as hot topics that can be further addressed by future studies. For example, the establishment of PPP Units could be presented as a positive step, with the purpose of designing, supporting the implementation, internalising knowledge and spreading better practices (Casady & Geddes, 2016; Neto et al., 2020). As there is space to improve, future research should have a closer look at their composition, role and internal organisation.

The second and third thesis objectives

Risk management is a hot topic among scholars (Ameyaw & Chan, 2015c, 2016). The reduced number of studies that address risk assessment and risk treatment or mitigations measures together, combined with the water sector's characteristics, demonstrated the valuable contribution and originality of this thesis. The researcher proposed the assessment of the risk management framework, based on expert's opinions. The outputs should support the answers to the second thesis' research questions, that are related to the theme: risk management perception the governments, sector regulators and utilities managers in PPP contracts in developing countries' (see Chapters 1.1.2, 4 and 6). Chapter 5 assessed a PPP water contract's content using a case study methodology. The outputs provided answers to the third thesis' research questions that are related to the theme: risk approach in PPP water contracts in developing countries' (see Chapters 1.1.2, 5 and 6).

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

The research design and methodology are structured as follows. First, an overview of the research design of the three thesis' objectives is presented. The next sections show the research design, the data collection and the analysis used in the three thesis' objectives.

Table 3-1 resumes the research design used to access the research propose (see Chapter 1):

Table 3-1: Thesis research design and methodology

	First objective	Second objective	Third objective
Research objective	Review of PPP studies in the water sector	Governments, sector regulators and utilities managers risk management perception in PPP contracts in developing countries	Risk approach in PPP water contracts
Main Research Objective	To identify the main insights offered by current literature regarding the PPP water sector	Identify critical risk factors	PPP water contracts are designed to address the critical risk factors issues
Research Context	PPP trends in academic papers	International experts opinion regarding the risk management and key risk indicators	PPP contracts in the water sector developing countries- Mozambique
Research Design	Narrative, systematic and semantic network analyses (i.e. Leximancer and Word Cloud)	Semi-structured interview using quantitative and qualitative analysis. Gioia methodology (i.e. SPSS, Word Cloud and MAXQDA)	Case study, desk research, in-depth interviews, mixed methods of content analysis (i.e. MAXQDA)

3.1 Thesis' first objective

The thesis' first objective, the review of PPP studies in the water sector, followed the research design and data collection analyses, according to the description made in Chapters 3.1.1, 3.1.2 and 3.1.3.

3.1.1 Research design

The research methods used in this thesis' objective were a hybrid methodology design that included systematic quantitative review methods (see Chapter 2.4), semantic network (see Chapter 2.5) and narrative analyses (see Chapter 2.6) (Jin & Wang, 2014). The systematic quantitative review determined the studies' geographical distribution by regions; time of publication; number of publications by journal, authors and institutions; sample documents' frequency based on geographical distribution by region; and studies' methodologies. Since Power BI software tools have been successfully used in previous studies (Krishnan et al., 2017), they were used to facilitate the data analysis of the sample documents based on geographical distribution by region.

The present research used the Word Cloud tool to generate a word cloud based on keywords frequency (Cui et al., 2018). The semantic network analysis was first conducted with Leximancer, and then the Word Cloud programme explored the connections among the topics that corroborated the narrative analysis' results (Jin & Wang, 2014). Leximancer extracted qualitative data from the semantic network detected using keywords from 122 selected studies. This software produced a co-occurrence matrix based on the keyword's frequency, thereby serving as a conceptual and relational analysis tool. Leximancer established the frequency of words and subsequently identified the connections between the words and major topics (Lupu et al., 2018). Triangulation was achieved by combining visual observations, identifying themes and connecting concepts, providing support for the narrative analysis discussed in section three.

3.1.2 Data collection

The first step was to review relevant studies (articles) related to PPP arrangements in the water sector published in English and listed in Scopus. The selected keywords were searched both in abstract and keywords. The literature review covered the last 25 years

of research. The second step was to analyse and store the resulting database of the identified articles in Excel. Finally, the following columns were filled in for each article: title, keywords, abstract, authors, author affiliation, research context (i.e. country or region), type of paper (i.e. empirical, conceptual or case study), type of PPP contract and research methods (i.e. qualitative, quantitative and mixed).

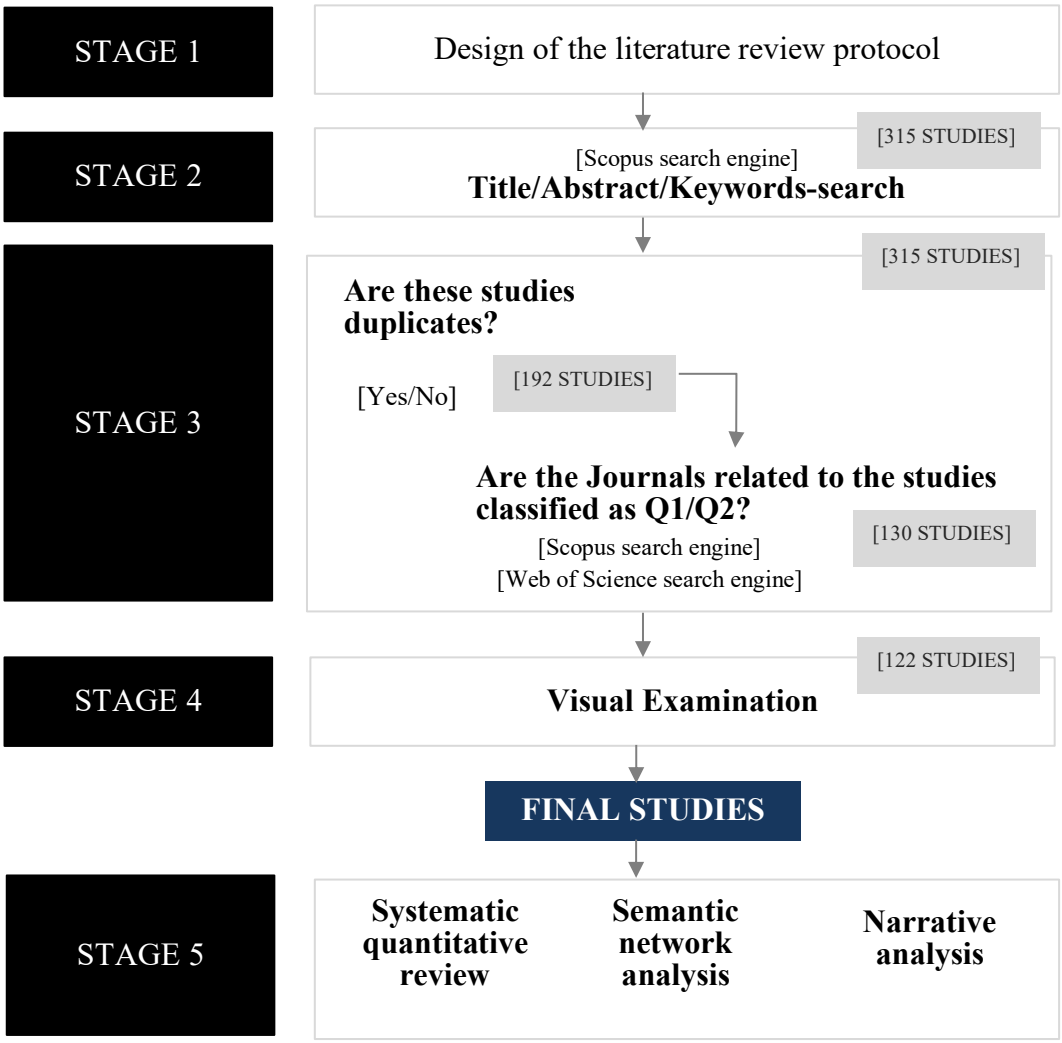


Figure 3-1: Research framework based on titles, abstract and keywords

To identify the relevant studies regarding PPP projects in the water sector, Yu et al.'s (2018) approach was applied to plan, design and execute the search (see Figure 3-1). Stage one included planning and designing the literature review protocol. Scopus was selected as the main search engine even though the Web provides other options (e.g. Google Scholar, Web of Science, PsycARTICLES, PsycINFO, SAGE Premier, PubMed and B-on). Scopus has been successfully used in similar studies (e.g. Bao et al., 2018; Cui et al., 2018; Osei-Kyei & Chan, 2015; Yi & Chan, 2014), and this database provides a

more effective access to the literature on management, business and accounting (Tober, 2011).

The second stage identified the keywords related to the topic under study. The words selected were categorised into nine different groups, taking into account that the water sector is part of the utility sector and includes other related activities, such as wastewater (ADB, 2009; Marin, 2009). As time restrictions were not applied, all the studies published until the end of 2018 were considered. The search strategy is shown in Table 3-2. The initial search retrieved a total of 315 studies (see the full search codes in Appendix F).

Table 3-2: Search strategy

Searches	Keywords			Results
1	PPP	Contracts	Wastewater	10
2	PPP	Utilities	Wastewater	4
3	PPP	Infrastructure	Wastewater	17
4	PPP	Contracts	Sanitation	16
5	PPP	Utilities	Sanitation	9
6	PPP	Infrastructure	Sanitation	24
7	PPP	Contracts	Water	64
8	PPP	Utilities	Water	61
9	PPP	Infrastructure	Water	110
Total				**315**

After identifying and keeping the unique results, the total number of studies was reduced to 192. The target journals were selected based on the following criteria: journals and books listed in the SCImago Journal Rank Indicator (SJR), and Web of Science database for 2017. The journals were ranked by the average number of citations received by documents published over the previous three years. Based on this criterion, the number of studies that fulfilled the prerequisites decreased to 130. The next step was a visual examination to assess the publications' scientific value and relevance to research of PPP in the water sector. A total of eight studies were excluded from the sample, resulting in a final corpus of 122 studies from 74 journals.

3.1.3 Data analysis

The data analysis had a hybrid design comprising (i) a systematic quantitative review, (ii) narrative, and (iii) semantic network analys3s. The systematic quantitative review was focused on the geographical spread of the articles by author, year, type of PPP, research method and the most frequent keywords. The results provided a reproducible and reliable assessment of the state of this field (see Chapter 2).

Leximancer was selected as it conducts unsupervised analyses of natural language texts provided in digital format (Tkaczynski et al., 2015). The content under analysis included keywords and abstracts. Leximancer facilitates the identification of important links among topics and shifts in researching hot topics over time. By using the Leximancer software, the semantic network analysis ascertains links among key topics.

The narrative discussion analysis identified the main topics, emerging themes and knowledge gaps (see Chapter 2.6).

3.2 Thesis' second objective

The thesis' second objective, perception of risk management by different stakeholders, such as governments, sector regulators and utilities managers in PPP contracts in developing countries, followed the research design and data collection analyses, according to the description made in Chapters 3.2.1, 3.2.2 and 3.2.3.

3.2.1 Research design

The research design was based on a semi-structured interview protocol and its results. The research method used in this thesis' objective was a hybrid methodology: qualitative methods (e.g. content analysis, narrative and Gioia methodology), semantic analysis for the identification of the risk categories, and quantitative methods (e.g. descriptive statistics).

The outputs and contributions of the thesis are the result of a semi-structured protocol, which was planned, constructed and performed to answer the thesis' second objective. The semi-structured interview protocol was designed and has already been successfully used in previous studies (Amankwaa & Blay, 2018; Senot et al., 2016). A more detailed

explanation regarding the construction of the semi-structured interview protocol can be found further below in this section.

The construction of the semi-structured interview template was based on the studies development and connection of key topics (semantic analysis), and it was followed by a content and narrative analysis to support the identification of the risk categories.

The risk assessment, treatment or mitigation measures' findings and thesis' contributions that constitute the first and second semi-structured interview components, were supported by the qualitative analysis in order to identify and classify the risk factors. The chi-square ($\chi 2$) test, the Kolmogorov-Smirnov test, the Wilcoxon test, the Kruskal-Wallis test and the Mann-Whiney U test were applied to the quantitative data treatment, which allowed the identification of possible relations between the interviewees' profiles and their responses (e.g. their professional category and sector). The results were supported by the quantitative data analysis using the SPSS software. The SPSS software for quantitative data treatment is broadly used by researchers and it has already been successfully used in previous studies (Javed et al., 2019; Sim et al., 2020).

The last semi-structured interview component is related to the possibility of introducing and improving the current risk management framework. The interviewees were invited to provide their opinion on how the key risk indicators concept can improve the current risk management contracts' framework.

To identify patterns and to propose results, a qualitative approach was used. The transcribed interviews were analysed using a thematic content analysis. The coded outputs were based on the Gioia methodology, using a systematic inductive approach (Gioia et al., 2013). This methodology has already been successfully used in previous studies (Lombardi et al., 2020; Meister et al., 2017). The research outputs were supported by the qualitative data analysis software MAXQDA, which has been previously used in similar research methodologies (Al-beity et al., 2020; Quinn et al., 2019).

The construction of the interview protocol

The results and evidence found in the literature review (see Chapter 2.6.1) demonstrated that risk management is a hot topic (Cui et al., 2018).

The semi-structured interview protocol was designed according to the following steps: i) the complete understanding of the problems/questions; ii) the creation of a set of adequate questions to the research questions; iii) the decision of the best environment to conduct the interviews; iv) getting in touch with the prospective subjects and providing

guidelines; v) the conduction of the interviews, its transcription, analysis of the results and reporting (Bogner et al., 2009; Given, 2008; Malhotra & Birks, 2007).

The interview protocol has three major sections. The objective of the interview protocol was to access and test the risk management framework (see Chapter 2.6.1). The interview guide can be found in Appendix G.

The first group is exclusively composed by closed questions (structured interview) where the interviewee was invited to classify the risk categories in PPP contracts by using the Likert Scale: a pre-determined scale of 1 to 5 (where 1 Less Important and 5 Very Important). The use of the Likert Scale in a structured interview is highly widespread between researchers to rank interviewees' opinions (Given, 2008). This technique has already been successfully used in previous studies (Do et al., 2020; Son & Trai, 2020).

The second group comprises semi-open questions. The interviewee identified potential risk factors, treatment and mitigations measures based on the same risk categories criteria (see the first interview group).

The last group is an open question, where the interviewee was asked to provide an opinion regarding the possibility of using key risk indicators in PPP contracts.

The creation of a set of adequate questions to the research questions was the first step. Based on the risk management framework (see Figure 2-5 in Chapter 2.6.1), the identification of the most relevant risk categories was identified. The following conclusions were the results of scholar's contributions (see Chapter 2.6.1) and of the semantic analysis (see Figure 3-2 and Table 3-3) using the Word Cloud programme.

Figure 3-2: Results from Word Cloud (37 studies)

Table 3-3 shows the most significant word frequencies connected to the nature of risk assessment issues and treatment or mitigation in the 37 previously identified studies.

The semantic analysis results allowed to observe words such as financial, water, politics, risk, public, management, operational, projects and construction (see Figure 3-2).

To strengthen the conclusions, and using the Word Cloud programme, data outputs, synonyms, antonyms and similar words were aggregated in the 'words' column. This was performed based on visual observation.

From a total of 158,801 words, the five identified risk categories (30,559) represent 19.24% (see Table 3-3).

Table 3-3: Risk category identification (37 studies)

Risk category	Words	Results
Financial	Financial	14,054
	Investment	854
	Economic	587
	Cost	441
	Tariff	336
	Exchange rates	153
	Inflation	134
	Payments	93
	Tax	87
	Loans	65
Sub total		**16,804**
Context	Politics	2,382
	Government	1,231
	Regulation (sector)	436
	Legal	244
	Regional	140
	Corruption	115
	Socioeconomic	122
	Education	15
Sub total		**4,685**
Technical	Operational	1,909

Risk category	Words	Results
and	Technical	1,647
operational	Performance	426
	Structure	232
	Technology	182
Sub total		**4,396**
	Commercial	1 172
	Contracts	862
Commercial	Market	377
	Population	196
	Customers	106
Sub total		**2,713**
	Infrastructure	1,083
Infrastructure	Construction	586
	Design	292
Sub total		**1,961**
Total (subcategories)		**30,559**
Total (Word Cloud)		**158,801**[a]

Note: [a]The counted words are the result of the 37 identified studies focused on risk management in the water sector (see Chapter 2).

Financial risks ranked first with 54.99%, followed by context (15.33%), technical and operational (14.39%), commercial (8.88%) and infrastructure (6.42%). The results show a clear tendency that is supported by literature, which allowed the researcher to consider the previous risk categories for the semi-structured interview protocol.

The financial risk category ranked first. The 37 PPP studies identified 16,804 words (54.99%) from a total of 30,559 words. The results allowed the observation of words, such as financial (14,054 words), investment (854 words) and economic (587 words).

Financial and economic risks have always been a major problem, especially in water and wastewater projects (Chan & Cheung, 2011; Ke et al., 2011).

The contractual inefficiency and the absence of financial guaranteed investments in PPP projects can cause economic constrains on PPP projects (Nakhla, 2016). The authors suggested the possible positive impacts of adapting the regulator's powers to ensure the adoption of financial constraints on new PPP contracts. Ameyaw and Chan (2016) also confirmed that financial risks are an important topic. They performed a study regarding

an efficient risk-allocation decision to an experiential knowledge of expert practitioners. The results ranked foreign exchange rate, non-payment of bills, high operational costs and inflation rate volatility as critical risk factors.

The context risk category ranked second. The 37 PPP studies identified 4,685 words (15.33%) from a total of 30,559 words. The results allowed the observation of words, such as politics (2,382 words), government (1,231 words) and sector regulation (436 words).

The context in which PPP contracts operate are naturally an important issue. Public resistance risk to PPP projects as a result of political and institutional issues can lead to delays in the private participation in water services or to the abandonment of PPP water contracts (Ameyaw & Chan, 2015d). Climate changes, regional, socioeconomic and other demographic indicators are also strong risk sources when considering a PPP project.

In a study performed by Ameyaw and Chan (2016), political interference and inflation rate volatility ranked in the group of the five most critical factors in PPP contracts operating in developing countries. The government's reliability and intervention, regulatory risk (weak regulation), public credit or the ability to capture the adequate investment levels for PPP contracts were also some of the main concerns (Chan & Cheung, 2011).

The technical and operational risk category ranked third. The 37 PPP studies identified 4,396 words (14.39%) from a total of 30,559 words. The results allowed the observation of words, such as operational (1,909 words), technical (1,647 words) and performance (426 words). Operational inefficiency can jeopardize the contract's objectives. Operational costs ranked in the top five of the critical risk factors (Ameyaw & Chan, 2015d, 2016). Poor technical and operational contracts can have a significant impact on the contract's outcomes. Inadequate technology or the lack of innovation incentives during the contract life cycle, especially medium and long-term contracts, will have an impact on the current and future service levels due to a lack of adequate infrastructure.

The commercial risk category ranked fourth. The 37 PPP studies identified 2,713 words (8.88%) from a total of 30,559 words. The results allowed the observation of words, such as commercial (1,172 words), contracts (862 words) and market (377 words).

Scholars currently indicate market demand changes and the lack of flexibility in the contracts to adapt to new realities as major concerns in PPP water contracts (Ameyaw &

Chan, 2015d; Ke et al., 2011). In fact, the faulty demand forecasting, water theft, procurement risk, quasi-commercial risk combined with a poor contract design, contribute to rank the commercial risk category as a major concern when planning and designing PPP water contracts.

The infrastructure risk category ranked last. The 37 PPP studies identified 1,961 words (6.42%) from a total of 30,559 words. The results allowed the observation of words, such as infrastructure (1,083 words) and construction (586 words).

The infrastructures preservation and adequate solutions emerge as significant risk sources. Construction time and cost overrun are among the critical risks in PPP (Ameyaw & Chan, 2015d). The water sector has strong investments and sunk costs (see Chapter 2.3.2). The infrastructure is complex to design and construct. Poor construction design, an incorrect procurement model and lack of coordination of the construction firms model, contribute to the overrunning of construction time and costs (Ameyaw & Chan, 2015d).

Poor contract arrangements and lack of monitoring by the public partner contribute to the decrease or absence of adequate preventive and reactive maintenance that can have a direct impact on the preservation of the infrastructures during the contract life cycle.

3.2.2 Data collection

The results of the first thesis objective, the review of studies of PPP in the water sector (see Chapters 2 and 6), provided 122 studies (100%), where risk management ranked first with 37 studies (30%). The 37 studies were analysed taking into account five risk categories. These were considered for the first step of the research of the risk management framework, the risk identification. The identified risk categories were used as a guideline for the construction and design of the semi-structured interview protocol (Senot et al., 2016).

The first step was to choose the best method to select the interviewees. Therefore, the non-probability snowball or networking technique was selected (Malhotra & Birks, 2007). This sampling method was successfully used in 11 of the 37 selected studies. This type of sampling technique was chosen due to the nature and profile of the potential respondents. Table 3-4 identifies the sampling method selected on the 37 studies focused on risk management in the water sector (see Chapter 2). The self-selected sample ranked first with 20 studies (54%), followed by the snowballing sample in second with 11 studies

(29%), then the opportunity sampling with 4 studies (11%), and finally the random and the cluster sample with one study (each representing 3%).

Table 3-4: Sample technique in the studies focused on risk management

Sample technique	Studies	Percentage
Self-selected sample	20	54%
Snowballing sample	11	29%
Opportunity sampling	4	11%
Random sample	1	3%
Cluster sample	1	3%
Total	**37**[a]	**100%**

Note: [a] The 37 identified studies focused on risk management in the water sector are the result of the classification of 122 studies identified in the literature review in Chapter 2.

The results support the snowballing technique as a commonly used technique by scholars that has already been successfully used (Chan et al., 2007; Jalba et al., 2014; Li & Zou, 2011).

Table 3-5 shows the methodology distribution: qualitative, one (9%), quantitative, seven (64%) and mixed methods, three (27%). The results supported the snowballing or networking technique as a powerful and reliable sampling technique used in studies connected with risk management in the water sector (Ameyaw & Chan, 2016; Chan & Cheung, 2011; Xu et al., 2010).

Table 3-5: Methodologies adopted by studies that used the snowball technique

		Research Design				
Methodology	**Nº**	**Descriptive**	**Content Analysis**	**Longitudinal**	**Interview**	**Survey**
Qualitative	1	1	0	1	2	0
Quantitative	7	1	1	0	5	1
Mixed methods	3	0	1	1	4	2
Total[a]	**11**	**2**	**2**	**2**	**11**	**3**

Note: [a]As multiple research designs were-considered, the sum of all of them was higher than 11.

The construction of the sample for this study was incredibly challenging to successfully fulfil the second thesis' scope and objectives.

To identify and filter eligible participants for the study, the following two criteria were used:

1. Practitioners who had working experience with PPP contracts in developing countries.
2. Experts who had extensive working experience within the governments, sector regulators and utilities sectors in developing countries.

3.2.2.1 Field work

Five initial potential respondents were identified, allowing the researcher to schedule a journey to Mozambique to perform the semi-structured interviews and to collect any additional and relevant information, including the access to the critical governmental institutions that have direct or indirect responsibility in PPP utilities contracts, especially in the water sector. These contacts proved to be extremely relevant in obtaining additional data to support the researcher's work and successfully perform the second and third thesis' objectives.

In Mozambique, the researcher started by performing the semi-structured interviews with the five previously identified participants. This first phase acted as a pilot study. The first group of semi-structured interviews were critical in helping the researcher improving the method, including the adaptation to the cultural and social differences, the presentation of the study's objectives to the participants, the revision of the order of the questions, the selection of the best environment to perform the interview, and the record of the outputs.

This type of technique is very useful in capturing the research learning curve and improving the semi-structured interview protocol. The literature recommends the use of this technique, especially when the research outputs are a result of interviews or questionnaires (Malhotra & Birks, 2007). This technique has been successfully used by scholars (Ibrahim et al., 2006; Osei-Kyei et al., 2018; Pradhan et al., 2017).

The semi-structured interviews were personally performed by the researcher in Mozambique between the 24th September 2018 and the 10th October 2018.

The interviews started with the project's main goals. After, the researcher asked the interviewees to talk about their PPP contracts and/or industry experience. Then, the semi-

structured interview was performed, and the interviewees were asked to refer other potential participants.

The duration of the interviews was not always the same. The first participant lasted approximately three hours, while the last one lasted only one. The researcher did not record the interviews. Additionally, all the interviews were performed in Portuguese considering that both the researcher and the interviewees were all Portuguese native speakers.

The researcher manually noted down the answers and transcribed them at the end of the day to an Excel file. The content of the interviews of the designated sample was translated from Portuguese to English, coded, and the data was synthesised in an Excel file and analysed. The data analysis was performed using quantitative and qualitative methods.

The researcher had to travel in the country to perform the interviews. Approximately 90% of the interviews were performed in Maputo and two in the Inhambane province, 400 km from the country's capital.

The results exceeded the initial expectations. The interviews took place in very different environments and according to the participant's convenience. In general, the interviewees' feedback was very positive. They demonstrated interest in having access to the results of the study and in referring additional participants for the study. The researcher successfully performed 15 semi-structured interviews and gathered data from a broadly heterogonous sample. Similar studies with less participates have been successfully performed (Ameyaw & Chan, 2015c).

3.2.2.2 Participants profile

The final list of interviewees was based on their accessibility and willingness to integrate the study. The panel was composed by experts who successfully fulfilled the study's requisites: working experience in PPP contracts or extensive working experience within the governments, sectors regulators and utilities sectors in developing countries (see Table 3-6).

Table 3-6: Participants profile

Expert	Position	Type of sector	Sector
1	Technical expertise	Public	Others
2	Top management	Public	Utilities
3	Top management (sector regulator)	Public	Water
4	Advisor	Private	Water
5	Advisor	Public	Water
6	Technical expertise	Public	Others
7	Top management	Public	Utilities
8	Top management	Private	Utilities
9	Director	Public	Water
10	Director	Public	Utilities
11	Coordinator	Public	Water Water
12	Consultant	Private	Others
13	Minister	Public	Utilities
14	Technical expertise	Public	Water
15	Coordinator	Public	Others

Top management (three), directors (two), coordinators (two), technical expertise (three), advisor (two), top management (sector regulator) (one), consultant (one) and one minister integrated the participants list. There was an effort to ensure the minimum representation of the private sector. There were 12 (80%) participants from the public sector, mainly from the industry and the water sector, and three (20%) representing the private sector, mainly from consulting firms and private water developers.

The participants held senior-level positions. This vast experience, background and relevant organisations of the experts guaranteed the reliability of the experts' opinions in this study (Ameyaw & Chan, 2015a).

Some of the participants had experience in more than one sector. There were participants with experience in the utilities, railroad, road, port and oil, and gas sectors. The participants' profiles included private partners, government, sector regulator and utilities managers with PPP contracts experience in developing countries.

3.2.3 Data analysis

The data collected helped rank the importance of the risk in PPP contracts, which was then correlated with the water sector. Qualitative and quantitative methods were applied. The researcher used the MAXQDA software and SPSS software to support the results.

For the risk assessment phase, the researcher created a coding system (qualitative method) to identify patterns in the frequency of interviewees' answers and to aggregate them into risk factors, based on the literature contributions (see Chapter 2.7). The critical risk factors were extracted from the risk factors observations, based on higher frequency results (i.e. top five). The researcher performed a narrative approach to the five critical risk factors.

There were 332 risk factors and possible treatment and mitigation measures identified (n=332), 184 in the risk assessment and 148 in the risk treatment or mitigation measures phases. Then, the SPSS software was used for the risk factors and their possible relations between the two stages using the $\chi 2$ test. This statistic test has been successfully used in previous studies (Kuźmiński et al., 2020; Xia et al., 2012).

To assess possible relations between the participants and their approach to risk, the researcher started by performing a normality test. The Kolmogorov-Smirnov test was applied to two ordinary fields in the sample: interviewees' profession and risk category rank (see Table 3-7).

Table 3-7: Kolmogorov-Smirnov

Fields	Statistics results	df[a]	p-value[b]
Participants professional rank	0.130	332	0.000
Risk category rank	0.199	332	0.000

Note: [a]df – Degrees of freedom
[b] $p>0.05$ – Parametric tests

The results showed that in both cases, $p <0.05$, the sample did not comply with the requirements to be considered a normal distribution. Therefore, non-parametric tests were used.

The researcher classified the participants according to the sector (water, utilities and others), whether they represented the public or private sides, their functions and their professional category rank using a Likert Scale. The selected tests were the Wilcoxon, the Kruskal-Wallis and the Mann-Whitney U tests considering that they did not have the assumption of normality of datasets (see Figure 3-3).

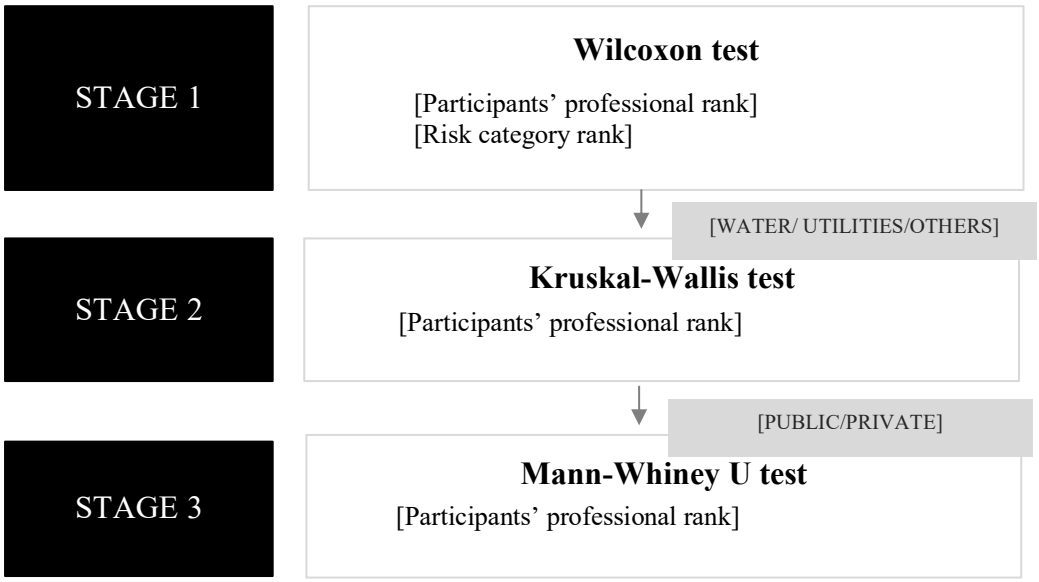


Figure 3-3: Non-parametric tests

The Wilcoxon test is a non-parametric test that has been successfully used in previous studies (Bagarić & Žitinić, 2013; Wibowo & Mohamed, 2010). It allows to support an opinion regarding the differences observed between ordinary ranking groups (i.e. interviewees' professional rank and risk categories).

The non-parametric Kruskal-Wallis test allows observing if there are significant differences between an ordinary ranking group (i.e. interviewees' professional rank) and a nominal group with three or more categories (i.e. sector-water, utilities and others). The Kruskal-Wallis test has been successfully used in previous studies (Babatunde et al., 2019; Osei-Kyei et al., 2017).

The non-parametric Mann-Whitney U test allows observing if there are significant differences between an ordinary ranking group (i.e. interviewees' professional rank) and a nominal group with two categories (i.e. sector type–public or private, and risk assessment phase – risk factors and risk treatment or mitigation measures phase–risk factors). The Mann-Whitney U test has been successfully used in previous studies (Osei-Kyei & Chan, 2017; Pu et al., 2020).

The last contribution for this thesis' objective was to assess to what extent the concept of key risk indicators could be used to improve the risk management framework. For that, the data collected was codified following the Gioia methodology (Gioia et al., 2013). The qualitative data analysis software MAXQDA was adopted to perform the coding process of first and second order, including the graphic presentation featured in the data analysis

sub section that supports the link between the codes and represents the relation between them. The results should provide material to answer the research questions.

3.3 Thesis' third objective

The third objective, risk approach in PPP water contracts, followed the research design and data collection analysis, according to the description made in Chapters 3.3.1, 3.3.2 and 3.3.3.

3.3.1 Research design

The research method used in this thesis' objective was the case study approach (see Figure 3-4). This research method has been successfully selected for previous studies to address research questions (Senot et al., 2016; Shrestha et al., 2017).

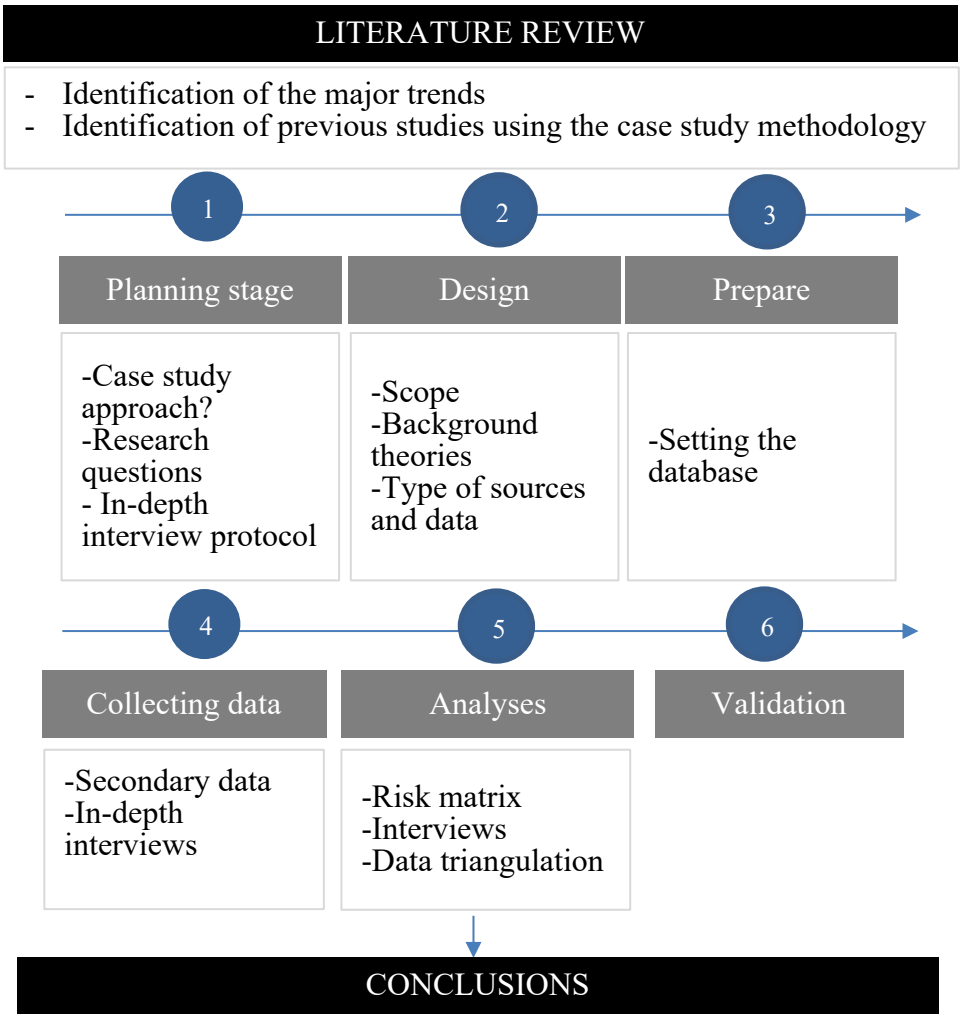


Figure 3-4: Case study methodology

According to Yin (2014), this type of research design is suitable to answer questions of the 'how' or 'why' type. A qualitative approach was equally selected (Abednego & Ogunlana, 2006; Cruz & Marques, 2012).

Figure 3-4 resumes the case study methodology followed by the researcher to produce the thesis' third objective outputs. Additional information is provided in Chapter 5.1).

The outputs and thesis contributions were the result of secondary data contributions (narrative analysis), a template content analysis (risk matrix) performed to the PPP water contract, and in-depth interviews (see Chapter 5).

The narrative analysis was used to perform the Mozambican context, including the PPP experience and the evolution of the water sector's policy.

The findings and research outputs were based on a template content analysis (risk matrix) performed to the PPP water contract, using the risk categories and risk factors identified (see Chapter 2.7), and two in-depth interviews were performed using a triangulation technique (Jonsen & Jehn, 2009).

The in-depth interview protocol was designed, planned and performed to address the thesis' third objective, following the similar method applied to the semi-structured interview protocol explained in the previous section. More details regarding the protocol construction are provided further in this section. The interviewees were invited to provide their opinion regarding the PPP water contract management design, execution and improvement opportunities, including the monitoring of internal and external mechanisms. A deductive and inductive qualitative approach was used. The interviews were transcribed from Portuguese to English and analysed using qualitative analysis (template analysis). The research outputs were supported by the qualitative data analysis software MAXQDA.

Planning stage

The planning phase was the first step. The researcher identified the research questions or the motivations to select the case study technique. The research question that led to the selection of the case study technique fulfilled the requirement.

Concerning the researcher's motivations, there was a focus on expanding and increasing the understanding of the current knowledge related to the PPP water contracts, and how they address risk management issues.

The literature contributions sustained the selection of the case study's research design (see Chapter 5.1).

The design and construction of the interview protocol are connected to the research purpose. In this particular case, the main purpose was to assess how the PPP water contracts in developing countries cope with risk management framework issues. The triangulation technique was applied to support results and conclusions (Jonsen & Jehn, 2009). The in-depth interview research method was used to learn and capture individual perspectives of one or a few narrowly defined themes (Brounéus, 2011). The researcher selected the in-depth interview research method to allow the interviewees to provide their opinion on the contract without the biased, previous knowledge of the researcher's evaluation criteria. The in-depth interview has been successfully used in previous studies (Bylund et al., 2020; Yousaf & Fan, 2020).

Complementary secondary data was used, including individual informal information to support the Mozambican context, PPP experience and background, and information related to the evolution of the water sector over the last decades. This information was used to suppress the shortage of available information and to triangulate the research results (Jonsen & Jehn, 2009).

The interview codes analysis method is a combination of a priori and a posteriori categories. It combines a top-down and a bottom-up approach. The process is similar to the thematic analysis, it is flexible and a recursive process.

Design

The research site, the PPP water contract area, was the metropolitan area of Mozambique's capital, Maputo, and four other cities.

The theories that support the case study approach are: i) the strategic alliances' theory, that characterizes agreements between partners beyond current company-to-company trades, excluding the possibility to integrate themselves (horizontally or vertically) (Elmuti & Kathawala, 2001), ii) the contracts' theory as a need to mediate the terms between partners (Hart & Holmstrom, 1986) and iii) the incomplete contracts' theory supported by the need to internalise and reduce contracts' issues, such as asymmetric information between partners, which is an essential component to reduce the risk of poor delivery of the contract service or infrastructure (Hart, 2017).

The case study design was based on the evaluation of a PPP water contract. The methodology approach was a qualitative analysis based on the template content analysis which, in turn, was based on the contract's contents (risk matrix) and the inputs of two in-depth interviews.

To ensure quality procedures during the research, an interview protocol for the in-depth interviews was developed and applied. The interviews were recorded, and the interviewees were asked for previous consent. The researcher performed the data treatment, ensuring that there was no conflict of interests, and that the analysis and research results were impartial. The PPP water contract's contents were introduced into an Excel sheet (template) and examined.

Prepare

Having already demonstrated experience conducting interviews as a result of working as an internal auditor over the last ten years, the researcher also previous performed 15 semi-structured face-to-face interviews (see Chapter 4).

There was a design protocol for the collection and the treatment of data. The names of the interviewees were omitted.

Collecting data

The research followed the protocol design by using the in-depth interviews and the template content analysis method to provide findings and research outcomes (see Chapters 5.5 and 5.6). Quality procedures were followed. The researcher was able to track data sources to support the findings and the conclusions presented. Regarding the secondary data, the researcher validated the reliability of the information gathered. The research's findings were supported by alternative information sources such as reports.

Analysis – validation - conclusions

For the thesis' third objective, the structure of the qualitative research presented started with the presentation of the case study's research design, Mozambique's context, PPP experience, and the water sector background. It was then followed by the findings sections and by the research's contributions to the thesis' objective.

The results of the performed interviews contributed to the research outputs with the purpose of complementing and supporting the template analysis performed in PPP water contracts (risk matrix results).

3.3.2 Data collection

The thesis' third objective was focused on how PPP water contracts deal with risk management issues using a case study approach (see Chapter 5.1). The first step was to

identify a sample of water contracts that should represent different backgrounds (different types of contracts, regions, duration and procurement).

The World Bank Public-Private Infrastructure Advisory Facility (PPIAF) Database's (PPI, ppi.worldbank. org) datasets include data regarding the current PPP in the water sector (excluding developed countries' data). It identified Brazil and Mozambique as countries with PPP experience. Considering the reduced number of studies on the field in top journals, Mozambique was considered to be a more suitable candidate to perform study, which also increased the potential contribution of this thesis. Therefore, Mozambique was selected for sampling. The selection was based on the fulfilment of the research's requisites: developing country context and researcher's information access. public agencies, such as local and central governments, public regulators and multilateral agencies were identified and contacted.

The second step was to determinate the best approach. The research has a hybrid design comprising (i) a qualitative narrative and content analysis (i.e. characterised region, PPP background and water sector, risk matrix, grouping data into categories and (ii) quantitative content analysis (statistical analysis to generate numerical values of the categorised data, e.g. frequencies).

The data collection for the narrative analysis is generally based on secondary data. Official mozambican websites were consulted, like the National Institute of Statistics, including databases of multilateral agencies.

The data collected (PPP water contract) was put into an Excel spreadsheet that included the following columns: risk assessment stages (e.g. risk category, risk factors, likelihood, impact and owner) and risk treatment or mitigation measures (e.g. classification of the measure as 'risk treatment or mitigation measure' or 'acceptance').

The selection of the interviewees was based on a non-probability sampling method. It was a self-selected method (Meltzoff & Cooper, 2017). The researcher selected the interviewees based on their profile, and on the possibility to provide useful information to the research outputs.

Similar to the snowball ball technique which identifies potential respondents, the researcher used her personal networking relations to contact them (self-selected) (Meltzoff & Cooper, 2017). The selection criteria were based on the interviewees' management experience in the PPP water contract that was considered into analysis, preferably in the same time frame. Two possible respondents were identified, and the

researcher personally addressed the invitations, performed the interviews (on-line) and requested their consent to record the interviews.

The interviews lasted approximately one hour each and were performed on 27th May and on 6th June 2020.

3.3.3 Data anaysis

The data analysis of the thesis' third objective is separated into three major areas. The first, the narrative analysis, stemmed from secondary data and informal information collected by the researcher.

In the second, a contract analysis was performed by recurring to a template content analysis approach. A risk matrix (Babatunde et al., 2019) was prepared and applied to the PPP water contract. The risk categories and risk factors that were previously identified in Chapter 2.7 served as a guide to create the risk matrix. The objective was to observe how the contract addressed risk management issues.

Finally, the results of the interviews were presented. As a research method for the interviews' analyses, the researcher selected the template analysis (King, 2012). This technique has been used in previous studies (Brooks & King, 2014; Poppleton et al., 2008). The template analysis can be considered a form of thematic analysis. It allows adapting data to the needs of a particular study (King, 2012). Researchers should start by familiarizing themselves with the data and defining codes and themes. Then they should create a template with a sub-set of the data and apply it to further data. The results should allow the update of the template by adjusting the codes and then complete the template.

The qualitative data analysis software MAXQDA was used to apply the researcher's code system and themes, firstly to the pre-defined categories and, on a second and final stage, to add new code systems and themes.

In the first phase, the researcher considered two major themes for analysis and built a hierarchal code system. The code system was based on the literature contributions and risk matrix results. The identified themes were: i) risk categories (includes the five risk categories identified by the literature) and ii) risks (defined in Chapter 5.5). In a second phase and during the data analysis, the researcher added one risk and theme to the hierarchal code system.

CHAPTER 4: RISK MANAGEMENT PERCEPTION IN PPP CONTRACTS – THESIS' SECOND OBJECTIVE

This chapter addresses the second thesis' objective by testing the risk management framework. The research design and methods used are explained in detail in Chapter 3.2. The results presented are based on semi-structured interviews performed to PPP experts in developing countries and presented in six major sections.

The first section introduces the research risk management framework and how it was applied to the semi-structured interviews protocol, based on the second thesis' objectives.

The second and third sections are focused on the risk assessment and treatment or mitigation measures' results. Risk categories and risk factors were recognised and ranked. Then, critical risk factors were identified and analysed, considering the risk treatment or mitigation measures provided by the participants.

The fourth section is focused on how the participants' profile and type of sector can influence their risk factors suggestions and compares the risk factors identified in the risk assessment and the treatment or mitigation measures.

The fifth section focused on how key risk indicators can improve the current risk management framework. It highlights the consistencies and improvement opportunities in PPP contracts as control and monitoring measures.

The last section presents the risk management framework's results and contributions to the thesis' objectives. The results should provide and support answers to the research questions. The research outputs were used and compared with the next chapter's results.

Research purpose

The second objective of this thesis was the 'risk management perception by different stakeholders such as governments, sector regulators and utilities managers in PPP contracts in developing countries' (see Chapters 1.1.2 and 3.2).

To address the research questions, a semi-structured interview protocol was performed to 15 experts, including method and design. The research questions were (see Table 4-1):

Table 4-1: Thesis second objective – research questions

Thesis second objective research questions	Chapter reference
1. What are the most relevant risk categories in PPP contracts, based on experts' opinions?	4.2
2. What are the critical risk factors within each risk category?	4.2
3. How to mitigate the critical risk factors?	4.3
4. How can the key risk indicators concept improve the current risk management framework of the contracts?	4.5

The results presented in the second chapter (see Chapter 2.6.1) supported the risk management theme as a hot topic. From the 122 identified studies connected to PPP in the water sector, risk management ranked first with 37 studies.

The analysis of the studies content performed in Chapter 2.6.1 showed the different approaches to classify risks, definitions and concepts.

Table 2-5 in Chapter 2.6.1 summarises the risk management studies regarding PPP water contracts from a sample of 37 studies. Thirteen studies identified the relevance of the risk process approach in PPP in the water sector.

The risk management framework can be broken into two critical phases: risk assessment, and risk treatment or mitigation measures.

Scholars successively supported their results regarding the risk identification, including risk factors and critical risk factors, mainly based on experts' opinions (Ameyaw & Chan, 2016; Wibowo & Mohamed, 2010).

When observing Table 2-5 (see Chapter 2.6.1), most of the studies are focused on risk identification and partially on its analysis (e.g. Ameyaw & Chan, 2015a; Chan & Cheung, 2011).

Studies fail to complete the risk assessment phase regarding the risk evaluation that leads to the identification of the critical risk factors, thus enabling the second stage: risk treatment or mitigation measures.

The researcher observed that scholars failed to provide solutions regarding risk treatment or mitigations measures. From the 13 identified studies, 70% did not address the risk treatment or mitigation measures' issues as part of the study.

The risk management framework leads to the introduction of tools to support critical risk factors and future threats (Moeller, 2007). In this context, the researcher proposed the adaptation of the key risk indicators concept as a PPP contract's monitoring and control tool.

It was expected that the produced outputs provided answers for the research questions.

4.1 Research risk management framework approach

The researcher adopted the risk management framework approach to the type of available data. The risk analysis and evaluation step in the risk assessment phase was based on the expert's opinion and how they ranked the risk categories (see Figure 4-1).

The semi-structured interview was performed and designed to address the research questions (see Chapter 3.2). A semi-structured interview is a combination of several types of questions to be performed to the interviewees, according to the interview's objectives. The researcher used three types of questions: i) closed questions (see Chapter 4.2.3.1), ii) direct questions (see Chapters 4.2 and 4.3 and 4.4) and iii) an open question (see Chapter 4.5). The first type is usually called a structured interview, the second a semi-structured and the third and last an in-depth interview. The construction of the semi-structured interview protocol is detailed in Chapter 3.2.

The identified risk categories were the result of the literature contributions performed in Chapter 2.6.1 and the semantic analysis performed by the researcher using the Word Cloud programme (see Chapter 3.2). The results allowed the identification of financial, context, technical and operational, commercial and infrastructure risks. The previous results completed the first phase of the risk management framework research (see Figure 4-1).

The second step was to introduce a group of semi-open questions on the semi-structured interview guide. The interviewee was invited to suggest potential risk factors based on each risk category.

Figure 4-1*:* Research risk management framework approach

The expected research outputs should allow to successfully complete the first stage of the risk management framework research.

To identify potential risk treatment or mitigation measures, a group of semi-open questions was introduced on the semi-structured interview guide. The interviewee was invited to suggest potential risk treatment or mitigation measures based on each risk category.

Finally, to fulfil the objective of contributing to improve the previously identified treatment or mitigation measures, an open question was introduced in the semi-structured interview guide. The interviewee was invited to provide an opinion regarding the introduction of key risk indicators during the contract life cycle and whether or not it could be a useful tool to improve the PPP contracts.

4.2 Risk assessment

The interviewees' outputs for the risk assessment phase were the combination of the structured interview of the risk categories rank and the semi-structured interview. The 15 interviews performed were considered valid for sampling.

The results allowed to answer three of the four research questions of the thesis' second objective, namely:

1. What are the most relevant risk categories in PPP contracts, based on experts' opinions?
2. What are the critical risk factors within each risk category?
3. How to mitigate the critical risk factors?

The risk categories are identified in Chapter 4.2.1. Risk factors are also identified (Chapter 4.2.2) based on the interviews' results and on the list of risk factors provided in Chapter 2.7. The answers provided on the assessment phase can be found in Appendix H.

Chapter 4.2.3 shows the results of the risk categories rank and identifies the critical risk factors.

The researcher classified the interviewees' answers when performing content analysis by grouping them into risk factors (frequency). Results showed an initial number of 25 risk factors distributed by five risk categories. The results provided 184 frequencies that were considered for sampling and results.

4.2.1 Risk categories identification

The researcher's selection of the risk categories was based on the results coming from the integration and analysis of the 37 studies identified in Chapters 2.6.1 and 3.2. The Word Cloud programme was used to assess the number of words and their association. These results were supported by the literature contributions (see Chapter 2.7).

The results identified and ranked five risk categories: i) financial risks, ii) context risks, iii) technical and operational risks, iv) commercial risks, and v) infrastructure risks.

The outputs provided support to consider the identified risk categories into the semi-structured interview protocol.

The methodology applied that supports the previous results is explained in detail in the methodology Chapter 3.2.

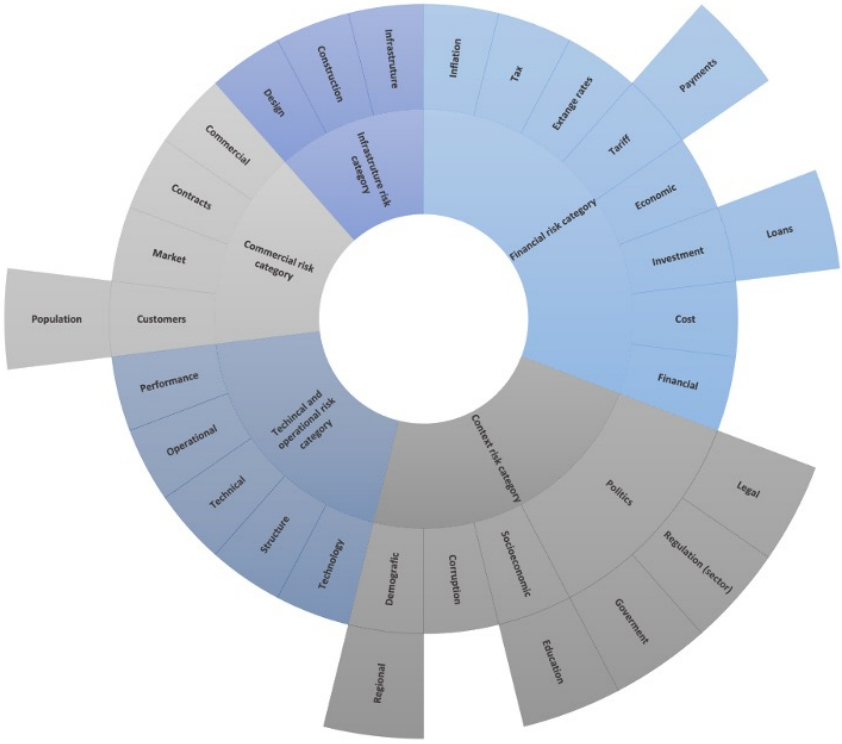


Figure 4-2: Risk categories association

Figure 4-2 shows the final outputs, including the word associations within each risk category. The identified words inside each risk category supported the identification of the risk factors.

In the first risk category, financial risks, it was possible to identify words, such as ‘financial’, ‘investment’, ‘economic’, ‘cost’ and ‘tariff’. Words such as ‘investment’ connect to the word ‘loans’, and ‘tariff’ to ‘payments’. In the second risk category, context, the researcher identified words such as ‘politics’ that connect to ‘legal’, ‘regulation [sector]’ and ‘government’. The word ‘socioeconomic’ is linked to ‘education’ and ‘demographic’ is connected to ‘regional’. Finally, the word ‘corruption’, was identified. Technical and operational emerged as the third risk category, where words such as ‘technology’, ‘structure’, ‘technical’, ‘operational’ and ‘performance’ were observed. The fourth risk category is related to commercial risks. It was possible to identify the word ‘customers’ linked to ‘population’, and others, such as ‘market’, ‘contracts’ and ‘commercial’.

Finally, the infrastructure risk category, where it was possible to identify the words ‘design’, ‘construction’ and ‘infrastructure’.

Similar results were obtained when counting the words frequency on the risk assessment analysis and risk treatment or mitigation measures (see Figure 4-3).

Figure 4-3: Results from Word Cloud – interviews results

4.2.2 Risk factors identification

The researcher performed a visual observation of the second group of the semi-structured interviews and grouped and classified the answers based on the risk factors list provided in Chapter 2.7. The results allowed the identification of 25 risk factors (see Table 4-2).

Table 4-2: Risk factors list – 15 participants

Risk factors	Risk factor frequency
Absence of policy and legal frameworks	2
Abuse of power by government officials	7
Conflicts between partners	4
Construction time and cost overrun	2
Continuous monitoring	5
Corruption	4
Design & construction deficiencies	4
Employee theft	5
Insufficient project finance supervision	7
Macro-economy consistency situation	6
No baselines for performance measurement	19
Non-payment of bills	14
Operation & maintenance cost escalation	9
Planning deficiency	6
Political interference	26
Poor contract design	8
Procurement risk	3
Regulatory risk (weak regulation)	11
Climate change	4
Technical leakage during distribution	1
Unfavourable global private investment climate	18
Water asset condition uncertainty	10
Water pricing and tariff review uncertainty	3
Water theft	5
Weak capacity of public and private partners	1
TOTAL	**184**

The risk factors are presented in alphabetical order, and their allocation to the risk categories and rank are presented in Chapter 4.2.3.

4.2.3 Risk analysis and evaluation

The risk analysis and evaluation were segregated in two major blocks. The first one, supported by the results from the closed questions, ranked risk categories, and the second was based on the higher frequency of risk factors within each category.

The results were supported by the quantitative data analysis using the SPSS software. Descriptive statistics was used to support how the participants ranked the risk categories.

4.2.3.1 Risk categories rank

Closed group of questions results

The first group of the semi-structured interview was a closed group of questions (structured interview). The interviewees were invited to classify the relevance of five risk categories.

The descriptive statists results allowed ranking the risk categories (Table 4-3). The scoring was based on the Likert Scale (see Chapters 3.2.1 and 3.2.3 for the Likert Scale application concept) from 1 (Less Important) to 5 (Very Important).

The 'Very Important+Important' (representing 5 and 4 on the Likert Scale) aggregated results ranked the infrastructure risk category first with 27% of answers. Financial and commercial ranked second with 23% and 20%, respectively, followed by context with 17%, and technical and operational with 13%.

The 'Moderately Important' (representing 3 on the Likert Scale) ranked commercial risks first with 40%, followed by financial with 27%, technical and operational with 20% and infrastructure with 13%. The context risk category had zero answers.

The last aggregated result, 'Slightly Important+Less Important' (representing 2 and 1 of Likert Scale), showed that interviewees considered context as the least relevant category with 35%, technical and operational with 24%, infrastructure with 17%, financial with 14% and commercial with 10%.

The previous results did not provide sufficient evidence regarding the interviewees' opinions. Therefore, it was necessary to perform an additional quantitative analysis (descriptive statistics) for additional information (SPSS software) (see Table 4-3).

Table 4-3: Risk category ranking – SPSS descriptive statistics results

Risk category	Mean	Mean rank	Median	Mode	Standard desviation
Financial	3.27	1	3	3 and 5	1.49
Commercial	3.27	1	3	3	1.10
Infrastructure	3.27	1	4	4	1.22
Technical and operational	2.79	4	3	2	1.31
Context	2.53	5	2	1	1.85

The mean rank identified three risk categories in the first place: financial, commercial and infrastructure. Considering a mean of 3.27 (SD=1.49) (the mean can vary between 2 to 5), it was possible to rank the financial risks as the first choice, followed by infrastructure with 3.27± 1.22 (the mean can vary between 2 to 4) and commercial risks with 3.27± 1.10 (the mean can vary between 2 to 4). Financial risks ranked first confirming the literature results (see Chapter 3.2.1).

Infrastructure risks ranked second. Using the previous exposed results and complementing the analysis with the median (4) and mode (4) outputs, we observed that globally the risk category infrastructure presented better results than the commercial risk category's median (3) and mode (3) outputs.

The technical and operational risk category ranked fourth with a mean of 2.79± 1.31 (the mean can vary between 1 to 4), median (3) and mode (2).

Finally, the context risk category with a mean of 2.53± 1.85 (the mean can vary between 1 to 4), median (2) and mode (1).

Risk categories rank from the risk factors perspective

The researcher identified 25 risk factors indicated by the interviewees. During the interviews, each interviewee was invited to provide its opinion and to suggest risk factors for each risk category.

The risk categories that ranked higher were context with 53 (29%) frequencies and financial with 47 (25%) frequencies. Commercial ranked third with 35 (19 %) frequencies and in fourth and fifth with similar results ranked infrastructure with 25 (14%) frequencies and technical and operational with 24 (13%) frequencies (see Figure 4-4).

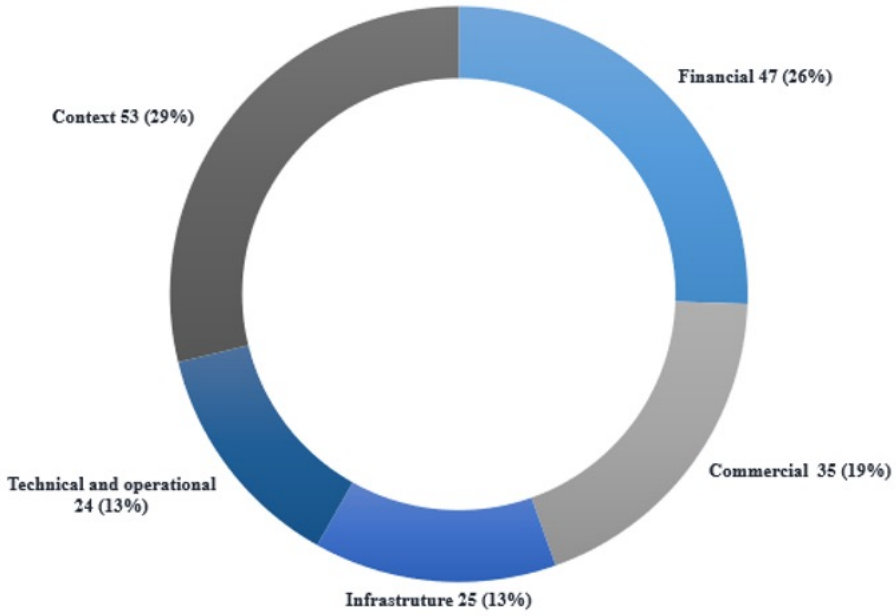


Figure 4-4:Risk factors and risk categories

When compared with the results obtained in the risk categories rank – closed group of questions results, we can observe that there were significant differences, except for the financial risks that dropped down from the first to the second position. Curiously, the context risk category is the one that presented once more the most different ranking position. The participants ranked the context risk category last. When comparing it with this risk factors evaluation perspective, the researcher observed that it ranked first with 53 frequencies (29%).

4.2.3.2 Critical risk factors identification

From the initial 184 frequencies and the 25 identified risk factors, the researcher ranked the frequencies, allowing the identification of the top five risk factors, hereinafter referred as critical risk factors (see Chapter 4.2.3.1). Table 4-4 shows the critical risk factors.

Table 4-4: Critical risk factors

Critical risk factors	Risk factor top frequency
Political interference	26
No baselines for performance measurement	19
Unfavourable global private investment climate	18
Non-payment of bills	14
Water asset condition uncertainty	10
TOTAL	**87**[a]

Note: [a]Total of 87 frequencies, from the initial 184.

The results allowed concluding that the 'political interference' risk factor was the top risk factor with 26 answers, mostly classified in the risk category context 19 frequencies (see Figure 4-5). The second risk factor was 'no baselines for performance measurement', with 19 answers, mostly classified in the commercial (9) and financial (7) risk categories. The third risk factor was 'unfavourable global private investment climate', with 18 answers, mostly classified in the financial (13) and context (4) risk categories. In fourth, 'non-payment of bills', with 14 answers, mostly classified in the commercial (13) risk category. Finally, 'water asset condition uncertainty', with 10 answers, mostly classified in the infrastructure (9) risk category.

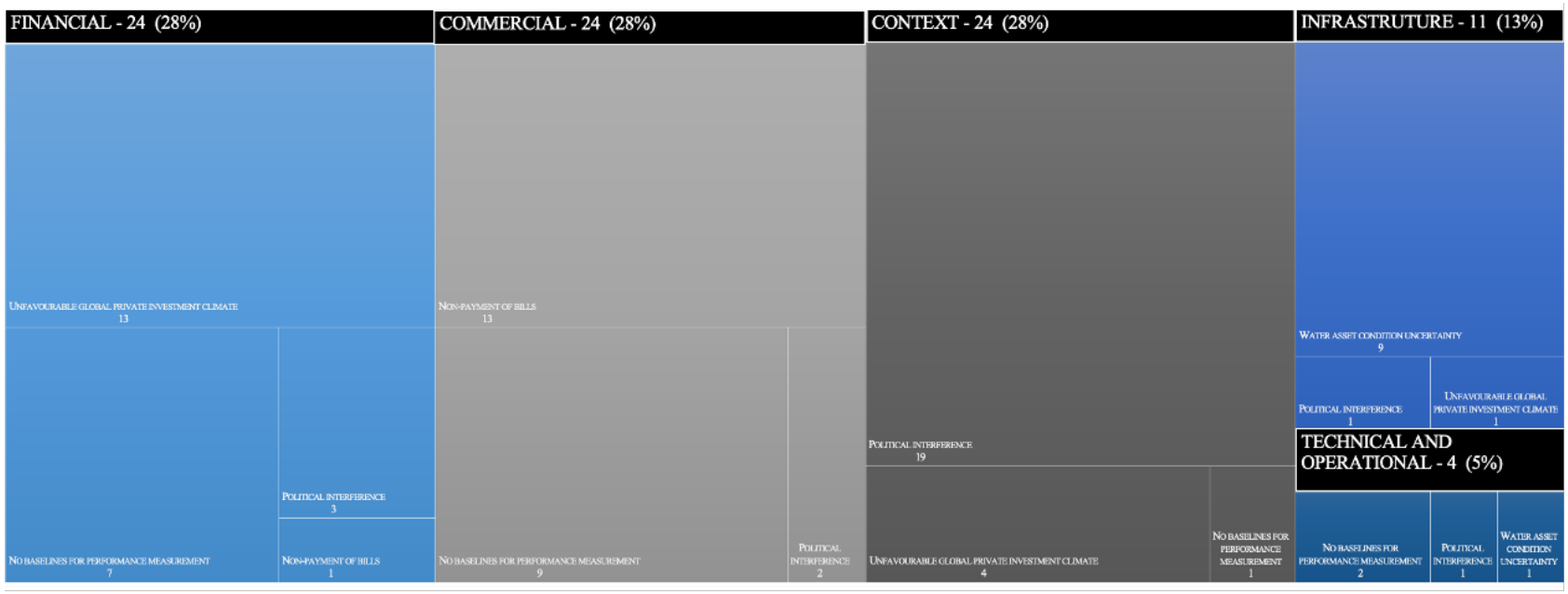


Figure 4-5: Risk categories and critical risk factors

4.3 Critical risks factors and treatment or mitigation measures

Five critical risk factors were previously identified in the risk assessment phase. In this section, the researcher observed in more detail each critical risk factor and added the contributions of the participants regarding the possible risk treatment or mitigation measures.

Political interference

The 'political interference' risk factor ranked first in the participants answers with 26 frequencies in the risk assessment phase. It was possible to identify this risk factor in all five risk categories in the assessment phase. According to the participant opinions, this critical risk factor can have a transversal impact in the projects' results. They were mostly classified in the risk category context (19), followed by financial (3), commercial (2) and infrastructure, and technical and organizational, both with 1. The literature supports political interference as a critical risk factor in PPP contracts (Ameyaw & Chan, 2015d, 2016). The risk treatment or mitigation phase allowed the identification of measures regarding these critical risk factor.

The costs of water in developing countries are strongly affected by political and macroeconomic instability, confirming the context risk category as the highest in the rank.

In the particular case of PPP water contracts, the government should have a political commitment to ensure that economic tariffs allow the reflection of operational costs to maintain the financial sustainability of the private partner, which has low or no control of this variable (Ameyaw & Chan, 2015d). The government has the responsibility to provide a functional framework that ensures the introduction of tools which will encourage gradual tariff increases (Beato & Vives, 1996). When substantial changes in the PPP project are imposed, the costs that it can generate should be fairly transferred to the users or be immediately supported by the government.

Political interference can equally restrict the activities of regulators and private operators (e.g. tariff adjustments) (Ameyaw & Chan, 2015d). The participants argued that it was necessary to 'create a robust legal framework to ensure the independence of the sector regulator, increasing its power to intervene in the water sector and PPP contracts'. Unjustified political interference and lack of government commitment will reduce the sector's attractivity to the private sector, especially in the case of PPP contracts, which by definition should have a medium- or long-term duration.

No baselines for performance measurement

The 'no baselines for performance measurement' risk factor ranked second in the participants answers with 19 frequencies. Similar to 'political interference', the participants showed that this critical risk factor is a transversal concern to most of the risk categories. The 'no baselines for performance measurement' risk factor was identified in all risk categories, except in infrastructure. It was mostly identified in the commercial (9) and financial (7) risk categories.

Ameyaw and Chan (2013) equally identified these risk factors when assessing the factors that can contribute to the success of PPP water contracts in Ghana. The hampered effective assessment of the private sector's performance can have a negative impact in the partners' relations.

The researcher identified two major potential sources: i) management and ii) control mechanisms. The participants suggested mitigation measures. As a possible mitigation measure for the management, it was possible to identify the sentence 'the creation of tools that will ensure effective management skills . . .'. For the internal control, the participants suggested 'the introduction of a requirement list . . . regarding the accounting management methods and registration, namely the type of software which will store the documentation' and 'the introduction of adequate levels of service [quality, quantity and accessibility] the private partner has to comply . . .'. For the control of the management skills and competences, a list of minimum work experience and competences (e.g. previous work experience in developing countries background) could be added as a mandatory requirement that the private partner has to fulfil during the PPP project.

The existence of control mechanisms of the private partner's performance by the public partner should be properly designed and addressed before the bidding phase. The monitoring mechanisms are a relevant theme that ensure the compliance of the partnership's objectives.

Unfavourable global private investment climate

The 'unfavourable global private investment climate' risk factor ranked third in the participants answers with 18 frequencies in the risk assessment phase. It was possible to identify this risk factor in the financial (13), context (4) and infrastructure (1) risk categories in the assessment phase. Ameyaw and Chan (2013) confirm the participants rank in their study regarding the identification of PPP risks in managing water supply projects in Ghana. They argue that the existence of an unfavourable global private

investment climate can reduce the possibilities of attracting good bidders. The need to capture and retain good bidders was supported by participants' answers, in which they mentioned that risk mitigation measures need to '. . . improve the investment plans, with the aim of having the government as the major endorser'. The public partner will have a key role by ensuring a good international reputation and increasing the private part's interest in PPP projects. This need is related to the purpose of the financial risk category's main objective: securing the rising of the necessary funds to ensure the PPP project's success.

As a possible mitigation measure, the participants indicated 'the creation of an insurance to mitigate the risk of the political interference (e.g. Multilateral Investment Guarantee Agency - MIGA)'. The political risk insurance is a tool already put into practice. Multilateral organizations such as MIGA already have possible solutions, proposing the political risk insurance as a valid tool to help mitigate and manage risks that can arise from adverse situations as the result of the governments intervention in developing countries.

Non-payment of bills

The 'non-payment of bills' risk factor ranked fourth in the participants answers with 14 frequencies in the risk assessment phase. It was possible to identify this risk factor in the commercial (13) and financial (1) risk categories in the assessment phase. Scholars confirm the 'non-payment of bills' as a relevant risk factor (Ameyaw & Chan, 2015a, 2015b; Rezaeenour et al., 2018). Marin (2009) reinforced this statement by alerting to the possible risks that can arise from the 'non-payment of bills'. The existence of legal constraints that do not enforce the payment of water services, especially in developing countries, will lead to the reduction of expected revenues from the private partner.

The participants indicated that 'the introduction or reinforcement of the principle of the paying user' ensured that when building a new contract, the direct and indirect mechanisms for billing costumers are included, and '. . . the introduction of a budget [by the private partner] to create awareness campaigns directed to their direct customers with the message – It is necessary to pay to get access to basic goods as a way to get better levels of service' as possible mitigation measures for the critical risk factor.

The social and economic conditions of the populations, especially in developing countries, can jeopardise the expected revenue levels and compromise the private partner's ability to provide adequate service levels. Additional measures, such as pro-

poor measures (e.g. low average tariffs for the poor) and ensuring an updated database of customers, are necessary to mitigate this critical risk factor and can emerge as alternative solutions. In developing countries, the possibility to create pre-paid water meters can be an interesting solution.

This need is related to the purpose of the commercial risk category's main objective, which is to secure the provision of water supply services to customers, including the collection capacity in PPP projects.

Water asset condition uncertainty

The 'water asset condition uncertainty' risk factor ranked fifth in the participants answers with 10 frequencies in the risk assessment phase. It was possible to identify this risk factor in the infrastructure (9) and technical and operational (1) risk categories in the assessment phase. Scholars also confirmed the relevance of this risk factor (Ameyaw & Chan, 2015a, 2015b). Service targets of a PPP project can fail due to obsolete technology, equipment defects, and poor maintenance and asset condition (Ameyaw & Chan, 2013).

The participants indicated 'the introduction of mandatory clauses in the contracts passing the responsibilities of the maintenance of the infrastructure to the private partner', 'the creation of mechanisms that allow an adequate registration of assets during the contract preparation phase' and '. . . mechanisms that allow an external evaluation of the accuracy of the infrastructure records' as possible mitigation measures for the critical risk factor. The 'water asset condition uncertainty' critical risk factor is closely connected to this thesis definition of the infrastructure risk category, which is the impact that a good or bad preservation and awareness of PPP assets can have in the success of the project's outcomes. The water infrastructure is complex to project, construct and maintain. It is characterised as having high sunk costs, and poor infrastructure management can have a relevant impact in the project's outcomes.

4.4 Participants profile and risk management framework approach

This chapter observed how the participants' profile can influence the results of risk assessment and the risk treatment or mitigation measures phase (i.e. sampling results). To assess this claim, the researcher applied quantitative methods supported by the SPSS software. The risk assessment and the risk treatment or mitigation measures phase allowed the identification of 25 (184 frequencies) risk factors, and 38 different types of

risk treatment or mitigation measures in the first stage, that can be associated to risk factors (148 frequencies) (see Appendix I). Table 4-5 shows the results based on the risk factors identification in both phases.

Table 4-5: Results - risk assessment and risk treatment or mitigation measures

	Number of factors	Frequency (answers)
Risk factors	25	184
Risk treatment or mitigation measures	38[a]	148

Note: [a] 38 different types of risk treatment or mitigation measures were identified, that can be associated to risk factors.

The researcher observed i) the existence of a relation on how the participants identified the risk factors between risk assessment and risk treatment or mitigation measures phase, ii) participants risk relevance considering the risk categories, iii) whether the sector type (water, utilities and others) can influence their opinions, and iv) whether working in the private or public side can influence their risk perception. For the $\chi 2$, Wilcoxon, Kruskal-Wallis and Mann-Whitney U tests, results were considered statistically significant with trusts levels of 95% ($p<0.05$).

i) Participants behaviour regarding risk factors identification between risk assessment and risk treatment or mitigation measures phase

The $\chi 2$ test, for 332 frequencies, showed $p=0.00$, and the value of 139.331 indicated that the results were statistically significant.

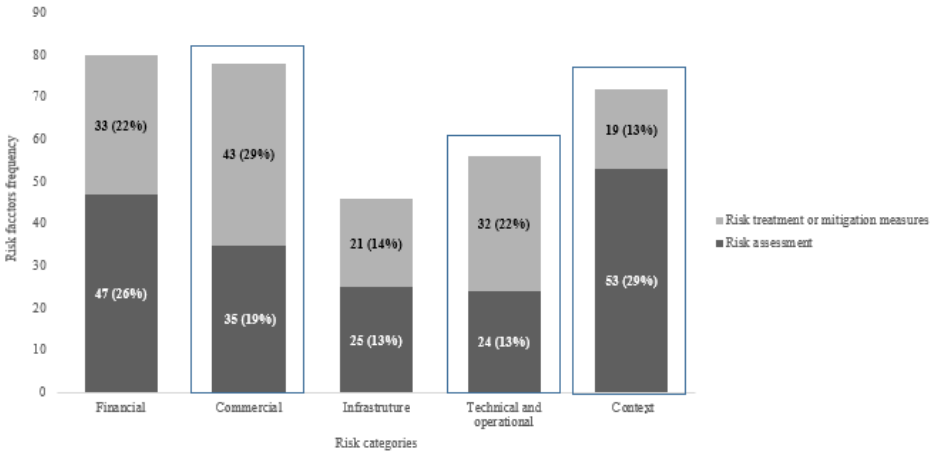


Figure 4-6: Risk categories – risk management framework

Grouping the results by risk categories we can observe that there was a significant difference (see Figure 4-6).

These results showed that there are significant differences on how the interviewees identified the risk factors between the risk assessment and the risk treatment or mitigation measures phase. The most significant differences were in the commercial risk categories which now ranked first with 43 (29%) in risk treatment or mitigation measures, followed by technical and operational 32 (22%), and finally the context risk category with only 19 (13%). These results confirmed the existence of differences in how the participants approach the risk assessment phase and the risk treatment or mitigation measures.

ii) Participants risk factors perception

The Wilcoxon test results showed p=0.02 concluding that interviewees' professional rank and risk categories were statistically significant, considering a trust level of 95% ($p<0.05$). From these results we can conclude that the lower the participants' professional rank, the higher they ranked risk categories (see Figure 4-7).

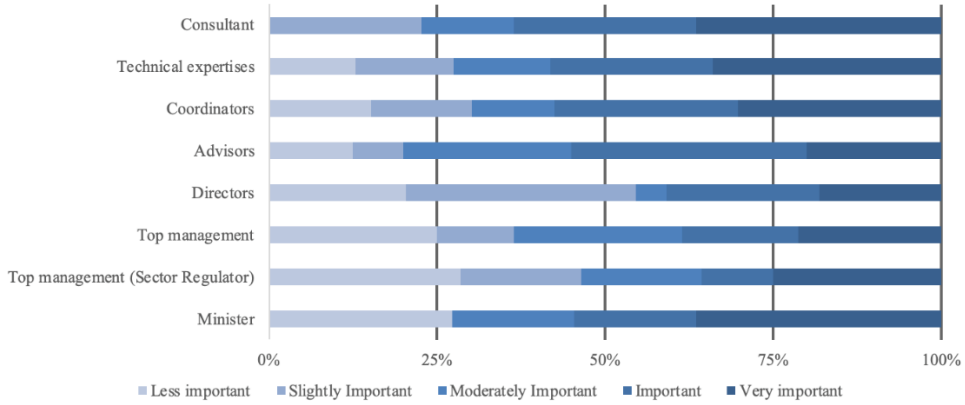


Figure 4-7: Wilcoxon test results

iii) Participants sector type (water, utilities and others)

The Kruskal-Wallis test results showed that there was not a significant difference between the interviewees' professional rank and the sector type in the risk assessment and the risk treatment or mitigation measures phase, presenting p=2.06.

iv) Participants perception work field side (private or public)

The Mann-Whitney U test results showed that there was not a significant difference between the interviewees' professional rank and work field side (private or public), in the risk assessment and the risk treatment or mitigation measures phase presenting p=0.660.

4.5 Key risk indicators in PPP contracts

The key risk indicators emerged as a thesis contribution to improve the current risk management framework in PPP contracts. Previous results showed the need to improve how the risk categories are addressed and should be adapted to the reality of PPP contracts (e.g. developing countries and national reality).

The 15 participants provided their opinion regarding this topic (open question), and all were considered valid for sampling.

The results allowed to answer the fourth research question of the thesis' second objective, namely:

4. How can the key risk indicators concept improve the current risk management framework of the contracts?

The researcher used the Gioia methodology to address the research question (Gioia et al., 2013).

4.5.1.1 Key risk indicators concept

The literature contributions observed in Chapter 2.6, ranked 37 studies connected to risk management in PPP water contracts. The studies' results are not consensual in how to cope with risk issues. Thirteen of these studies were selected and analysed (see Table 2-5 in Chapter 2.6.1) regarding the risk management framework in PPP contracts in the water sector. The results showed that there is no consensual methodology and terminology among scholars for the risk assessment framework. Hayne and Free (2014) conducted a wide range of interviews of key stakeholders and concluded that organisations and individuals act and behave in varied ways to keep their institutions risk-free. The cited study found that risk management strategies are based on diverse forms and techniques of applying theories, methods, construction procedures, designs, implementations and monitorisation. To design, create, implement, maintain and update a risk management framework during PPP contract lifecycle, partners need to introduce the concepts of communication, consultation and monitoring into the framework.

Figure 4-1 in Chapter 4.1 describes the risk management framework approach proposed. Two significant phases were considered: i) risk assessment where the risks are identified, analysed and evaluated; ii) the implementation of treatment or mitigation measures to cope with the critical risk factors identified in the previous risk phase (ISO, 2018c).

The PPP contracts' risk management framework can be improved (Luís et al., 2016). The main characteristic of a PPP water contract is to establish a partnership between two or more partners (public and private) that is generally prepared and designed to last several years. The aims of the contracts can include infrastructure project development, construction (greenfield projects), reconstruction (brownfield projects), operation or the combination of different phases. Considering the characteristics of the contracts, we observed that the risk management framework must be updated and provide proper mechanisms and tools to allow the production of relevant management information to support the quality of the PPP contract's outputs according to the contractual clauses, during the contract term.

The need to design, create, implement, maintain and update the risk management framework during the PPP contract life cycle, leads to the need to introduce the communication and consultation, and then the monitoring concept into the framework (see Figure 4-8).

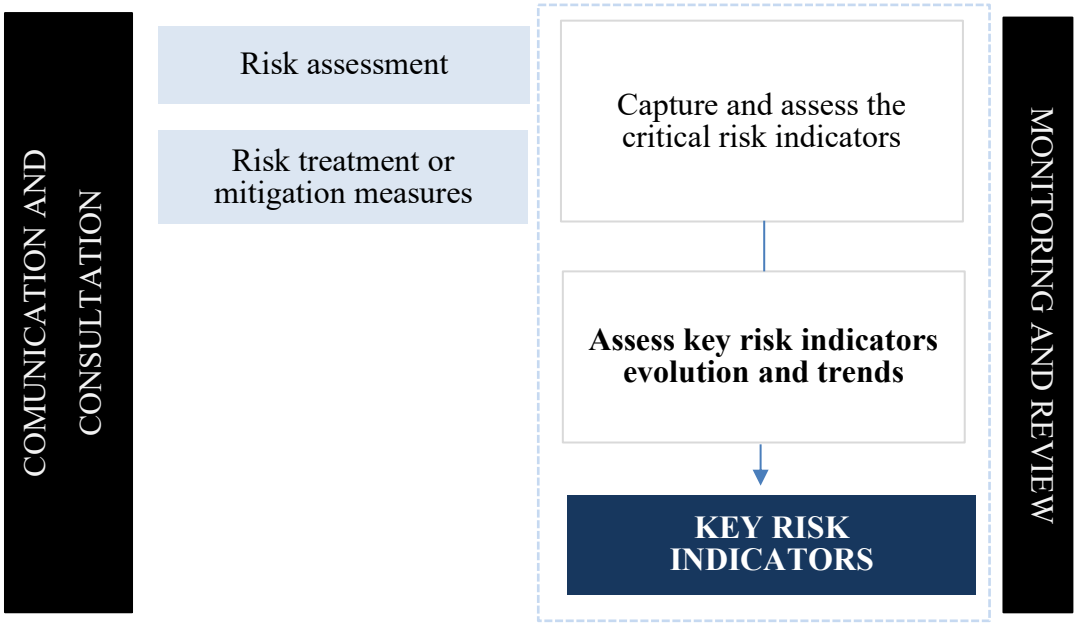


Figure 4-8: Key risk indicators framework

The risk management framework approach design proposed the introduction of the key risk indicators concept as a support measure to all process phases.

The interviewees were invited to provide their opinion on this matter. The open question 'How can the key risk indicators concept improve the current risk management framework of the contracts?' was asked to all of them.

Key risk indicators are broadly used in the literature to provide support for risk management (Peček & Kovačič, 2019; Radojković et al., 2019; Timmermans et al., 2016).

Reviewing and monitoring risk management frameworks is necessary to improve the effectiveness of process design (ISO, 2018c). The introduction of measures has a significant impact on the outcomes of risk management. The ISO (2018c) recommends that reviewing and monitoring processes should be planned and become a permanent part of all risk management phases. These processes must include collecting and analysing information, auditing, recording results and presenting feedback to the parties involved. The findings then need to be incorporated into the relevant organisations' performance. Peček and Kovačič (2019), however, argue that the ISO has failed to provide adequate tools to facilitate risk reviewing and monitoring processes.

This chapter's objective is focused on to which extent the use of the key risk indicators, which have already been successfully used in different organisations to help preventing the present and future risk (Blokdyk, 2020; Yuan et al., 2015).These indicators can be modified to suit the needs of PPP arrangements as a way to improve the monitoring processes of these contracts.

4.5.1.2 Key risk indicators in PPP contracts–framework construction

The researcher used the Gioia methodology – a systematic inductive approach to concept development, presented in the article 'Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia methodology' (Gioia et al., 2013) - to address the research question. Qualitative methods were used to identify patterns in interviewees' answers and propose results. The interviews' results were transcribed and analysed using thematic content analysis. Notably, this methodology's ability to capture what could be observed from the data and to address the research question was uncertain. The interviews focused on eliciting the participants' opinions on key risk indicators use in PPP contracts and assessing and defining ways that these indicators could be linked to the context of developing countries. The Gioia methodology and outputs were supported by the

qualitative data analysis software MAXQDA and have been successfully performed in previous studies (Lombardi et al., 2020; Quinn et al., 2019).

The researcher did not know if the use of such methodology could capture what we observed in our data and support the answer to the research question. Therefore, the interviewees' opinions on the use of the key risk indicators concept in the PPP contracts and how they could be linked to the developing countries context was assessed and captured.

The results presented are based on the data analysis section and are limited to the content analysis. The stages of analysis of the Gioia methodology are described below.

The present research conducted a first-order analysis by identifying and creating codes for the data collected based on informants' terms, conventions and phrases (Gioia et al., 2013; Meister et al., 2017). To assess the codes' similarities, the literature on PPP contracts and key risk indicators was consulted to obtain positive, useful insights based on a second-order theme analysis (Gioia et al., 2013).

The researcher organised and presented the findings related to the research question: 'How can the key risk indicators concept improve the current risk management framework of the contracts?'.

To understand how the interviewees presented their arguments, we proposed the model generated from the data structure, after assessing and coding the raw material.

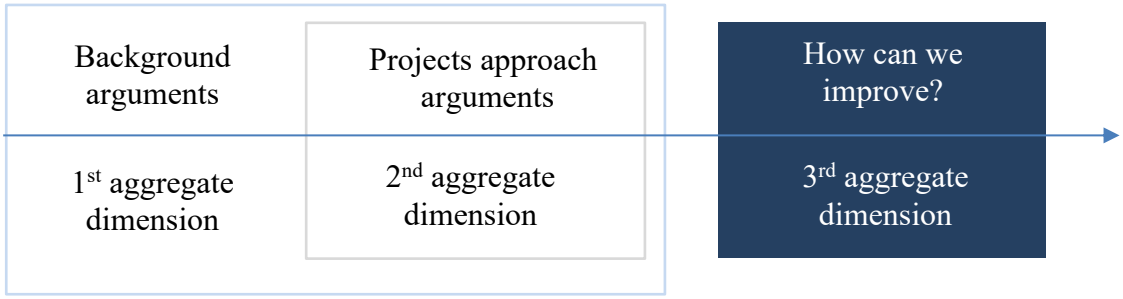
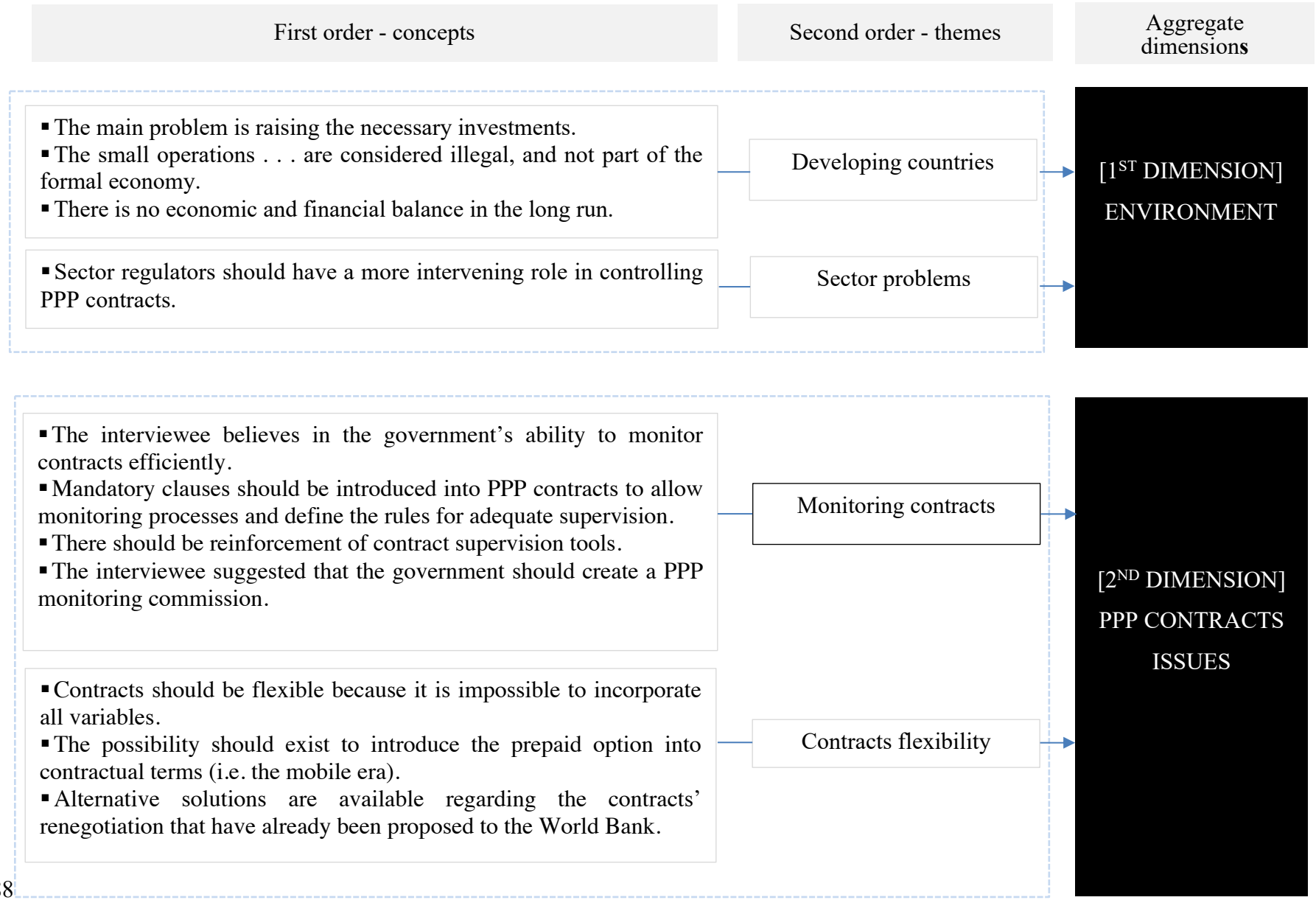
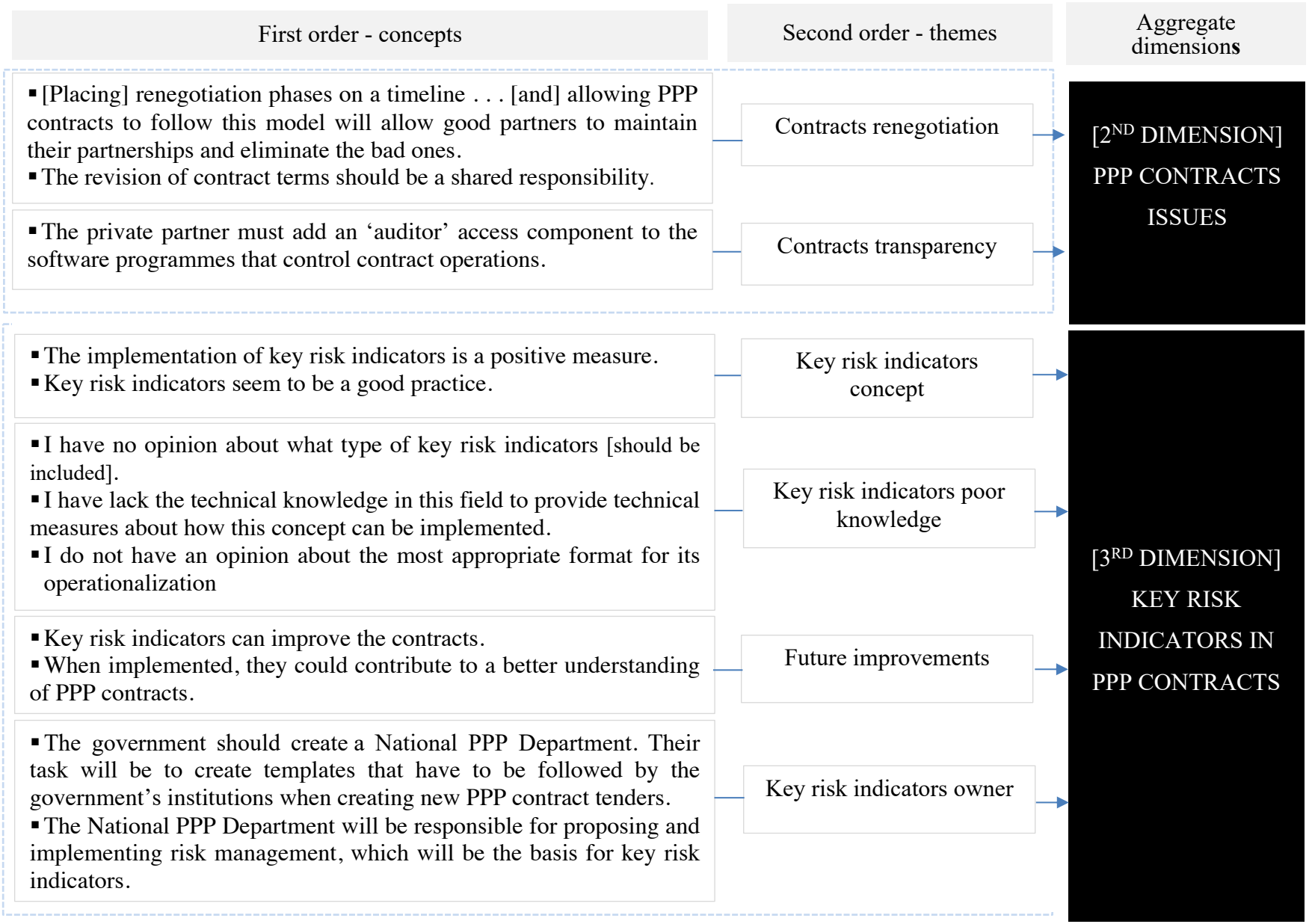


Figure 4-9: Interviewees arguments structure

During the process, researcher could observe how the interviewees structured and presented their opinions (see Figure 4-9). They started by identifying the environment and data context (first aggregate dimension), the PPP contracts' dimension (second aggregate dimension), and finished by assessing how key risk indicators in PPP contracts could support improvement opportunities in the current risk management framework (third aggregate dimension). They showed their arguments in a problem-solution model basis.


First order - concepts
Second order - themes
Aggregate dimensions
▪ The main problem is raising the necessary investments.
▪ The small operations . . . are considered illegal, and not part of the formal economy.
▪ There is no economic and financial balance in the long run.
Developing countries
[1ST DIMENSION] ENVIRONMENT
▪ Sector regulators should have a more intervening role in controlling PPP contracts.
Sector problems
▪ The interviewee believes in the government's ability to monitor contracts efficiently.
▪ Mandatory clauses should be introduced into PPP contracts to allow monitoring processes and define the rules for adequate supervision.
▪ There should be reinforcement of contract supervision tools.
▪ The interviewee suggested that the government should create a PPP monitoring commission.
Monitoring contracts
[2ND DIMENSION] PPP CONTRACTS ISSUES
▪ Contracts should be flexible because it is impossible to incorporate all variables.
▪ The possibility should exist to introduce the prepaid option into contractual terms (i.e. the mobile era).
▪ Alternative solutions are available regarding the contracts' renegotiation that have already been proposed to the World Bank.
Contracts flexibility


First order - concepts
Second order - themes
Aggregate dimensions
▪ [Placing] renegotiation phases on a timeline . . . [and] allowing PPP contracts to follow this model will allow good partners to maintain their partnerships and eliminate the bad ones.
▪ The revision of contract terms should be a shared responsibility.
Contracts renegotiation
▪ The private partner must add an 'auditor' access component to the software programmes that control contract operations.
Contracts transparency
[2ND DIMENSION] PPP CONTRACTS ISSUES
▪ The implementation of key risk indicators is a positive measure.
▪ Key risk indicators seem to be a good practice.
Key risk indicators concept
▪ I have no opinion about what type of key risk indicators [should be included].
▪ I have lack the technical knowledge in this field to provide technical measures about how this concept can be implemented.
▪ I do not have an opinion about the most appropriate format for its operationalization
Key risk indicators poor knowledge
▪ Key risk indicators can improve the contracts.
▪ When implemented, they could contribute to a better understanding of PPP contracts.
Future improvements
▪ The government should create a National PPP Department. Their task will be to create templates that have to be followed by the government's institutions when creating new PPP contract tenders.
▪ The National PPP Department will be responsible for proposing and implementing risk management, which will be the basis for key risk indicators.
Key risk indicators owner
[3RD DIMENSION] KEY RISK INDICATORS IN PPP CONTRACTS

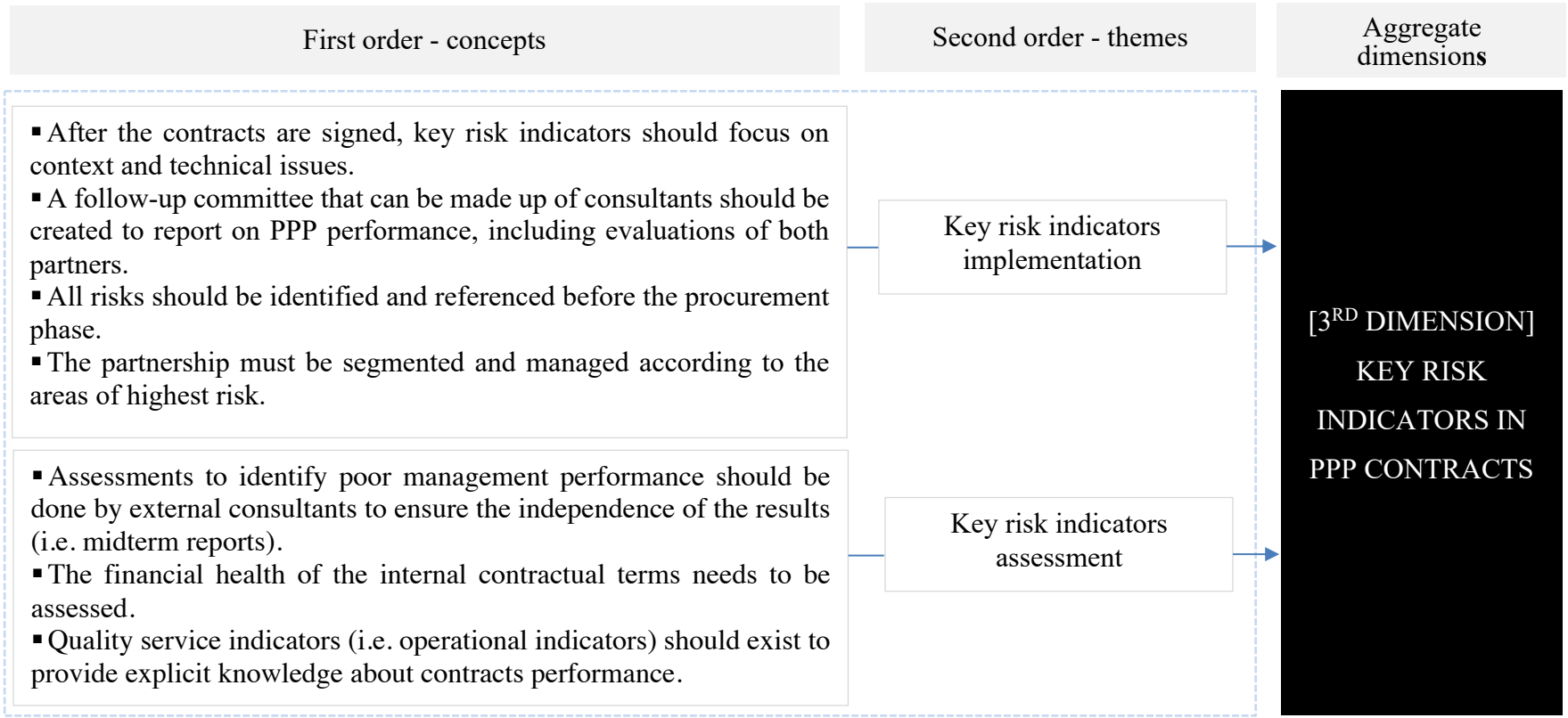


Figure 4-10: Key risk indicators data structure

In parallel, the researcher observed that they supported their opinions from a more extensive and broader basis (background arguments), to a more focused basis (projects approach arguments) ending with the arguments, 'How can we improve?' proposed concrete solutions to improve the PPP contracts, using the key risk indicators concept.

The summarised analysis in Figure 4-11, result from the data structure (see Figure 4-10). The relevant PPP theories and risk key indicators theories were used as platforms to explain the links between the second order analysis themes identified.

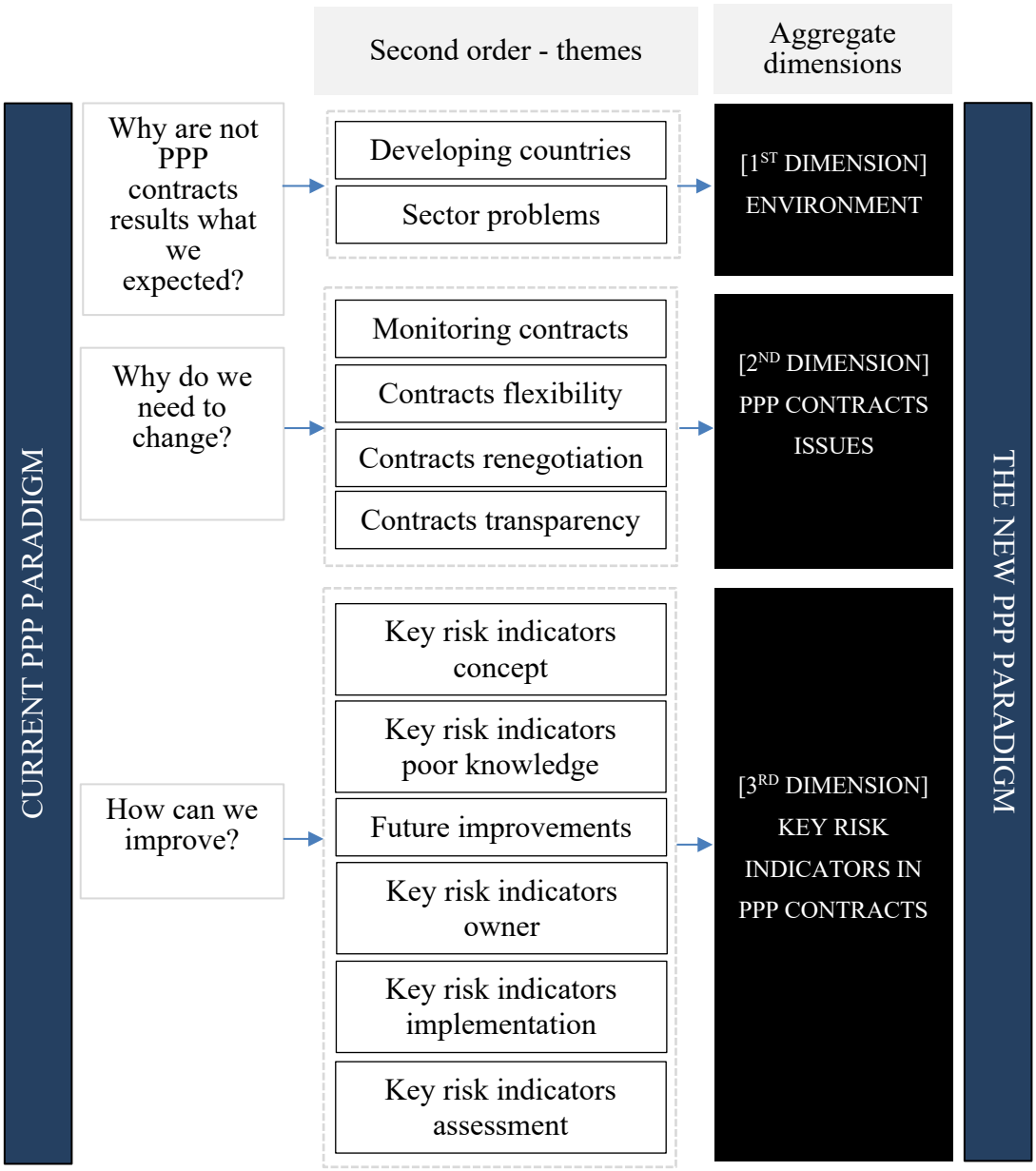


Figure 4-11: Model generated based on data structure

There were three aggregate dimensions identified in the model: first, the enabling environment, second, the PPP contracts issues, and third, a paradigm shift (key risk indicators in PPP contracts) (see Figure 4-11). The interviewees were coded with the purpose of answering the research question.

To understand how to get to conclusions, the researcher started by explaining the relation between the first order coding, which in turn led to the second order coding and to the last level, the aggregate model dimensions. In the next paragraphs, examples of existing links between the codes (first order coding) are provided, as well as their relation to the second order coding.

The results of the model generated based on data structure supported the literature review outputs (see Chapter 2.6). The first aggregate dimension, environment and context, connected to the identified theme governance in the water sector, appeared in seven studies (6%) of the sample (122 studies). The second aggregate dimension, PPP contract issues, was associated with the identified theme PPP contracts that appeared in 23 studies (19%) of the sample (122 studies) where the major PPP contracts types and issues are discussed (see Chapter 2.6.2). The last aggregate dimension, key risk indicators in PPP contracts, connected with the themes PPP contracts and risk management. The latter ranked first with 37 studies (30%) of the sample (122 studies) that addressed, in particular, the thesis' second objective (see Chapter 2.6.1).

Environment

The first aggregate dimension, environment, was linked to the question 'Why are not the PPP contract results what we expected?'. The environment and context came from the joint themes 'developing countries' and 'sector problems'.

When observing the data structure, we could extract expressions from the first order coding linked to the second order coding, 'developing countries' (see Figure 4-12). Various sentences were connected to economic structural problems such as 'the main problem is raising the necessary investment,' 'there is no economic and financial balance in the long run' and 'small operations . . . are considered illegal and not part of the formal economy'. In addition, the substantial weight attributed to poor national and sector accountability linked to control methods can affect PPP contracts. A sentence identified as part of the second-order theme of sector problems reenforces this statement: 'sector regulators should have a more intervening role in controlling PPP contracts'. The macroeconomic context in which PPP contracts operate is decisive in the preparation of

new partnerships, and political decision makers cannot ignore local requirements, contexts and environments. The literature on previous studies has also discussed the importance of these matters (Cui et al., 2018; Kwofie et al., 2016).

Researchers observed variations in PPP implementation between countries (Cui et al., 2018). The problems shown by developing countries are different from those of developed countries, particularly capturing the necessary level of investment, governments' negative reputation and inefficacy, reduced political will and contractual environments' uncertainty (Babatunde et al., 2015). Depending on internal policies, the water sector can, for example, be frequently considered a national priority, so policymakers become overly focused on ensuring that all population has access to adequate levels of service (e.g. water quality standards). Public partners may thus neglect their water systems economic sustainability. The result is poor PPP contract designs that fail to cover relevant project contingencies (Appuhami & Perera, 2016).

When adequately formulated, PPP contracts can present advantages for developing countries because good contracts allow partners to avoid inadequate internal human resources and technological skills. Well-designed contracts also provide opportunities to improve stakeholders' understanding of all aspects of PPP arrangements (Appuhami & Perera, 2016). Financial benefits can arise as good PPP contracts capture significant levels of international investment (Cui et al., 2018). These advantages show that the PPP project business model continues to be able to improve national economies and populations' living standards.

PPP contract issues

The second aggregate dimension identified is why a paradigm shift in PPP contracts is necessary. PPP contract issues are linked to the question 'Why do we need to change?'. The second aggregate dimension, PPP contract issues, came from the conjunction of the second order themes: i) 'monitoring contracts', ii) 'contracts flexibility', iii) 'contracts renegotiation' and iv) 'contracts transparency' (see Figure 4-11).

An analysis of the first-order codes that support the second-order themes revealed that PPP contract improvements should be based on the interviewees' opinions. The second-order theme of contract monitoring includes expressions such as 'the interviewee believes in the government's ability to monitor contracts efficiently'. Other examples are 'mandatory clauses should be introduced into PPP contracts that facilitate monitoring

processes and define adequate supervision rules' and 'the interviewee suggested that the government should create a PPP monitoring commission'.

Contracts' flexibility and renegotiation can emerge as relevant topics (Cruz & Marques, 2013b). These first-order concepts cover expressions such as 'contracts should be flexible because it is not possible to incorporate all variables. Another example is '[including] renegotiation phases on a timeline . . . [means that] PPP contracts following this model will allow good partners to maintain their partnership and eliminate the bad ones'. Finally, the contract transparency second-order theme was identified as an important issue when designing and controlling PPP contracts. This theme included the sentence 'the private partner must add an [auditor] access component to the software programmes that control contract operations'.

The second-order themes highlight the urgent need to improve the contracts of current projects by introducing tools and methods that will allow control and renegotiation and add transparency through an increased monitoring of contracts. Scholars have identified and assessed multiple factors contributing to the generation of contracts' efficiency throughout their lifecycle and producing balanced value-for-money outputs (Ameyaw & Chan, 2013; Cui et al., 2018; Xia et al., 2012).

By definition, PPP contracts should have a medium- or long-term duration. Studies have shown that conflicts can arise when projects are inadequately prepared during the design and procurement phases and when contracts fail to include effective monitoring plans (Guasch et al., 2014; Marques & Berg, 2010). Contracts with an insufficient capacity to internalise structural, social and economic changes further contribute to incomplete PPP contracts. In combination with information asymmetries, these contracts can require renegotiations of the terms of the arrangements (Marques, 2018).

The incomplete contract theory thus added an important aspect to the model – renegotiation in which contract revisions can involve updating terms in response to new information unavailable when the initial contracts were signed. This finding introduced the contract flexibility concept into the framework (Grossman & Hart, 1986). Improving PPP contracts by adding the monitoring concept further provides transparency, flexibility and facilitates the contract renegotiation process, leads us to the last aggregate dimension, the key risk indicators in PPP contracts.

Key risk indicators in PPP contracts

The last aggregate dimension supported the previously identified paradigm shift regarding PPP contracts. Key risk indicators in PPP contracts are connected to the question 'How can we change?'. The third aggregate dimension, key risk indicators in PPP contracts, resulted from the conjunction of the second order themes: i) 'key risk indicators concept', ii) 'key risk indicators poor knowledge', iii) 'future improvements', iv) 'key risk indicators owner', v) 'key risk indicators implementation' and vi) 'key risk indicators assessment' (see Figure 4-11).

The second-order theme of key risk indicator concept was associated with positive feedback in 11 interviews. Nearly three-quarters of the interviewees (74%) provided support for this theme with sentences such as 'the implementation of key risk indicators is a positive measure' and 'key risk indicators seem to be a good practice'. The literature also supports these results by connecting this concept to monitoring, supporting and improving risk management frameworks (Timmermans et al., 2016).

The interviewees' poor understanding of key risk indicators was identified as an opportunity for improvement, which should be addressed when adapting the key risk indicator concept to PPP contracts. Expressions related to this second-order dimension included 'I have no opinion about what type of key risk indicators [should be included]' and 'I have lack the technical knowledge in this area to provide the technical measures to implement this concept'. Another example is 'I do not have an opinion about the most appropriate format for its operationalisation'.

Building on earlier research output, the analysis identified the second-order theme of future improvements and the potential for adapting key risk indicators to PPP contracts. Sentences such as 'key risk indicators can improve contracts' and 'when key risk indicators are implemented, they can be defined' showed that the introduction of this concept into the framework can contribute to a better understanding of PPP contracts. The ability to replicate and retain knowledge actively is a critical component of learning, capturing and preserving experiences and good practices, as well as improving mechanisms (Berta et al., 2010). Researchers have confirmed the importance of developing knowledge as a decision-making tool (Jin et al., 2020).

The last subgroup of the second-order themes was analysed together due to their high inter-relation. Their contributes were essential to build the risk management framework based on key risk indicators (see Figure 4-11). The theme 'key risk indicators owner' was

connected to the theme ‘monitoring contracts’ previously identified in the second aggregate dimension. Monitoring contracts can only be valid if there is an entity outside of the partnership that is responsible for performing that task. This claim was identified in sentences such as ‘the government should create a National PPP Department . . . that creates templates to be followed by government institutions when creating new PPP contract tenders’.

The creation of national entities (i.e., PPP Units) to control PPP contracts is not a new idea. The overall expansion of these contracts has generated interest in establishing PPP Units to implement or analyse PPP arrangements (Tserng et al., 2012). Developed and developing countries have this practice already in use (e.g. Unidade Técnica de Acompanhamento de Projetos[1] (UTAP) in Portugal, the Infrastructure and Projects Authority[2] (IPA) in the United Kingdom and the PPP Unit[3] in Mauritius). A study presented by the Organisation for Economic Co-operation and Development (OECD) (2010) conducted a study that found support for creating PPP Units to improve the existing knowledge about PPP project preparation, procurement and contract performance.

However, these PPP Units still have room for improvement. For instance, an inadequate definition of roles and lack of independence can contribute to inadequate PPP project options (OECD, 2010). The existence of PPP Units – even those provided with qualified staff – is not enough to ensure the success of PPP projects. Roles must be clearly defined and proper government endorsement and independence achieved (Neto et al., 2020).

The participants’ support for the second-order theme of key risk indicator implementation included expressions such as ‘these partnerships must be segmented and managed according to the areas of higher risk’.

[1]Unidade Técnica de Acompanhamento de Projetos (UTAP) – is an administrative entity with administrative autonomy, under the supervision of the Ministry of Finance. This body has the responsibility for the overall monitoring of PPP processes and ensures specialised technical support, particularly in matters of an economic, financial and legal nature.

[2]Infrastructure and Projects Authority (IPA) – is responsible for the Infrastructure Delivery Plan and National Infrastructure and Construction Pipeline.

[3]PPP Unit – included in the Ministry of Finance, Economic Planning and Development and has the responsibility of controlling PPP projects.

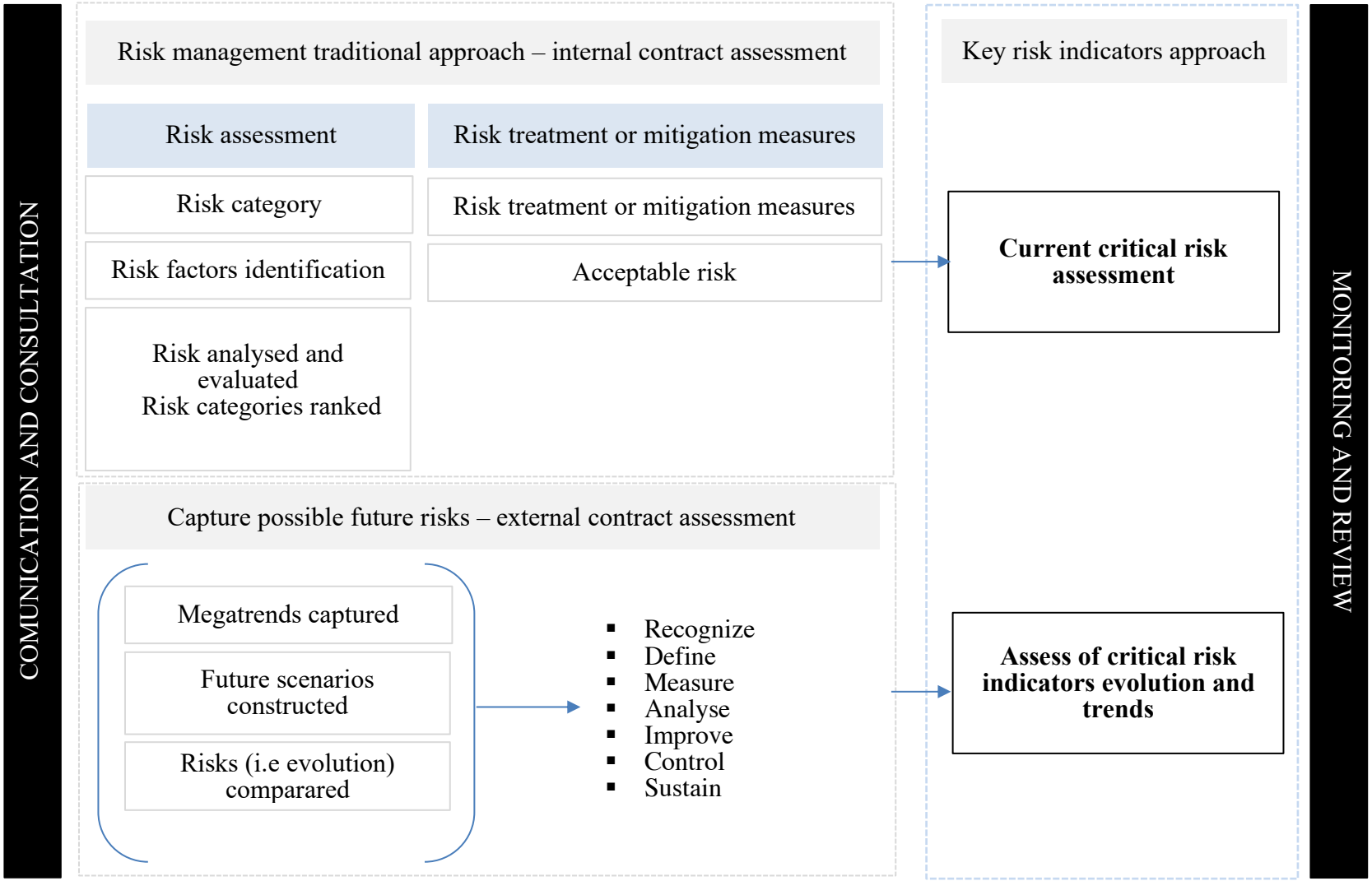


Figure 4-12: Research key risk indicators approach PPP contracts

This theme leads directly to the last second-order theme of key risk indicator assessment, in which the interviewees suggested possible ways to evaluate the performance of PPP contracts. The data analysis identified related interview content including 'assessments to identify poor management performance should be carried out by external consultants to ensure the independence of the results (i.e. midterms report)'. Another instance is the idea of 'assess[ing] the financial health of internal contractual terms'. Key risk indicator assessment was the last yet most important second-order theme identified in the present research on a key risk indicator approach to PPP contract schemes (see Figure 4-12).

The second-order themes of key risk indicator ownership, key risk indicator implementation and key risk indicator assessment combined to reveal a logical, coherent route to improving how PPP contracts are monitored and controlled. This approach captures existing critical risk assessment methods and assesses critical risk indicators' evolution and trends. The proposed model should facilitate improvements in the current knowledge about contracts and predictions of possible external changes that could have an impact on the terms of the partnerships (Luís et al., 2016).

The development of key risk indicators needs to be tailored to suit each contract needs and objectives. Luís et al. (2015) propose that a heat map be constructed to compare critical risks and outcomes with each risk category's narrative and context for each water company. In addition, the identification of significant risk indicator trends must take into account megatrend characterisation, cross-consistency assessment and scenario selection and characterisation including how baseline risks evolve in each scenario (Luís et al., 2016). Future risk identification should be supported by risk recognition, definition, measurement, analysis, measure improvement, control and sustained (Blokdyk, 2020).

Aggregate dimensions links

The three identified aggregate dimensions are clearly linked. The results reveal how the interviewees constructed their opinions and arguments. That is, environment – followed by PPP contract issues – are logical arguments supporting the third aggregate dimension approach to improving PPP contracts.

4.6 Research risk management framework results and thesis objectives contribution

The semi-structured interview results presented interesting outputs to the thesis' second objective. The participants' profile did not influence their answers regarding the risk management approach, except when considering the professional category and risk perception. In this case, the lower the participants' professional rank, the higher they ranked risk categories.

The semi-structured interview results provided answers to the research questions identified (see Chapter 4.1). The researcher highlight again, the four main research questions and insights.

1. What are the most relevant risk categories in PPP contracts, based on experts' opinions?

Participants ranked the financial risk category first, followed by infrastructure, commercial, technical and operational, and finally context. When observed from the perspective of risk factors, and therefore an indirect risk categories assessment, the most significant change was the context risk category, which went from the last to the first position. The results showed how the risk category context needs additional attention and can be a rich field to future research.

2. What are the critical risk factors within each risk category?

In the risk assessment phase, 25 risk factors were recognised. Ranked by frequency, the top five were identified. The 'political interference' critical risk factor ranked first, where 70% of the observations were in the context category. Second, the critical risk factor 'no baselines for performance measurement', where 47% of the observations were in the commercial category. Third, the 'unfavourable global private investment climate' risk factor where 72% of the observations were in the financial category. The 'non-payment of bills' risk factor ranked fourth, where 92% of the observations were in the commercial category. Finally, the 'water asset condition uncertainty' critical risk factor ranked fifth, where 90% of the observations were in the infrastructure category.

The technical and operational risk category was not identified as relevant in the five critical risk factors' results.

3. How to mitigate the critical risk factors?

For the five critical risk factors identified in the risk assessment phase, it was possible to recognise possible risk treatment or mitigation measures suggested by the participants. The creation of a robust legal framework and the creation of restriction mechanisms with the purpose of reducing the governments' interference was proposed as a possible solution for the 'political interference' critical risk factor.

The existence of control and monitoring mechanisms of the private partner's performance could anticipate future problems in the partnership. These mechanisms could be designed and incorporated in the PPP project before the bidding phase and are a practical solution for the 'no baselines for performance measurement' critical risk factor.

'Unfavourable global private investment climate' critical risk factor could be minimized. Participants suggested, for example, that the government could act as the endorser of the necessary investments. The political risk insurance could act as an interesting contribution to transfer risk, bringing more security to the private partner in case of major disasters, especially in developing countries, against adverse government actions or war and terrorism.

Pro-poor measures, updated customers and assets databases, and the application of alternatives collection solutions, such as pre-paid water meters, could emerge as possible solutions to address the 'non-payment of bills' and 'water asset condition uncertainty' critical risk factors.

4. How can the key risk indicators concept improve the current risk management framework of the contracts?

Although the context and financial risks categories are extremely relevant to the risk management framework, the interviewees struggled to present possible solutions.

Considering the research's outputs (see Chapter 4.5), the introduction of key risk indicators supports and improves the current risk management framework as a valid claim. The research's key risk indicators approach in PPP contracts added a phase into the supervision (monitoring and reviewing) that assesses the evolution and trends of the critical risk indicators. External contract assessments, the capture of megatrends, the construction of future scenarios and risk evolution are timely incorporated in PPP contracts during their life cycle. These external factors are easily connected to the context and financial risks categories. The macroeconomic trends and markets foreseeability are not easy to introduce in PPP contracts during the procurement phase until the contract's

signature. Contracts renegotiation are currently an alternative, but they are costly and time-consuming (Guasch et al., 2014).

The key risk indicators concept in the PPP contracts was presented to the interviewees as an open question. Using the Gioia methodology combined with the analysis software MAXQDA, the researcher proceeded to the coding process of the first and second order. The researcher presented on the data analysis subsection the link between the codes and presented the relation between them. The results supported the research question that the key risk indicators concept could improve the current contracts risk management framework as a monitoring and control tool by increasing the current contracts' knowledge. They would be focused on capturing the risks of the current contracts and on a later phase, future threats that cannot be predicted when both partners sign the contract.

The interviews provided insights into how the process should be built and indicated the government as the logical process owner. Supported by this claim, the researcher revised the attributions of PPP Units and their advantages, which are already in use in several countries.

PPP Units, however, have a long way to go and much room for improvement. A solid government reputation associated with high levels of transparency can increase the potential for current and future PPP projects. The literature reports that PPP Units can be fundamental to increasing PPP projects' success, but units' qualified personnel and management are not enough to secure this success. Supervision of tasks and governments' legal support combined with PPP Units' empowerment and independence are also essential to their ability to fulfil their mission (Neto et al., 2020).

CHAPTER 5: RISK APPROACH IN PPP WATER CONTRACTS IN DEVELOPING COUNTRIES – THESIS' THIRD OBJECTIVE

This chapter addresses the third thesis' objective by observing the risk approach in PPP water contracts in developing countries and using a case study methodology (see Chapter 5.1). The chapter has six major sections. The results were based on a narrative description of the country's context, PPP law and water sector in Mozambique (see Chapters 5.2, 5.3 and 5.4).

In Chapter 5.5 a PPP water contract is analysed using a risk matrix. With the purpose of triangulating the risk matrix results, two in-depth interviews were performed.

The last section shows the risk contract analysis' results and contributions to the thesis' objectives (see Chapter 5.6). The results should provide and support answers to the research questions.

5.1 Research design – case study

The case study as a research design was successfully and previously used (Senot et al., 2016; Shrestha et al., 2017). This research design can be used recurring to qualitative (Abednego & Ogunlana, 2006; Cruz & Marques, 2012), quantitative (Ameyaw & Chan, 2016; Xu et al., 2010) or mixed methods (Guerrini & Romano, 2017; Ibrahim et al., 2006).

Table 5-1 shows several examples of scholars' previous studies using the case study research design, including a combination with qualitative or mix methods. The studies presented are connected to the PPP water sector analysis, which demonstrates the scientific validity of this research design. All the presented journals' studies ranked first quartile (Q1) or second quartile (Q2) in the SJR for 2018. This rank allows scholars and researchers to assess the quality of the studies, including peer review requisites (Sun, 2019).

The working methodology and the techniques used in qualitative research allow investigators to retain the holistic and meaningful characteristics of real-life events – such as individual life cycles, small group behaviour, organisational and managerial processes, neighbourhood change, school performance, international relations, and the maturation of industries (Yin, 2014).

Table 5-1: Studies using the case study research design

Autor's	Study name	SJR[a]	Research design	Methodology
Abednego and Ogunlana (2006)	Good project governance for proper risk allocation in public-private partnerships in Indonesia	Q1	Case study	Qualitative
Appuhami et al. (2011)	Coercive Policy Diffusion in a Developing Country: The Case of Public-Private Partnerships in Sri Lanka	Q1	Case study	Qualitative
Cruz and Marques (2012)	Mixed companies and local governance: No man can serve two masters	Q1	Case study	Qualitative
Gopakumar (2014)	Experiments and counter-experiments in the Urban laboratory of water-supply partnerships in India	Q1	Case study	Qualitative
Guerrini and Romano (2017)	Contract renegotiation by an Italian wastewater utility: Action research to promote effective tariff revision	Q1	Case study	Mixed methods
Ibrahim et al. (2006)	The analysis and allocation of risks in public private partnerships in infrastructure projects in Nigeria	Q2	Case study	Mixed methods
Luís et al. (2015)	Assessing interdependent operational, tactical and strategic risks for improved utility master plans	Q1	Case study	Mix methods
Luís et al. (2016)	Evolution of strategic risks under future scenarios for improved utility master plans	Q1	Case study	Qualitative
Marques (2016)	PPP arrangements in the Brazilian water sector: A double-edged sword	Q2	Case study	Qualitative
Marques (2018)	Is Arbitration the Right Way to Settle Conflicts in PPP Arrangements?	Q1	Case study	Qualitative
Marques and Berg (2011a)	Public-private partnership contracts: A tale of two cities with different contractual arrangements	Q1	Case study	Mixed methods
Neto et al. (2020)	PPP Development and Governance in Latin America: Analysis of Brazilian State PPP Units	Q2	Case study	Mixed methods

Note: [a] SJR for 2018.

The first step was to assess if the case study option was the best and the most adequate analysis technique, i.e. if the response received was acceptable for our research problem. The researcher started by searching the answers to the questions below (Yin, 2014).

The research questions were the 'how' or 'why' type. The thesis' third objective – 'Risk approach in PPP water contracts in developing countries' fulfilled this requisite. The research questions were (see Table 5-2):

Table 5-2: Thesis third objective – research questions

Thesis third objective research questions	Chapter reference
1. How are the PPP water contracts in developing countries designed to address risk?	5.5
2. Is there room to improve PPP water contracts in developing countries?	5.5

The research design and data collection used (narrative analysis resulting from secondary data, in-depth interviews and contract template analysis) were explained in detail in Chapter 3.3. The researcher performed the in-depth interviews, selected the interviewees, performed the interviews and analysed the PPP water contract. The results are presented in Chapter 5.6 and were based on the triangulation of each individual's contributions (see Chapters 5.2 to 5.5).

The researcher had no direct contribution to data collection. Consequently, there was no risk of data contamination since the researcher's participation was limited.

The research was related to contemporary events. The impacts of the PPP contract are still visible today. Since 2010, when the private partner left the partnership, the company scope was resized and the company name changed. Since then, several options have been considered, including the return to the PPP contract model. This fact increased the research contributions significantly.

The construction and elaboration of the case study should fulfil the following steps (Yin, 2014): i) planning stage; ii) design; iii) prepare; iv) collect and v) analysis – validation – conclusions. For additional information see Chapter 3.3.1.

The analysis results can be observed in Chapters 5.2, 5.3 and 5.4 Chapter 5.6 presents the results and the contributions to the thesis' third objective, complemented by the conclusions presented in Chapter 6.

5.2 Mozambique's context

From an analytical perspective, the World Economic Situation and Prospects categorised all countries in the world into three broad categories that reflect the basic economic conditions of each country: i) developed economies, ii) economies in transition and iii) developing economies (United Nations, 2019). According to the same source, each category can be split into subgroups based on, e.g. their geographical location. In the developing countries category, the considered geographical regions are East Asia, South Asia, Western Asia, Africa, Latin America and the Caribbean.

The World Bank Atlas method adds the per capita gross national income converted to current US$ to the previous classification. The Atlas method is based on the average of the current year and the previous two years' exchange rate to adjust inflation to the country's current prices (Fantom & Serajuddin, 2016).

In the World Bank database of 2018, Mozambique ranked as a low-income economy (US$ 1,025 or less), geographically located in Sub-Saharan Africa (Fantom & Serajuddin, 2016; United Nations, 2019).

Mozambique is an independent country since 1975. From 1977 to 1992, the country was hit by a civil war between the Front for the Liberation of Mozambique (Frelimo) and the Mozambican National Resistance (Renamo). During this time, the country lost a considerable part of its internal production, and presented a reduction on the productive assets, low investment in the infrastructure and poor investment levels (Coelho et al., 1998).

The country has 28 million people (data updated in 2016), it stretches near 2,000 kilometers, it has 2,500 kilometers of coastline and an area of 800,000 square kilometers. It is bordered by six countries and it has a strong economic connection with South Africa (World Bank, 2017b).

Frelimo maintains the control of the country since the independence and it has won the presidential and parliamentary elections six times (European Union, 2019; World Bank, 2017b). The presidential elections of 2019 confirmed that tendency. Results confirmed by the international observers, confirmed that Frelimo won the election in all country districts with 73.46% of valid votes and two-thirds of the parliamentary seats (184 seats). The second political force, Renamo, had 21.48% and 60 parliamentary seats, followed by the third-largest political force, the Mozambique Democratic Movement (MDM) with 4.33% and six parliamentary seats (European Union, 2019).

The country shows a gradual decline in corruption control, accountability and government effectiveness (Macuane et al., 2018; World Bank, 2017b). The perception of considerable levels of corruption of public services, inadequate accountability and use of government revenues and natural resources led to the decrease of the credibility by the civil society organizations (World Bank, 2017b). Additionally, some geographic areas controlled by Renamo are rich in natural resources, which also has an impact on the political stability and safety treats (Green & Otto, 2014).

In February 2017, Mozambique's government presented a debt crisis. As a result of undeclared loans involving three companies connected to the security services, Mozambique's external debt was 137% of its gross domestic product, adding up to US$ 2 billion. The result was that the ability to fulfil the debt service until 2021 was compromised without external help. In this context, the intervention of the International Monetary Fund was requested and the multilateral agencies suspended all loans. To reestablish trust, Mozambique's government agreed to an independent international audit and displayed results of the undeclared loans (Macuane et al., 2018).

Combined with political and security problems, the debt crisis of 2017 led to low investments levels and the credit rating agencies ranked Mozambique with the Moody's classification of Caa3[4] (World Bank, 2017b) as debt levels increased. Recent data from September 2019 showed a slight improvement to Caa2 (Villa & Diron, 2020). The current expected recoveries associated with ratings for defaulted or impaired securities improved from [65%, 80%] to [80%, 90%] (Moody's Investor Service, 2020).

Foreign Direct Investment (FDI) levels are low partly due to the public administration sector (World Bank, 2017b). For example, in the extractive sector the FDI reduced 48% between 2015 and 2016. The manufacturing sector suffered a possible reduction driven by the slowdown of the construction and utility sectors. In the same period, the agricultural sector registered positive numbers, although it is highly exposed to climate shocks.

The combination of currency depreciation and fragile financial sector put the Mozambican banks at risk (World Bank, 2017b).

[4]The classification of the Caa Moody´s obligations are considered to be speculative with poor standing and exposed to a very high credit risk. The notations 1, 2 and 3 complement the previous classification, where '1' indicates the highest rank of its generic category, '2' indicates the middle range and '3' the lowest (Moody's, 2020).

5.3 Mozambique PPP experience

In 1989, Mozambique's government engaged in a national privatization policy, following the neoliberal economic mainstream. Companies under the government's control and considered as monopolies, such as telecommunications, water and ports, were open to private initiative. Between 1996 and 2002, several types of PPP contracts were performed (Pequenino, 2017).

In August 2011, through Law No. 15/2011, of 10 August, Mozambique formally created the first specific legislation on the PPP economic model. Figure 5-1 shows the evolution of Mozambique's PPP contracts over the last decades.

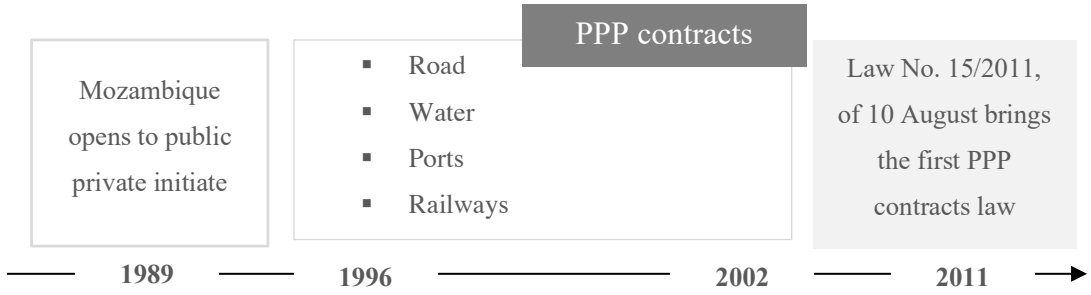


Figure 5-1: Evolution of private initiative in Mozambique and PPP contracts

PPP contracts before PPP law

The EN4-Maputo-Wikbank road was a PPP contract performed between the Republic of South Africa through the National Road Council, the Republic of Mozambique and the Trans African Concessions. According to Pequenino (2017), the contract object included the promotion, design, construction, rehabilitation, finance, and the construction of the tolls system and connected infrastructures. In practical terms, it included the rehabilitation of 380 km of the existing road and the construction of additional 50 km (Taylor, 2000). In terms of the infrastructure contracts' nomenclature, it is considered to be a concession type that combines the ROT and the BOT models (see Table 1-1 in Chapter 1.1.1). The contract was signed in 1997 and should last 30 years. The contract involved US$ 650 million, and the tolls collection was based on the direct user's fee charges. The funds were locally raised. The EN4-Maputo-Wikbank road was an answer to the necessity of improving the already strong economic trade between the two countries, and it also including the neighbouring countries, Botswana and Namibia. The risk was mainly allocated to the concessionaire who could have its project investment return affected by the existence of alternative routes (Osei-Kyei & Chan, 2016). The project was considered

to be a success and started its operations in 2000, presenting a reduced number of customer complaints. Transparency and adequate procurement procedures were added as the potential cause of the project's success (Osei-Kyei & Chan, 2016; Taylor, 2000).

The experience of PPP in the water sector happened through the concession contract between Fundo de Investimento e Património do Abastecimento de Água (FIPAG) and Águas de Moçambique, S.A.R.L. (AdM) as a private party. The contract started in 1999, it was revised in 2004 and the Republic of Mozambique acquired the private participation in 2010. Partners agreed on the payment of a financial compensation regarding the remaining years of the contract (between 2011 and 2014), and the debt payment of US$ 7,03 million to Águas de Portugal (Pequenino, 2017). The current case is detailed and explained in Chapters 5.4 and 5.5.

The Port of Maputo was a PPP contract performed between the Republic of Mozambique through the public company Portos e Caminhos de Ferro de Moçambique and the Sociedade de Desenvolvimento do Porto de Maputo, S.A.R.L. According to Pequenino (2017), the contract object was to optimize and develop operations, including raising the adequate finance levels. Operations started in 2003 and included 15 years of concession, finance, rehabilitation, operation, and upgrading, with the option of managing the port for 10 more years. In terms of the infrastructure contracts' type, it is considered to be a concession type that combines the ROT and the BOT models (see Table 1-1 in Chapter 1.1.1), similar to the PPP road case. It was a pioneering project in Africa, being the first to be developed under a PPP contract model (World Bank, 2009a). The capital expended involved US$ 70 million. The joint venture company was held in 51% by the private partner and in 49% by the public partner. The quality and reliability of service delivery, and the right private partner were decisive factors for the success of this project (Osei-Kyei & Chan, 2016).

The PPP project Nacala Corridor was a new railway which involved the construction of 1,468 km connecting the Moatiz's coal mining area to the port of Nacala. The latter is included in the project that started in 2000 and it has a concession period of 20 years. The company was a shareholding between Portos e Caminhos de Ferro de Moçambique North (49%) and Sociedade de Desenvolvimento do Corredor de Nacala (51%) as the private partner (Rock & Wu, 2020).

PPP legal framework

Developing and implementing the PPP should follow several stages: structuring and appraising the PPP; designing the PPP contract; implementing the PPP transaction – once reached a financial close, the public partner should manage the PPP contract during its lifetime, including monitoring, enforcing the PPP contract's requirements and managing the partnership's relationship (World Bank, 2017a).

Law No. 15/2011, of 10 August, complemented by the regulation Decree No. 16/2012, of 4 June, has the purpose of creating rules and a legal framework for PPP contracts in Mozambique (Pequenino, 2017).

Structuring and appraising the PPP is the first step of the PPP contract framework. In this phase, all the project's key aspects are expected to be assessed. Taking into account the infrastructure complexity, contract's targets and objectives are defined. These factors can increase the procurement costs and have simultaneously a negative impact on the preparation time (Love, 2002; Pu et al., 2020). Second, a draft the PPP contract is expected to be designed. A well-structured initial stage can generate a reduction of costs in the procurement phase (Kwak et al., 2009).

The third phase is implementing the PPP transaction. The procurement is connected to the public tender process (Pu et al., 2020). Factors such as transparency and previous value for money studies can have a significant impact on the procurement process. According to the authors, the public tender process is relevant. An incorrect choice will increase the possibility of conflicts between partners and contract renegotiation. Issues such as the quality of service and value for money are at risk if the terms of the contracts are not correctly defined, or for example, if the wrong bidder is selected.

The Mozambican PPP procurement was decidedly connected to the public tender rules. The PPP contract is an administrative contract that follows all the public tender procedures and, consequently, all the related rules of the public tendering rules (Pequenino, 2017).

The pre-contractual procedures that include the project conception and the design can be elaborated by the private or by the public providers. The government is responsible for defining all the major steps in the project. All the procedures must respect the principles of a healthy and competitive environment, as well as transparency.

The PPP contract must have mandatory contractual clauses as a result of Decree No. 16/2012, of 4 June. They should include the identification of counterparties, the duration

of the contract, the description of the contract's objective, monitoring methods applied, levels of service or goods, and the definition of the public and private obligations and rights. Additionally, it should include the property and land's rights, and licenses and permits during the construction phase, when applicable. The method for adjusting tariffs, accountability and records should also be considered. The sanctions and its calculation are mandatory.

The contract should define the conditions that lead to a contract revision terms. The contract's termination, including the compensation scheme, must also be defined. Finally, the contract must have anti-corruption contractual clauses.

Decree No. 16/2012, of 4 June also defines the need to perform all the feasibility studies (e.g. financial-economic nature and environmental), before formally starting the tendering phase.

The public tendering rules should be followed. In exceptional cases, depending on the government's approval, it is possible not to follow the open procedure and choose alternative models such as the direct award procedure. Pequenino (2017) argued that this exception is being overused by Mozambique's government. The author claimed that from 2011 to 2017 there was no open procedure PPP contract used. The author provided the examples of PPP contracts such as the PPP concession railway line between Chiúta and Nacala-à-Velha, the PPP concession railway line of Tchobanine, the PPP concession of the Port of Coal of Tchobanine, the PPP concession railway line of Moatize-Malawi-Nacala-à-Velha and the PPP concession of the Port of Coal of Nacala-à-Velha. They were all contracted based on the direct award procedure.

The contract's monitoring procedures predict that the private partner must be available to receive inspections and auditors in their facilities and infrastructures. The period report provides evidence of the levels of service and other equally pre-agreed key performance indicators. It is mandatory and the private partner's responsibility.

Transparency issues were a concern when designing the PPP contract legislation in Mozambique. Law No. 15/2011, of 10 August says that all the annual reports produced by the PPP companies, including the key events and financial statements, should be of public domain. The government is responsible for providing accountability of the PPP projects and contracts. It is mandatory to declare all PPP contracts (including the ones that are in the procurement phase) in the annual government budget by contracts' type and category. The Public Integrity Center of Mozambique claimed that there was a lack

of published data regarding the PPP contracts' performance, which does not comply with Law No. 15/2011, of 10 August (Mabunda & Cavelane, 2014).

During the operations phase, the PPP contract should be monitored and supervised by the public partner and by the sector regulator. The public partner can start the process of ending the partnership if one of the following situations is identified: a significant low performance that compromises the contract's objectives; a lack of payment of financial obligations as stated in the contract; the contract's transmission to a third party without the consent of the public partner and all the third public parties responsible for monitoring the contract; or another severe contractual breach e.g. decrease of service levels, the project is abandoned or an unjustified suspension of operations (Pequenino, 2017).

Under the PPP law in Mozambique, the contract termination is possible when one of the following conditions happen: the contract expires due to the end of the contractual terms time frame; contract termination by the public partner based on the need to protect the public interest; and contract termination.

According to Pequenino (2017), the available mechanisms to help solving PPP conflicts in Mozambique are categorized in two groups. The first are the non-jurisdictional mechanisms that include direct negotiation between partners, conciliation, mediation and arbitration. The second are jurisdictional mechanisms, the administrative litigation.

PPP monitoring process

In Mozambique the PPP monitoring responsibility was shared among the Ministry of Economy and Finance, the sector regulator and the public partner, according to each PPP contract. In line with Law No. 15/2011, of 10 August, the Ministry of Economy and Finance had the financial monitoring responsibility. From an economic and financial perspective, the government was responsible for the designation and provision of the needed resources of intersectional collaboration to proceed to the evaluation of the PPP contracts. The researcher concludes that there was not a national PPP Unit that had the responsibility to observe the performance of PPP contracts in an integrated manner (e.g. financial-economic and operational performance).

Observing the risk management framework approach, it was possible to conclude that the monitoring and reporting of PPP contracts were allocated to different public players, restraining the possibility to obtain a consistent overview of the PPP contracts in Mozambique. As a consequence, the implementation of additional monitoring measures

and reporting tools was not an easy task to be performed consistently and in a timely way. Improvements in securing the accountability of the projects and in implementing an adequate risk management approach were required.

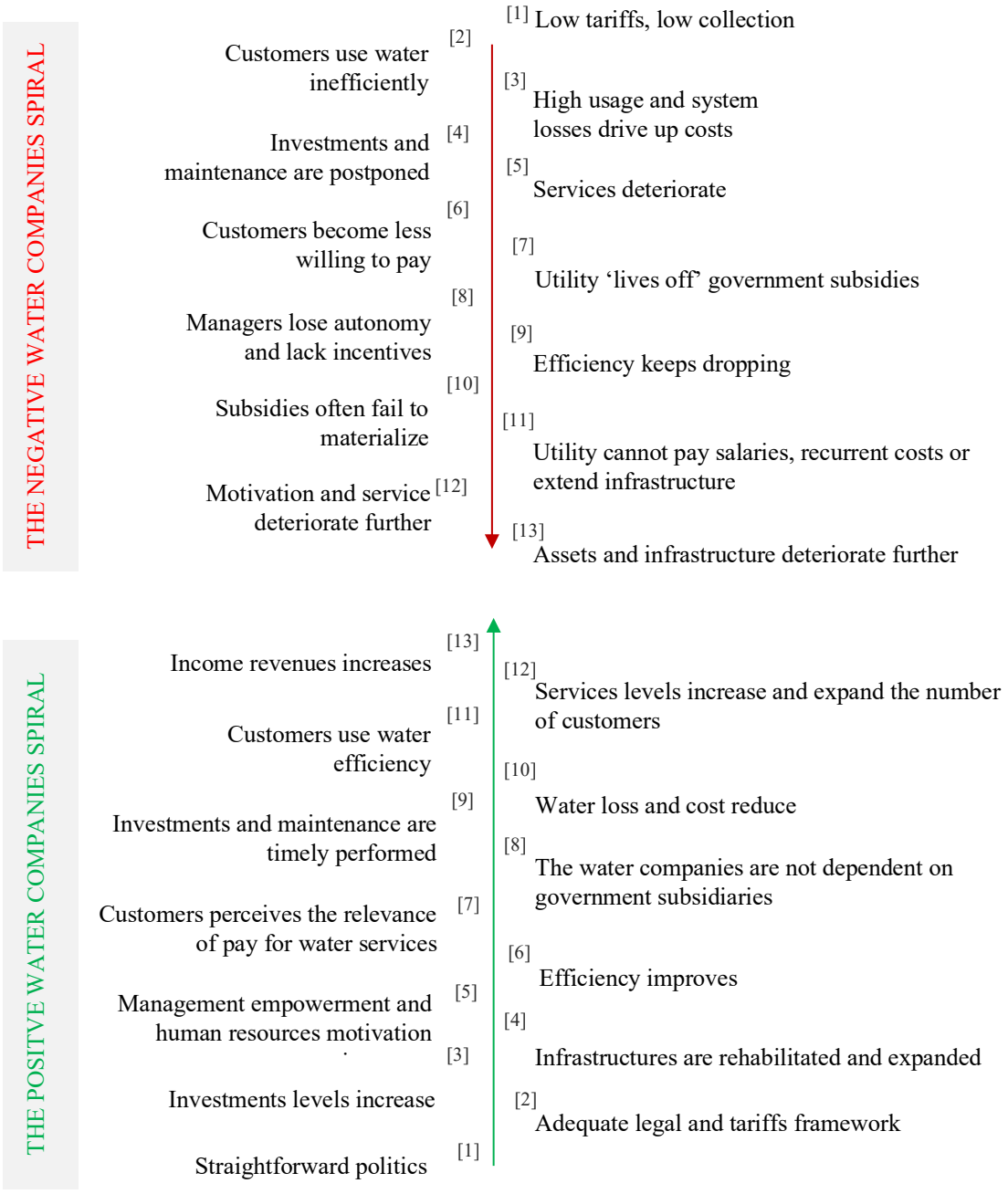
5.4 The water sector in Mozambique – context and evolution

In 1998, Decree No. 72/98, of 23 December approved the Delegated Management Framework for water supply for provincial capital cities and others that were deemed convenient and a priority. The FIPAG (entity responsible for performing the infrastructure investments, including the financial management of water supply assets) and the Conselho de Regulação do Abastecimento de Água (CRA[5]), hereinafter referred to as sector regulator, that had the goal to regulate the water sector, set tariffs, mediate the relations between FIPAG, the water companies and customers, were the main actors responsible for implementing the Delegated Management Framework (Cronjé & Beete, 2009; Wilson & Dias, 2016).

The Delegated Management Framework was Mozambique's government answer to the need for improving the water sector standards. Figure 5-2 supports this claim, presenting the negative spiral decline of services' performance of water supply in developing countries (Beete, 2010; PPIAF, 2004). The region context and a cycle of consecutive events led to the decline of water supply services. Low tariffs and collection levels led to an inefficiently water use by customers, thus increasing the water losses. When preventive maintenance is postponed, the service levels decrease. The customer starts having a perception of the low-quality service level, which combined with the context (a developing country, where most of the population has a low-income), affects their willingness to pay for the water services.

The water companies are highly dependent on government subsidies, having to informally agree with government's interference and the reduction of local managers' autonomy. Poor accountability structure and real productivity incentives contribute to efficiency reduction (PPIAF, 2004).

[5]Decree No. 18/2019, of 18 February, increased the CRA mandate. Since 2019 CRA's designation is Autoridade Reguladora de Águas, Instituto Público AURA I.P.



Source: Adapted from '*Quadro da Gestão Delegada: A Evolução dos Sistemas de Abastecimento de Água e a Regulação*' of N. Beete, 2010; *Conference 14º ENaSB*, 10 and 'New Designs for Water and Sanitation Transactions : Making Private Sector Participation Work for the Poor' of PPIAF, 2004.

Figure 5-2: The negative and positive water companies spiral

The economic and political context in developing countries often fails to secure the attribution of the necessary financial funds (subsidies), which, in turn, ensure the financial and economic sustainability of the water companies. As a consequence, water companies have financial difficulties and struggle to comply with their obligations, e.g. attracting and maintaining highly qualified human resources and performing the necessary

investments in infrastructures. The combination of these factors leads to low levels of motivation and service standards, which highly contribute to the deterioration of the infrastructures.

The Delegated Management Framework was Mozambique's answer to reverse the spiral decline of water supply service performance and move to the positive water companies spiral. For that, it was necessary a paradigm shift (see Figure 5-2) (Beete, 2010; Cronjé & Beete, 2009). When initially conceded, the Delegated Management Framework was designed to have the following steps: infrastructure rehabilitation and expansion, expansion of operations and maintenance of the water systems, and the economic and financial sustainability of the systems. These steps were not considered isolated from each other. In fact, the first two steps can happen almost simultaneously (Beete, 2010).

The starting point is to assess water losses and take measures to reduce them. The assessment phase should be based on studies that allow a correct overview of the water systems' current status. These studies will simultaneously provide the investment needs in rehabilitation and infrastructure expansion, including the current service levels, customers and identification of possible scenarios. The water sector design should be based on pre-defined rules and procedures.

The last step, the economic and financial sustainability of the systems, is the consequence and result of the successful implementation of the Delegated Management Framework. A sustainable water systems expansion is the result of considerable operation costs' reduction and an increase in efficiency and paying customers. According to the Delegated Management Framework, the water companies reduce their dependence from government subsidiaries, increasing their independence and becoming less vulnerable to political interference.

The Delegated Management Framework design encourages the private sector's participation in the water sector. The control, monitoring and water company' performance, as well as performing the investments in infrastructure, should be all under the control of a public entity (Beete, 2010; Cronjé & Beete, 2009). In this context, FIPAG was created (see Figure 5-3).

The private sector' participation in the Mozambican water sector had the purpose of increasing the quality of service, providing access to technology and improving local human resources skills. There were three major options for the private sector's

participation in the water sector: i) technical assistance, performance management contract (the operator receives a management fee-based in performance achievements); ii) *affermage* contract (the private partner pays a fee to the infrastructure owner); and iii) the concession contract (the private partner has the responsibility to finance the investments programme, reverting the infrastructure to the public partner when the concession ends).

Figure 5-3 summarises the water sector evolution in Mozambique since the Delegated Management Framework creation and the sector regulator in 1998.

The FIPAG started its operation in 1999. In the same year, there was the first PPP experience in the water sector in Mozambique with the signature of the PPP contract with AdM.

The private sector had several initiatives over the years. Under the FIPAG' responsibility, we can highlight the PPP contract AdM and the management partnership through technical assistance contracts formed between Vitens Evides International (VEI) and FIPAG.

The initial PPP contract AdM of 1999 was renegotiated, and one of the private partners left the contract. The partnerships officially ended in 2010 when the Mozambican government, though FIPAG, acquired the private partner's part in the PPP contract. Since 2011, the national water company, Águas da Região de Maputo has been responsible for the water supply in the cities of Maputo, Matola and Boane village. The management model is currently under revision.

The Management Partnerships with VEI started in June 2003 with the signature of a Letter of Intent Collaboration with FIPAG (Coppel & Schwartz, 2011). The two first contracts were performed under the international collaboration and free of charge for FIPAG (World Bank, 2009b)

In 2004, a technical assistance protocol for management support and training was signed in four cities, Xai-Xai, Chokwe, Inhambane and Maxixe in Southern Mozambique (Coppel & Schwartz, 2011; Cronjé & Beete, 2009). The contract had a time scope of seven years (from 2005 to 2012), and an amount of US$ 11,3 million supported by VEI. The Water Operators Partnership for Southern Cities in Mozambique contract provided technical assistance in a vast scope of services, namely:

- Financial management and customer services.
- Asset and repair, and rehabilitation services.

- Reduce the level of non-revenue water.
- Support and capacity building in general plans and programs.
- Daily management, operations and maintenance.
- Water operations.

In 2006, five more technical assistance contracts were added: Chimoio, Gondola, Manica, Tete and Moatize. The contracts' time scope was from 2006 to 2012, and the amount was of US$ 7,35 million. Similarly, to the previous contract, interlay was supported by VEI. At the time, the main goal was to improve the management and operations of the water supply operator. The water companies should be able to provide safe and reliable water services to their users and sustain these services. The scope of services included:

- Daily technical management.
- Daily non-technical management support.
- Asset management, repairs, distribution renovation.
- Reduce the level of non-revenue water.
- Support and capacity building in general plans and programs.
- Urban development and planning.

In 2012, the Capacity Building in Sustainable Water Infrastructure Management in Mozambique Northern Region contract was signed. The contracts' time scope was from 2012 to 2016, and the amount was of US$ 1,63 million, of which US$ 1,045 million (64%) were supported by VEI. At the time, the contract objective was to capacitate the management teams of FIPAG Northern Regional Office and water supply companies Angoche and Nampula through:

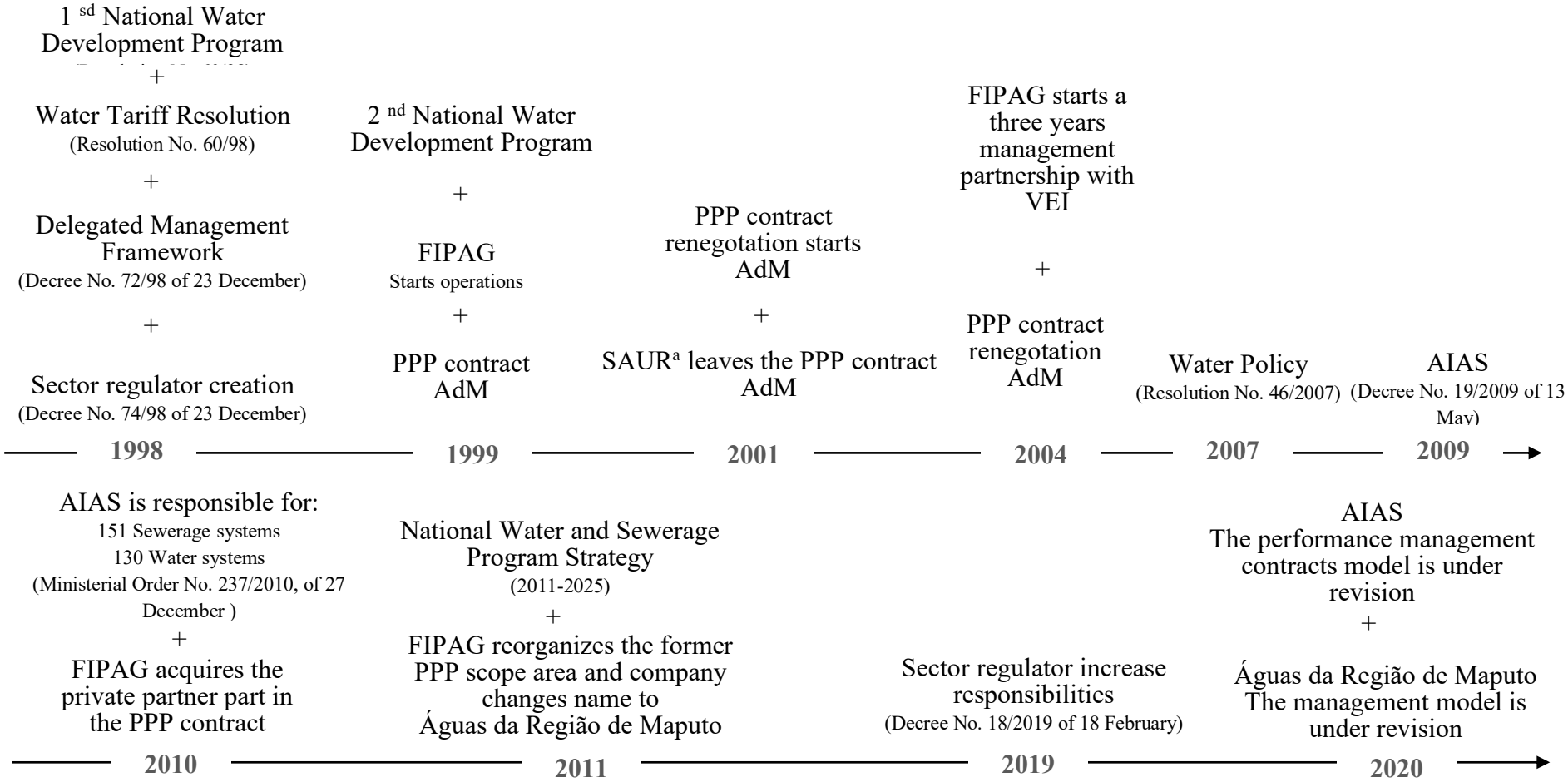
- Staff training in change management, finance, business planning and control.
- Embedding roles and responsibilities of relevant stakeholders in the water sector.
- Formulating project proposals to attract investments.
- Executing a baseline survey in Angoche and Nampula′s peri-urban areas to raise users' awareness of public standpipes and train operators of standpipes and include relevant stakeholders to increase drinking water access.
- Providing training to staff of FIPAG Northern Regional Office and water supply companies of Angoche and Nampula.

The contracts' objectives were completed on schedule and considered a success regarding the expected outputs. Appendix J provides an overall view of VEI's projects in Mozambique until 2020. VEI's regional manager provided the data with the purpose of supporting and contributing to the research. In parallel Mozambique was creating the necessary institutions to support the Delegated Management Framework.

In 2009, Decree No. 18/2009, of 13 May, approved the extension of the scope of the Delegated Management Framework for Water Supply and Sanitation.

In addition to FIPAG and the sector regulator, the Administração de Infra-estruturas de Água e Saneamento (AIAS) was created (Decree No. 19/2009, of 13 May) for the implementation of the Delegated Management Framework. Their mission was aimed for efficiently manage the water supply systems of the main cities and the main villages of each district, and others that are allocated, as well as the sewerage systems of all urban centres in the country. It was up to this infrastructure management to promote the operational management of the systems to autonomous agencies, both private and public.

In this context, and through Ministerial Order No. 237/2010, of 27 December, 130 water supply systems and 151 sanitation systems were transferred to the management of AIAS. With funding from the state budget and the Netherlands through the Projects (PO15 and PO35), AIAS intervened in around 50 water supply systems and awarded the operational management to: i) 19 operators (several private entities by public tender – operational agreement); ii) three systems to FIPAG (autonomous public entity, based in a management agreement); and iii) three systems under the direct management of the respective municipalities (Namaacha, Manhiça and Vilanculos, on the basis of a collaboration agreement).



Note: [a]The private partner was the consortium of SAUR International, IPE Águas de Portugal International and five local investors (Cronjé & Beete, 2009).

Figure 5-3: Mozambique water sector evolution over the last two decades

The concession contract model was not applied to the systems under the AIAS' responsibility. The autonomous public agencies that ensured the operational management of the systems were awarded through a direct award procedure and on the basis of the collaboration management agreement. These were contracted as 'operators' by public tender for a period of five years and with the possibility of being renewed for a maximum period of two years. The performance models' contracts are currently under revision. According to the new contracts' templates provided by AIAS, the major changes should bring more transparency and contract rules' definitions. Quality standards and water system rules were defined. The obligations and duties of the public and private partners were clarified. The private partner was obliged to comply with the sector regulator' report requests. Economic and financial performance was defined, including the contractual fees that the private partner was required to pay to the public partner and the sector regulator. Transparency concerns were taken into account, with the introduction of anti-corruption clauses in the contracts. The contract extinction and the available mechanisms to solve conflicts were described. The new contracts model should be approved by the end of 2021.

5.5 PPP water contract analyses–risk approach

The risk approach in PPP water contracts in developing countries was the thesis' third objective. To approach the research questions, the PPP water contract in Mozambique was selected, using content analysis, risk matrix technique and in-depth interviews.

Chapter 5.5.1 provides the PPP water contract's context and time frame. The risk matrix results (see Chapter 5.5.2) and the triangulation of the obtained results with the two in-depth interviews are shown below. The outputs provided answers to the two research questions (see Chapter 5.1, 5.5 and 5.6).

5.5.1 PPP water contract context

The PPP water contract procurement process had the objective of providing water services to the city of Maputo for 15 years, and to Beira, Quelimane, Nampula and Pemba for five years.

The contract was signed between FIPAG and the consortia representing the AdM on 27 September 1999 (see Figure 5-4). Under the same contract, an *affermage* contract (city of Maputo) and a management contract (cities of Beira, Quelimane, Nampula, and Pemba) were included (see Table 1-1 in Chapter 1.1.1). The services in each area were independent of each other, including the management of the five cities (Maputo and the four cities) which was under the direct responsibility of the consortia.

The international public bidding started in October 1998, with three pre-qualified consortia companies. According to Cronjé and Beete (2009), the submitted proposals included two significant parts: financial (worth 75%), and technical and operational (25%).

The final result was a balance of each city's contribution to the contract. Maputo water sales represented 70%, and the remaining four cities 30% (World Bank, 2009b).

It was proposed a fee to be paid by the wining consortia for the first five years in the case of the city of Maputo and the four cities. The wining proposes, also included the tender supervision services during the first five years and the investment program management (Cronjé & Beete, 2009; World Bank, 2009b).

The PPP AdM contract had difficulties throughout the years (World Bank, 2009b). In February 2000, cyclone Eline had a considerable impact on Mozambique, causing the death of 700 people and US$ 400 million of damage (Cosgrave, 2001). Partially due to the natural disaster and the lack of experience in donor projects, AdM failed the timely deliver five service areas between 2000 and 2006 (World Bank, 2009b).

In 2001, the FIPAG and AdM started negotiations to review the contractual terms. The negotiations were the result of a request performed by the sector regulator grounded on the need to defend customers' interests when there are sudden changes in conditions that are not covered by the contract. The negotiations were focused on reviewing the operator's tariffs and the tariff indexing the formula for the area of Maputo due to the sudden changes aforementioned (Cronjé & Beete, 2009). The contract's terms became effective in April 2004. The results were two contracts (see Figure 5-4). The first contract was an *affermage* contract for the Maputo region that should terminate in 2014. The second was a management contract for the other four cities until 2008.

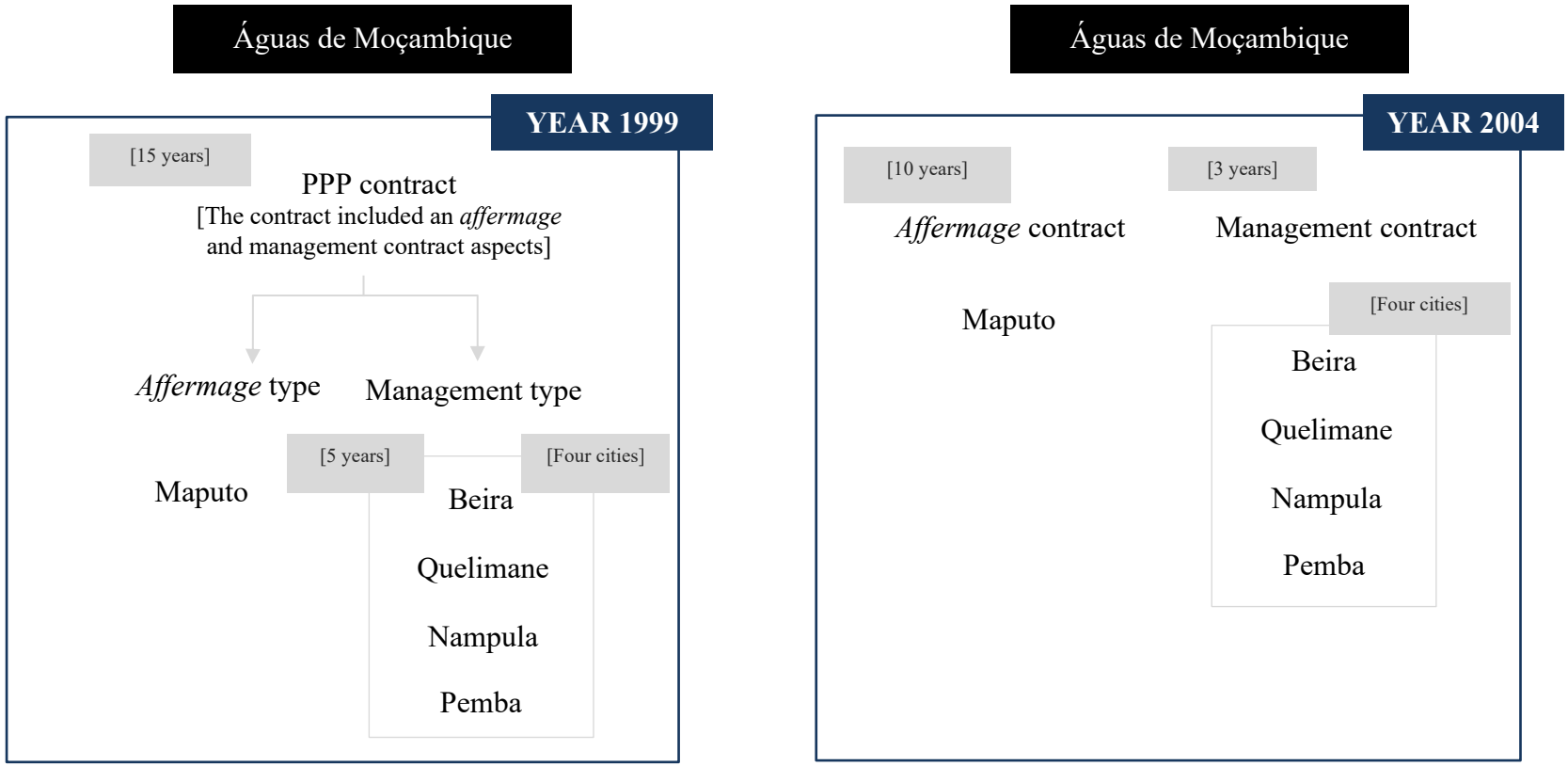


Figure 5-4: PPP water contract evolution

Higher fees were agreed, and service specifications, obligations and procedures were to be introduced: i) the definition of responsibilities regarding reactive and preventive maintenance between the partners; ii) the attribution of responsibilities regarding the replacement of the assets and iii) AdM had to perform the new connections and maintain the ones that already existed (World Bank, 2009b).

The management of the contract terms for the cities of Beira, Quelimane, Nampula and Pemba were renegotiated and extended for three years, ending in March 2008. They had to secure a minimum number of AdM resident staff in each area, to increase the base fee and to introduce output-related fees.

The procurement responsibility of the World Bank was transferred to FIPAG. In parallel, in 2001, AdM was going through several financial problems (World Bank, 2009b). The consortia constituted by SAUR International, IPE Águas de Portugal International and five local investors suffered a setback with the retreat of SAUR International of the partnership. The SAUR International participation was sold to the second shareholder, Águas de Portugal.

A report performed by the World Bank (2009b), showed that in 2007 the results were not positive for the private and public partners. The delegated works program that should provide building capacity to reduce water losses, and implement rehabilitation works and replacements was too delayed. Water service coverage levels, service quality and efficiency levels were below the initial expectations. The collection ratio of 0.87 in Maputo had a significant negative impact on the financial performance and results of AdM. It was not profitable due to the low service coverage, low collection percentage, and the financial cost of the technical assistance contract with Águas de Portugal Internacional Serviços Ambientais, S.A. The AdM management team presented several issues. According to the World Bank's (2009b) report, they were unprepared and presented a lack of management experience to lead this type of contracts in developing countries. Additionally, the AdM design to manage the five contracts failed (e.g. only one team was responsible for managing all contract scope). The lack of direct managers in the other four cites significantly contributed to the lack of operations control.

In December 2010, years after the management contract for the four cities had ended, Mozambique's government bought AdM through FIPAG. A new phase in the management model had started.

The next section is focused on the analysis of the 2014 *affermage* contract through the construction and analysis of the risk matrix.

5.5.2 PPP water contract analysis - risk matrix results

The research method used was a template content analysis based on a risk matrix. This research method has been previously and successfully used (Mahamid, 2011; Sedmak, 2020; Yang et al., 2020).

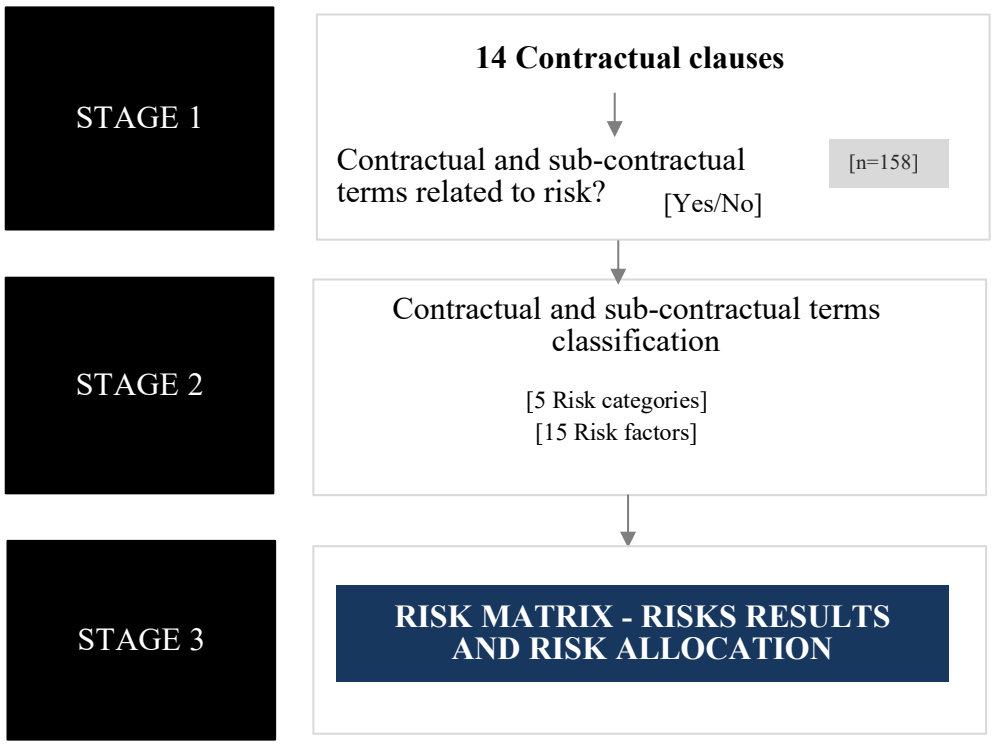


Figure 5-5: Research contract analysis

The Contrato de Cessão de Exploração Revisão do Serviço de Abastecimento de Água Maputo, dated 28 January 2004, was divided according to the contract's chapters to obtain a detailed risk analysis assessment. The results were put into an Excel file and analysed. The contract's content analysis has been previously and successfully applied by scholars (Qin et al., 2019).

Risk management, that includes risk identification, evaluation, ranking and risk treatment or mitigation measures has recently attracted scholars' attention (Ameyaw & Chan, 2015a; Pradhan et al., 2017). Figure 5-5 describes the researcher's risk matrix approach.

5.5.2.1 Stage 1 – risk matrix construction

The researcher identified 14 contractual clauses in the contract. They were decomposed according to their content into the Excel file.

From the initial 567 contractual and sub-contractual terms, the researcher removed the clauses that were not connected to risk, reducing them to a total of n=158 (see Figure 5-5).

5.5.2.2 Stage 2 – risk categories and risk factors identification

The risk matrix primary results allowed to identify 158 contractual and sub-contractual terms. The results allowed to identify the existence of five main risk categories: i) financial risks, ii) context risks, iii) technical and operational risks, iv) commercial risks, and v) infrastructure risks and 15 risk factors, based on the literature contributions (see Chapter 2.7) (see Figure 5-6).

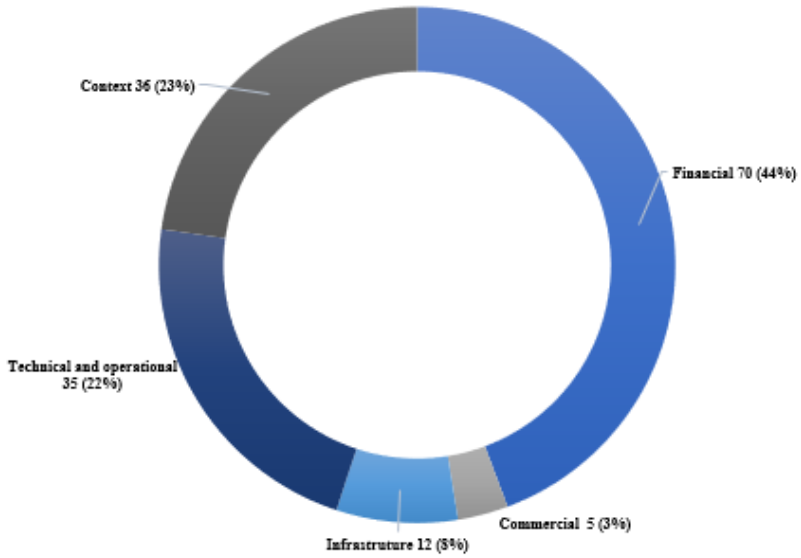


Figure 5-6: Risk matrix and risk categories

The risk category that ranked higher was the financial risk category with 70 risk factors (44%), which is slightly lower compared to the results of the financial purpose in the first contract procurement phase of 75% (Cronjé & Beete, 2009).

Context with 36 (23%), and technical and operational with 35 (22%) ranked second and third with similar results. The infrastructure risk category ranked fourth with 12 (8%) and finally the commercial risk category with only five (3%).

The results allowed the identification of 15 risk factors (see Table 5-3).

Table 5-3: Risk matrix – risk factors list

Risk factors	Risk factor frequency
Absence of policy and legal frameworks	9
Conflicts between partners	22
Construction time and cost overrun	2
Continuous monitoring	20
Corruption	6
Design and construction deficiencies	3
Financial availability	10
Fluctuations demand	1
Inaccurate market forecast	7
Macro-economy consistency situation	5
Non-payment of bills	1
Poor contract design	27
Water asset condition uncertainty	8
Water pricing and tariff review uncertainty	12
Weak capacity of public and private partners	25
TOTAL	**158**

5.5.2.3 Stage 3 – risk matrix results and risk allocation

The identified risks were the result of the unpredictable variation (in value) caused by the variation of a risk factor, which could affect the total project-value.

A total of 15 risk factors were identified in the contract. The researcher attributed to each of the 158 contractual and sub-contractual terms a probability of occurrence (likelihood) and the impact on the contract if it materialised. A Likert Scale from 1 to 5 (where 1 Less Important and 5 Very Important) was considered.

The risk matrix had three zones according to the degree of severity of risk categories and factors: i) green, ii) yellow and iii) red (see Figure 5-7). The 5x5 matrix ranges from 1 to 5 for both impact (horizontal axis) and the probability of occurrence (likelihood) (vertical axis).

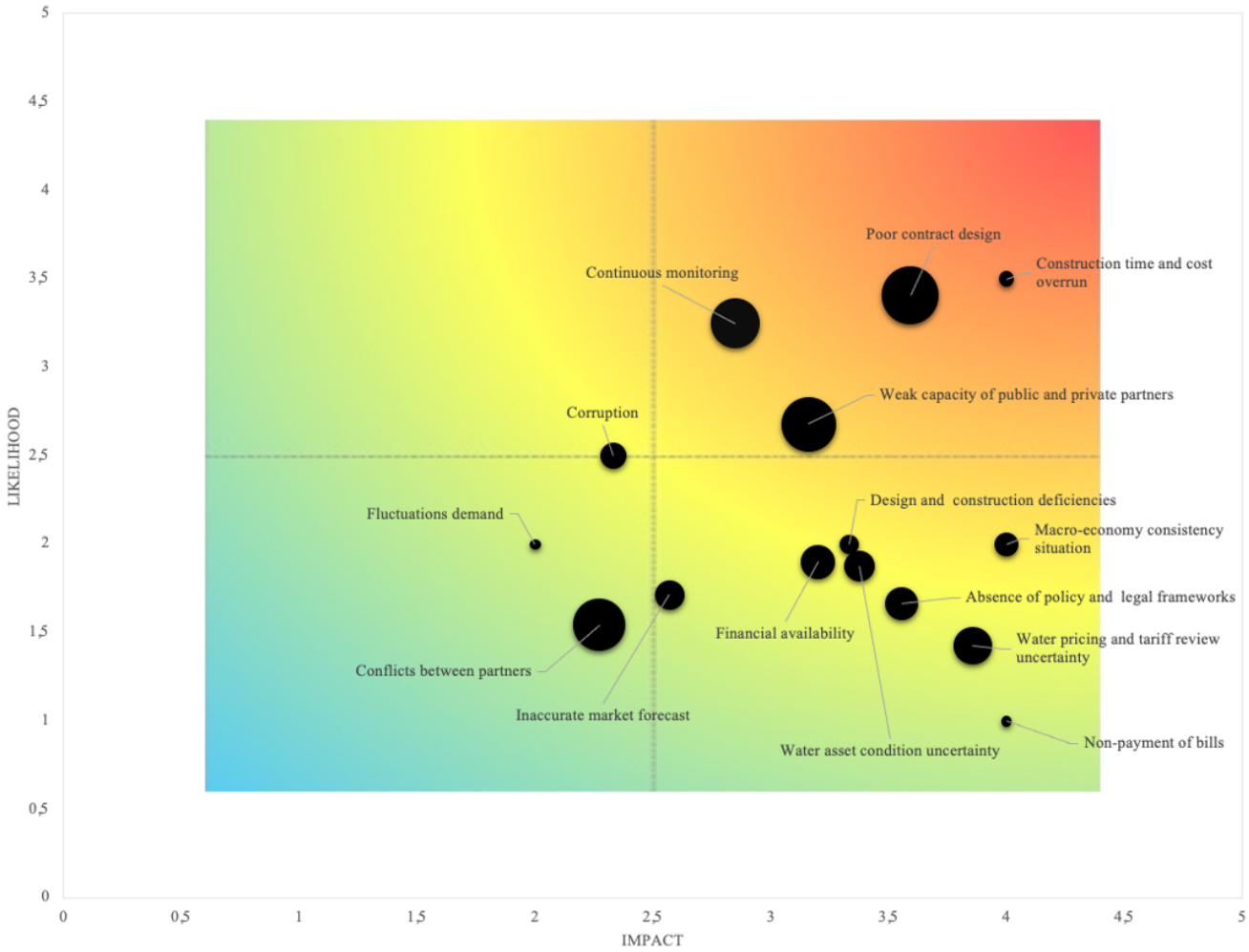


Figure 5-7: Risk matrix results

The size of the bubbles is dimensioned to the number of times that each risk was identified in the contract. The bigger the bubble, the higher the number. The three zones had the following characteristics: i) green zone–risks in this zone are low level and cannot be taken into account; ii) yellow zone–risks present a moderate level of importance; and iii) red zone–where the most relevant risks are. They should have immediate action because they are of critical importance.

Risk results – green zone

Three risks were identified in the green zone. They were a combination of low probability (likelihood) and impact. From the initial n=158, they represented the lowest frequency, 19%, namely 'conflicts between partners' 22 (14%), 'inaccurate market forecast' 7 (4%) and 'fluctuations demand' 1 (1%). It is a relatively low percentage considering that the contract prematurely ended, which shows that risks such as 'conflicts between partners' and 'inaccurate market forecast' should be deeper analysed in the contract design phase.

Risk results – yellow zone

The yellow zone presented 35%, where 'water pricing and tariff review uncertainly' 12 (8%), 'financial availability' 10 (6%), 'absence of policy and legal frameworks' 9 (6%), 'corruption' 6 (4%), 'water asset condition uncertainty' 8 (5%), 'macro-economy consistency situation' 5 (3%), 'design and construction deficiencies' 3 (2%), and 'non-payment of bills' 1(1%) were identified.

Risk results – red zone

The red zone was the one that presented a higher frequency, 47%. 'poor contract design' 27 (17%), 'weak capacity of public and private partners' 25 (16%), 'continuous monitoring' 20 (13%), and 'construction time and cost overrun' 2 (1%) were identified. These results show that the contract had a high-risk exposure and it was necessary to increase the prevention measures (e.g. monitoring mechanisms).

Risk allocation

Risk allocation is also crucial for researchers to understand who is responsible for addressing the identified risks (i.e. the risk owner) (Wibowo & Mohamed, 2010).

From a risk allocation perspective (i.e. risk owner), the researcher observed that the private partner had 74 (47%), followed by the public partner with 36 (23%), shared

responsibilities with 23 (14%), sector regulator with 22 (14%) and the government with 3 (2%).

5.5.3 PPP water contract analysis – in-depth interviews

With the purpose of assessing and triangulating the results from the previous section, the researcher addressed an invitation to two interviewees with managerial responsibilities in the contract. To enrich the research outputs, the researcher selected interviewees that could present different perspectives of the contract (private and public partner).

Table 5-4: Template results

		Frequency
FIRST	**THEME – Risk categories**	
	Financial	13
	Commercial	5
	Infrastructure	4
	Technical and operational	3
	Context	6
	THEME – Risk	
	Conflicts between partners	8
	Construction time and cost overrun	5
	Continuous monitoring	7
	Corruption	2
	Design and construction deficiencies	1
	Fluctuations demand	1
	Non-payment of bills	3
	Poor contract design	4
	Weak capacity of public and private partners	7
SECOND	**THEME – Risk**	
	No risk allocation mechanism	3
	THEME -What are the current problems in the water sector?	4
	TOTAL (first and second)	**76**

The researcher selected the in-depth interview research method with the purpose of allowing the interviewees to provide their opinion without preconceived ideas regarding the coding systems, themes and research purposes. The data analysis was based on a template analysis using a deductive and inductive approach.

First, a top-down approach (deductive analysis) and on a second stage, a bottom-up approach (inductive analysis) were used. There were 76 frequencies identified and they were distributed as follows: i) risk categories 31 frequencies; ii) risk 41 frequencies, iii) and 'What are the current problems in the water sector?' with four frequencies. Table 5-4 presents the hierarchical coding and themes identified by the researcher using the MAXQDA software.

First codes and themes selection

The set of codes and themes were based on the outputs of Chapter 2.7 (closed approach). To answer the thesis' third objective, the risk approach in PPP water contracts in developing countries, the researcher selected the codes and themes using the MAXQDA software. These were based on the literature contributions, risk matrix results and monitoring and contract evaluation. These results allowed the identification of five risk categories and nine risks.

The primary analysis of the data allowed the researcher to identify one more code and theme.

Second codes and themes selection

The introduction of the code 'no risk allocation mechanism' resulted from the relevance that both interviewees gave to the subject regarding the PPP water contract (open approach). Literature also supported this claim by identifying these risk when addressing the PPP risk approach for water contracts (Ameyaw & Chan, 2013, 2015b; Rezaeenour et al., 2018). The theme 'What are the current problems in the water sector in Mozambique?' was added with the purpose of providing possible future insights and policy implications in the water sector in Mozambique. Next, the results of all identified themes are presented.

THEME – Risk categories

Based on the literature outputs (see Chapter 2.7 and 3.2.1), the risk categories were considered to be included in the analysis by the researcher. The five pre-selected codes–

financial risks, context risks, technical and operational risks, commercial risks, and infrastructure risks - were added to the analysis.

From the researcher's analysis, the risk categories that ranked higher were the financial and the context risks, which confirmed the risk matrix classification.

The financial risk category ranked first once more with 13 frequencies, which was in line with literature outputs.

The researcher identified quotes, such as 'the public partner was dependent on external financing to make the necessary investments . . .', and 'the private partner was losing a lot of money'. Insufficient funds can lead the PPP to fail (Zhang et al., 2018). These results also show how the contract did not present the expected results for both parts (private and public partners). According to the interviewees, the contract was unbalanced. This characteristic could also be found in the other risk categories, such as commercial, and technical and operational.

The context risk category ranked second with six frequencies. It was possible to identify quotes, such as 'the contract only continued, especially after the floods and the departure of the french partner eventually more for historical reasons . . .' and 'PPP have many difficulties because the governments in developing countries mix a lot of politics in the middle'. The results showed that, in fact, the critical risk factor 'political interference', which was already identified in the risk assessment phase, could have consequences in PPP contracts. Studies performed by Ameyaw and Chan (2016) and Chan and Cheung (2011) ranked political interference risk and government's intervention as major concerns regarding PPP contracts.

The infrastructure risk category brought interesting results to the study. Interviewees frequently associated the financial problems as the result of the public partner's delay in performing the necessary and contractual agreed investments (infrastructures), that led to a substantial decrease of the private partner's expected revenues.

THEME – Risk

There were ten recognised risks, resulting from 41 frequencies (based on MAXQDA results). From the 15 risks identified in the risk matrix, nine (60%) were listed.

The interviewees' answers confirmed the four risks considered of high importance. Therefore, these risks were classified on the red zone in the risk matrix, representing 56% of the total identified frequencies. They were 'continuous monitoring' 7 (17%), 'weak

capacity of public and private partners' 7 (17%), 'construction time and cost overrun' 5 (12%) and 'poor contract design' 4 (10%).

The risk 'conflicts between partners' was underestimated in the risk matrix (classified in the green zone). No mediation mechanisms were identified in the contract, and according to the interviewees, it was considered as a relevant topic. Finally, based on the interviewees' opinions, the researcher added the 'no risk allocation mechanism'.

Continuous monitoring

The contract's monitoring and evaluation was a shared responsibility between the public partner and the sector regulator. This code presented seven frequencies. According to the interviewees, the private partner had to send a report to the public partner and the sector regulator, on a monthly basis, that should contain detailed information regarding the operation, investments performed, the amount of water billed to customers and water losses percentage. The public partner should check and perform audits to the private partner at any given time that it considered convenient to check the accuracy of the provided figures. This report was extremely relevant, especially the support of the calculation of the monthly variable fee that the private partner had to pay to the public partner. An adjustment of the reported figures was performed annually.

The researcher observed that the contract referred to the obligation the private partner had to present information to the public partner; nevertheless, it did not detail the minimum technical requirements for the services levels and assets.

The researcher observe no obligation to present a detailed report regarding the infrastructure's preservation status. The infrastructure's preservation status should integrate the monthly and annual report; nevertheless, there were no information regarding the structure and the used criteria. AdM had to present an investment plan every year; however, there is only a broadly indication of the type of information. The public partner randomly performed the infrastructure's preservation status assessment.

Based on the previous statements, we can question why there were not more contractual concerns about the infrastructure's records and evaluation.

Weak capacity of public and private partners

The risk 'weak capacity of public and private partners' ranked second with seven frequencies. The private partner's lack of experience in contract management in developing countries, associated to a low-performance perception, increases the conflicts

between partners. For example, in quotes, such as '. . . the company did not maximize the opportunity to increase the number of connections', and '. . . it has delayed a series of works which we felt would benefit the rehabilitation of the networks and their expansion, and therefore increase the number of connections' we could perceive that reality.

The weak internal capacity of the private partner was one of the major concerns of the public partner. However, minimum requirements to the top and medium management were not identified in the contract. The lack of minimum requirements can jeopardise the quality of the decisions made and compromise the knowledge retention in the country.

From the private perspective, the public partner was not comfortable with the fact that most of the personal hired for top management positions were not national citizens, which contributed to the increase of the conflicts between PPP partners. These last claims were perceived in the quotes '. . . we change the allocation of top positions by providing the opportunity to national citizens', '. . . there are many competent national professionals that should be valued', and 'the positions changed from foreigners to national citizens, for example, commercial director, operations, distribution and human resources'. In these quotes, we could observe the intent of the private partner to respond to the public partner's concerns.

Construction time and cost overrun

The contract predicted that the water network expansion was highly dependent on the investments to be performed by the public partner. In addition, the public partner was highly dependent on external funds to ensure that infrastructures were timely built or maintained. This claim was observed in the quote 'FIPAG committed itself to dates [investments in infrastructures] on the contract, which were not directly dependent on them . . .. It makes no economic sense!'.

The risk 'construction time and cost overrun' had five frequencies. In the quote '. . . the private partner was obliged to carry out preventive maintenance, but on the other hand, some mechanical equipment, which had overlapped their expected lifetime, was the public's responsibility, but he was repairing or buying new equipment' we could perceive the private partner' difficulties. The existence of undefined areas in the contract and the overlaps of maintenance responsibilities can contribute to a deterioration of the conditions of the infrastructure through time.

Poor contract design

The risk 'poor contract design' showed four frequencies. According to the interviewees, the contract presented relevant gaps regarding the responsibilities for constructing and maintaining the infrastructures. The contract was not flexible and did not predict the actions that could be followed in the case of the non-conclusion of the investments in a timely way by the public partner.

According to the interviewees, the contract contained unrealistic investment levels, that led to a significant negative impact on the expected demand and jeopardised the contract's financial sustainability.

The lack of concrete pro-poor measures in the contract penalised the private partner's position and their revenue-raising capacity. Mozambique is classified as a low-income country (Fantom & Serajuddin, 2016; United Nations, 2019), where a significant part of the population has a low-income. Consequently, the non-payment of bills and water theft (or illegal consumption) were a concern when operating in developing countries (Ameyaw & Chan, 2015a). The private partner's interviews referred that concrete actions were taken at their expenses. The private partner developed awareness campaigns in several Maputo neighbourhoods to promote the population's awareness on water theft, and the social and economic advantages of paying the water bills in a timely way.

Conflicts between partners

The risk 'conflicts between partners' presented eight frequencies. The risk 'conflicts between partners' was classified in the green zone in the risk matrix. However, the interviewees' answers showed that this was a significant concern.

It was possible to identify quotes, such as '. . . there were moments of high tension' and '. . . first, it was a set of objectives that were contractually assigned that were not being fulfilled', that demonstrated that the relationship between the private and public partners was not always good. When contracts start everything looks perfect, but time and several other reasons, such as incomplete contracts and ex-post opportunism, can lead to conflicts between partners (Marques, 2018). According to the author, to avoid conflicts it is essential to endow the contract with solid contract management and governance principles. Conflicts need to be addressed efficiently to prevent escalation (Marques & Berg, 2011b).

Considering that it is expected to be a long-term relationship, partners should establish open communication channels and understand the possible benefit of

maintaining good relations and mutual understanding. The existence of appropriate management structures, including peer-to-peer communication, the separation of responsibilities, roles and consistency in supporting the top and senior management, can be vital to prevent future conflicts (Marques, 2018).

Partners recognised the sector regulator as an informal mediator of the contract, which was observed in quotes, such as 'I invested . . . time in the relationship with FIPAG and the sector regulator' and 'sector regulator was a key person in this whole operation, especially to mediate conflicts'.

No risk allocation mechanism

The risk matrix did not allow the identification of risk management concerns. When allocating risks on the risk matrix, the researcher also identified that the shared responsibilities option counted 3 (14%). If shared responsibilities are not clear in a contract, it can lead to a no-action attitude by partners.

There were not risk management concerns regarding the contract performance and fulfilment. The interviewees' answers also confirmed this fact. The private partner had proceeded to the internal contract evaluation (compliance audit), but these results were considered as internal information and they were not discussed with the public partner. This lack of risk issue concerns could be an exciting contribution to the thesis' objectives. The lack of risk management concerns regularly performed by an external entity could contribute to the increase of conflicts between partners.

THEME – What are the current problems in the water sector?

The last theme is 'What are the current problems in the water sector?'. The researcher identified this theme four times in the interviews. It was possible to identify quotes, such as 'the Delegated Management Framework has not been internally removed from the water sector in Mozambique'. Nevertheless, FIPAG is currently responsible for performing the investments and for supervising the Maputo water contract, for example. The PPP water contract had been indirectly managed and monotonized by FIPAG since 2011. This institution was responsible for designating the top management of the current Águas de Maputo. A new management model was being searched. The Delegated Management Framework (Decree No. 72/98, of 23 December) should be updated to the current reality, or the attributions and limitations of the water stakeholders should be redefined.

5.6 Research risk approach in PPP water contracts in developing countries results and thesis objectives contribution

The result of the PPP water contract analysis provided exciting outputs to the thesis' third objective. PPP water contracts in developing countries have space to improve. Research results allowed identifying risk categories, risk factors, risks and risk allocation in a PPP water contract in a developing country. The researcher applied the triangulation method to present results and findings to the PPP water contract, namely using content analysis, risk matrix technique and in-depth interviews. To help support findings and conclusions, a case study research methodology was applied. Mozambique was the selected region for sampling. The country fulfilled the study's requisites, namely because it was classified as a developing country. There was also a Delegated Management Framework (Decree No. 72/98, of 23 December) that allowed the participation of private initiatives in the water sector.

The PPP water contract analysis provided valuable contributions to answer the research questions (see Chapter 5.1). Next, the research questions and the main insights are presented.

1. How are the PPP water contracts in developing countries designed to address risk?

The risk matrix's primary results ranked the financial risks category first, followed by context risks, technical and operational risks, infrastructure risks and commercial risks. Fifteen risks were identified in the risk matrix (see Chapter 5.5.2).

Triangulating the information obtained in the previous section allowed us to go forward to the next step. Using a template analysis, the researcher performed two in-depth interviews that allowed the identification of five risk categories where both financial and context risks categories ranked first and second, respectively. Ten risks were identified.

The results confirmed the need to give high priority to the four risks identified in the red zone (most relevant risks) in the risk matrix: 'continuous monitoring', 'weak capacity of public and private partners', 'construction time and cost overrun', and 'poor contract design'. The researcher identified a different classification for the 'conflicts between partners' risk. Although it was considered as having low-risk exposure in the risk matrix, the interviewees considered it to be among the top priorities. No mediation mechanisms that could formally support conflicts resolution were formally recognised in the contract.

Finally, the researcher added the ‘no risk allocation mechanism’ based on the opinion provided by the interviewees.

The ‘continuous monitoring’ risk was a shared responsibility between the sector regulator and public partner. From an operational and rational perspective, the shared responsibility concept is in itself a considerable weakness. Risk should primally be allocated to the party that can have a more effective influence and it should provide reasonable evidence that all possible measures are being taken. The contract predicted the existence of a periodic information delivery from the private partner; however, the researcher identified a gap in the minimum requirements of information presented regarding the services level and assets (e.g. no information regarding the applied methodology, a template of the water meters’ locations and type of objective evidence to be provided regarding services levels and assets).

The ‘weak capacity of public and private partners’ was highlighted by the interviewees, especially regarding the presented insufficiencies of the private partner’s medium and top management, including the absence of local resources that could jeopardise knowledge retention in the medium and long run. There were mutual complains of poor management capacity.

The ‘construction time and cost overrun’ was a factor that contributed to the rise of ‘conflicts between partners’. The interviewees emphasised that the contract had unrealistic investment levels, which when added to a lack of contract’s flexibility it meant that the private partner had to support higher costs due to a revenue reduction. This claim was supported by the interviewees who also highlighted the ‘poor contract design’ regarding these matters. They argued that the contract was not flexible to revenue reduction, it did not include no pro-poor measures and did not present an accurate attribution of responsibilities regarding the construction and rehabilitation of the infrastructures. Additionally, the public partner should perform the investments that were dependent on third parties loans and donations, as it could be observed in the quote ‘FIPAG committed itself to dates (investments in infrastructures) on the contract, which were not directly dependent on them . . .. It makes no economic sense!’.

The researcher highlighted the ‘conflicts between partners’ risk, that was classified in the green area in the risk matrix; however, the interviewees’ answers showed that it was a relevant topic. Partners considered that despite the positive intervention of the sector regulator as a moderator between the parts, the rise of conflicts was the leading cause of

the early contract termination. The interviewees considered that there were moments of tension between the parts, caused by the existence of a set of contract's objectives that were not being properly addressed (e.g. investment and revenue levels and no effective and formal moderation mechanisms to mitigate them).

Finally, regarding the theme risk, the researcher observed that it was not possible to identify risk management concerns in the risk matrix and on the interviewees' answers.

There is space for improvement on the PPP water contracts in developing countries. The research's outputs supported this claim.

2. Is there room to improve PPP water contracts in developing countries?

The creation or reinforcement of the monitoring mechanisms was identified as being once more a major concern which has space to improve. Scholars have already provided good insides regarding this matter, which could be extremely useful to prevent future conflicts and early determine the end of the PPP contract. PPP contracts should be effectively and objectively managed. The contract's management terms must be synthetised in a document that includes the terms, procedures and action of both parties during the contract's life cycle (Marques, 2017).

The monitoring and improvement of future PPP contracts could be integrated into a PPP Unit. Figure 5-8 shows how the PPP water contract was designed and potential improvements that could be performed based on the research outputs. It also provides a suggestion to improve the relations between partners and to reduce the conflicts between them by introducing a PPP contract risk approach.

The research results showed that there are improvement opportunities in PPP water contracts. Conflicts between partners were evident when observing the results of the in-depth interviews. The contract prematurely ended in 2010, when the public partner acquired the private part in the PPP water contract.

Figure 5-8 provides an overview of the PPP contract arrangements, including the relations between partners and the sector regulator. Based on the outputs of Chapter 4 and identifying the lack of an independent player who is responsible for addressing risk management issues through the contract life cycle, the researcher had a solid basis to propose a paradigm shift. It is proposed the introduction of a reliable risk approach by applying the research risk management approach, that will include the assessment of the current risks of the contract and the introduction of the key risk indicators concept.

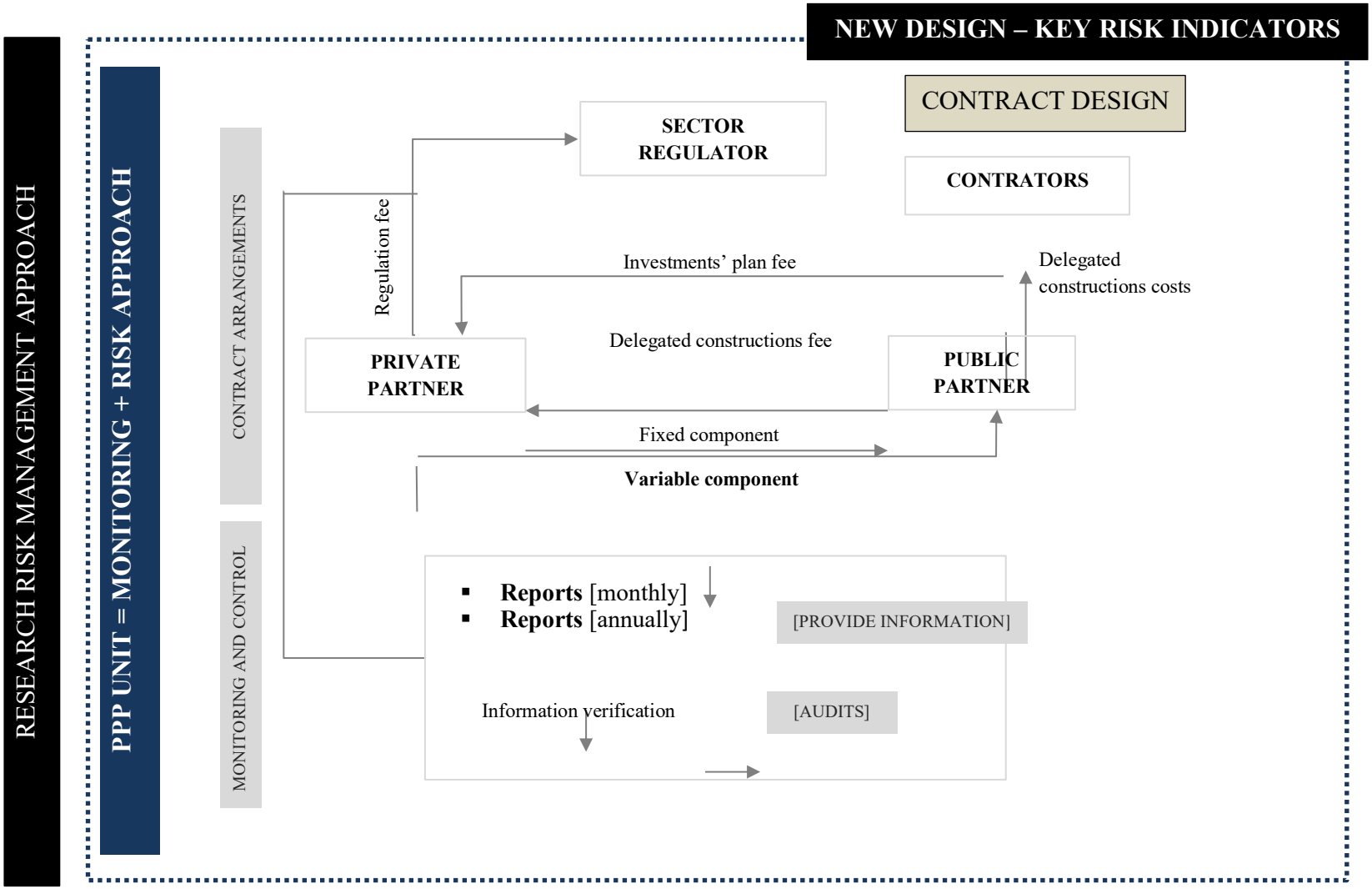


Figure 5-8: The contract design and the key risk indicators

This new design should be also combined with the introduction of an independent PPP Unit, that will be responsible for the risk approach and share monitoring responsibilities with the sector regulator.

Mozambique's PPP law and water sector policies must be timely updated. Pequenino (2017) argued that the direct application of the public tendering to PPP contracts does not reflect reality. For example, since the implementation of PPP law in Mozambique until 2017, there was no open procedure PPP contract used. According to the legislation, the public tendering rules should be followed, and exceptional cases depend on the government's approval. It is urgent to revise the PPP legal framework in developing countries to bring transparency to the tendering rules and attract investments and more efficient private operators to the future PPP contracts.

An inconsistency between the existing sectoral policy and the actual situation was also identified. The interviewees mentioned that the water sector management model was nearly 20 years old and it had not been adequately updated. The last theme considered in the in-depth interviews, 'What are the current problems in the water sector?', highlighted the need to redefine and review the current private initiative participation in the sector, including revising the roles of the public partner in terms of participation and responsibilities.

At the time, the public partner controlled (directly or indirectly) and provided the water service directly to customers in some parts of the country, and it was also responsible for the infrastructure construction, rehabilitation and maintenance. The public partner was monitoring itself since the extinction of the PPP water contract. FIPAG's mission was to 'promote water service in major cities through effective management of private sector participation, making investments and using assets in an efficient and sustainable way, promoting fair tariffs and safeguarding the environment', but they were simultaneously providing the service directly to the populations (e.g. Maputo region), showing an apparent misalignment between their mission and their current attributions and functions.

These arrangements were particularly relevant when considering that in 2020 the previous PPP water contract was under revision for a new businesses model.

CHAPTER 6: CONCLUSIONS–RESEARCH CONTRIBUTIONS, LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

This chapter addresses the thesis' conclusions. The outputs from the previous chapters were used, namely the research results and outputs for the three thesis' objectives.

The literature review was the first thesis' objective. This objective presented the current state of the art regarding the topic of PPP in the water sector and risk management approach. The review of scholars' contributions helped identifying and supporting the key topics and the research gap.

The second thesis' objective was focused on the risk management perception on PPP contracts. This objective presented the results of 15 semi-structured interviews to governments, regulators and utilities' managers in developing countries based on the results of the literature review and scholars' contributions.

The main purpose of the last thesis' objective was to assess how PPP water contracts in developing countries cope with risk management approach using a case study.

The first section summarises the results of the three thesis' objectives (see Chapter 6.1). These results provide an adequate background to the next section, the discussion.

The second section shows the discussion, including the theoretical contributions, and the managerial and society implications (see Chapter 6.2).

The third and last section describes the research limitations and directions for future research (see Chapter 6.3).

6.1 Results summary

PPP in the water sector have recently received increasing attention from scholars in the literature, which can be seen by the increasing number of published articles and in a variety of research methods and topics (Cui et al., 2018).

This section shows the results summary according to the three thesis' objectives. The thesis' research questions were supported and addressed based on the research's results and outputs (see Chapter 2.8, 4.6 and 5.6).

Review of studies for PPP in the water sector – first thesis' objective

The results allowed to answer the research questions identified in the introduction section (see Chapter 2.8). The number of studies related to the PPP in the water sector increased, especially over the last decade, being identified 86 (70%) from a sample of 122. The most productive institutions are located in Asia 26 (21%), followed by Europe 24 (20%) and Africa 17 (14%). From a perspective of the distribution of the authors and countries/regions considered as sample for the studies, the results are similar.

The studies' publications were not concentrated in specific journals. In fact, the results showed that they were distributed among 74 journals. Regarding the research design, an absence of tendency when choosing the studies' methodologies (qualitative 54 (44%), quantitative 41 (34%) and mixed methods, with 26 (22%) was observed.

The results revealed the existence of five main research domains: risk management, PPP contractual arrangement, infrastructure, governance, and financing and tariffs.

Risk management issues ranked first with 37 studies (30%). This theme is considered as a hot topic by scholars (Cui et al., 2018). It is possible to identify studies published in top journals in recent years (Ameyaw & Chan, 2016; Pradhan et al., 2017).

The second theme was PPP contractual arrangement with 23 (19%), where the poor design and the prevalence of several possibilities could lead to future problems between the PPP partners and to the need to renegotiate the terms that regulate the partnership. In this context, it emerges the necessity to revise the actual contract models in order to meet the expectations of both partners–the private and the public.

Financing and tariffs ranked third with 22 studies (18%), which means that there is the need to improve the contracts to attract the necessary investments (Shen et al., 2006). This should be balanced with the financial and economic sustainability to ensure that private payments are made (i.e. user's fees, payment by the public partners or both), respecting the social and economic characteristics of the water sector (Ameyaw et al., 2017). In this context we introduced the next identified theme: infrastructure in the water sector with 16 studies (13%). The water sector is characterised by the need of extensive investments in construction, rehabilitation and maintenance of the infrastructure, where poor project design, lack of sustainability concerns and institutional support can compromise the success of the partnership (Marin, 2009). As a result of the narrative analysis, the absence of an adequate governance structure from the public partner was the last identified theme with seven studies (6%). Scholars identified a mismatch between

political motivations and value for money projects assessment (Beisheim & Campe, 2012; Cui et al., 2018). In this context, studies connected to the PPP institutional support and governance structure connection emerge as a hot topic that can be addressed in future studies.

Risk management perception in PPP contracts – second thesis' objective

The results allowed to answer the second research questions (see Chapter 4.6). A semi-structured interview (Jalba et al., 2014) was used to assess the PPP perception by governments, sector regulators and utilities managers in developing countries. The semi-structured interview protocol had three major sections: i) closed questions (Benítez-Ávila et al., 2018), ii) direct questions (Senot et al., 2016) and iii) and an open question (Bylund et al., 2020).

The results from the closed questions ranked the financial risks category first. These results are supported by the literature and by studies that used similar research methods (Ameyaw & Chan, 2015b). Infrastructure ranked second, followed by commercial, technical and operational, and finally context. When compared with the results of the direct questions, where risk factors were identified, we highlight that the risk category that indirectly ranked first was context, which shows a considerable different perspective from the first results.

Using the literature's contributions as a reference (see Chapter 2.7), 25 risk factors related to the risk assessment phase were identified from the direct questions. Ranked by frequency, the top five critical risk factors identified: 'political interference'; 'no baselines for performance measurement'; 'unfavourable global private investment climate'; 'non-payment of bills' and 'water asset condition uncertainty'. The participants suggested possible risk treatment or mitigation measures. The 'political interference' critical risk can be mitigated by designing a robust legal framework and by adopting restriction mechanisms that penalise the government's direct interference without a solid basis and a compensation scheme. The implementation of a more effective control and monitoring mechanisms of the private partner's performance before the bidding phase is suggested as a mitigation measure to the 'no baselines for performance measurement' critical risk factor. The government's greater commitment by acting as the endorser of the necessary investments and the use of insurance policies will reduce the 'unfavourable global private investment climate'. The introduction of pro-poor measures and pre-paid water meters were identified as possible solutions to mitigate 'non-payment of bills'.

Finally, the 'water asset condition uncertainty' critical risk factor can be reduced by updating the databases of data assets and introducing mandatory pre-agreed criteria between partners to catalogue the assets during the PPP life cycle.

These results support the researcher's claim that it is necessary to introduce alternative solutions into the risk management framework. The researcher presented an open question to the interviewees regarding the introduction of key risk indicators in the traditional risk management framework.

The results showed that interviewees support this introduction. It is necessary to find new approaches to solve the identified gap. The key risk indicators are a concept already in use in corporations' (enterprise risk management) risk management approach (Appuhami & Perera, 2016). The researcher proposes the introduction of this concept in the PPP contracts by adding this new concept under the monitoring, review and supervision. PPP Units are not a new concept and have space to improve (Neto et al., 2020).

This paradigm shift should allow the internalisation of external factors in the PPP contract in a timely way, which are not possible to predict when the contract is signed. This concept will capture mega-trends, risk evolution and the construction of future scenarios for PPP contracts during their life cycle, and will prevent conflicts between partners, contract renegotiations or premature contract endings (Blokdyk, 2020). This will allow the improvement of the current knowledge of the contract (Luís et al., 2016).

Risk approach in PPP water contracts in developing countries – thesis' third objective

The research results allowed to answer the research questions identified in the introduction section regarding the thesis' third and last objective (see Chapter 5.6).

The researcher selected a PPP water contract in a developing country for sampling. A case study research methodology to support findings and research outputs was applied (Cruz & Marques, 2012; Lee & Yu, 2012; Neto et al., 2020). The researcher's findings are supported by a narrative methodology, risk matrix analysis and two in-depth interviews.

Using the literature's contributions as a reference (see Chapter 2.7), 15 risk factors were identified in the risk matrix. Subsequently, using a risk matrix, the researcher classified them according to the likelihood and impact on the contract. The results confirmed them as being risks and allowed their categorisation into three major areas: i)

green zone–risks in this zone are low level; ii) yellow zone–risks present a moderate level of importance; and iii) red zone–where the most relevant risks are.

The in-depth interviews' results allowed to identify ten risks, of which nine had already been identified in the risk matrix results. The 'no risk allocation mechanism' risk was added.

The results confirmed the high priority risks identified in the red zone (most relevant risks) in the risk matrix: 'continuous monitoring', 'weak capacity of public and private partners', 'construction time and cost overrun', and 'poor contract design'.

The researcher identified a gap in the minimum requirements of information presented regarding the services level and assets, confirming the high classification for the 'continuous monitoring' risk. Additionally, the interviewees confirmed that there were no risk management contract mechanisms.

The 'weak capacity of public and private partners' was highlighted by the interviewees, especially regarding the presented insufficiencies of the medium and top management of the private partner, including the absence of local resources that could jeopardise knowledge retention in the medium and long run.

The 'construction time and cost overrun' was a factor that contributed to the rise of 'conflicts between partners'. This claim was supported by the interviewees who also highlighted the 'poor contract design' regarding these matters. They argued that the contract did not present an accurate attribution of responsibilities regarding the construction and rehabilitation of the infrastructure. Additionally, the public partner should perform the investments that were dependent on third parties' loans and donations, as it could observed in the quote 'FIPAG committed itself to dates [investments in infrastructures] on the contract, which were not directly dependent on them . . .. It makes no economic sense!'.

The researcher highlighted the 'conflicts between partners' risk, that was classified in the green area in the risk matrix; however, the interviewees' answers showed that it was a relevant topic. They considered that despite the positive intervention of the sector regulator as a moderator between the parts, the rise of conflicts between partners was the leading cause of the early contract termination.

Finally, regarding the theme risk, the researcher observed that it was not possible to identify risk management concerns in the risk matrix or in the interviewee's answers.

There is space for improvement on the PPP water contracts in developing countries. Research outputs supported this claim. Chapter 5.6 proposed the introduction of key risk indicators to improve the future PPP water contracts' efficiency. As part of the solution, it was also proposed the creation or reinforcement of the PPP Units that should have an active role in the creation and monitorisation of the PPP contracts.

PPP law and sector policies should be updated. The Mozambican PPP law follows the public tendering rules. However, they do not reflect the reality. Since the implementation of PPP law in 2011 until 2017, all PPP contracts were direct procedures and not an open procedure as the public procurement law predicts (Pequenino, 2017). In this context, a revision of the current PPP legal framework in developing countries is necessary to attract more investment and more efficient private operators.

The theme added by the researcher, 'What are the current problems in the water sector?', showed that an institutional reform in the water sector in Mozambique is urgent. For example, the public partner (FIPAG) has the mission to 'Promote water service in major cities through effective management of private sector participation, making investments and using assets in an efficient and sustainable way, promoting fair tariffs and safeguarding the environment'. However, it currently controls (directly or indirectly) and provides the water service directly to customers, being simultaneously responsible for the infrastructure's construction, rehabilitation and maintenance. The Delegated Management Framework (Decree No. 72/98, of 23 December) must be updated and revised, or conflicts of interests among the stakeholders will continue.

6.2 Discussion

The discussion is separated in two major blocks. The first one comprehends the thesis' theoretical contribution (see Chapter 6.2.1), and the second is related to the managerial and societal implications (see Chapter 6.2.2).

6.2.1 Theoretical contribution

PPP contracts are based on the principle of building a partnership between two partners: the public and the private. They are expected to be in a long-term contract and a vehicle to develop, rebuilt or maintain complex infrastructure by increasing efficiency and social well-being (Yescombe, 2007; Yu et al., 2018).

PPP contracts can increase the number of projects that will not be possible under the traditional procurement (Yescombe, 2007). Society can benefit from the efficiency and innovation of the private sector, including the access to funding resources (Ameyaw & Chan, 2013; Marques, 2016; Yescombe, 2007).

The partnership must be balanced in all stages of the contract. Unbalanced contracts will compromise the PPP objectives and will not produce the expected outputs (Marques, 2016). When the society, partners (public and private), the government or sector regulators perceive a reduction of well-being, conflicts may arise (Marques & Berg, 2010).

Contracts are incomplete by nature (Williamson, 1976), and PPP contracts are no exception. Incomplete contracts, asymmetric information and moral hazard have captured scholars' attention over the last years (Fang et al., 2009; Fernandez et al., 2018; Hajjej et al., 2017; Owusu-Manu et al., 2018; Vinogradov & Shadrina, 2018).

The results of the thesis' first objective allowed identifying risk management as a hot topic to be addressed in PPP contracts. Results showed that from the 122 studies, 37 were focused on the risk topic and 13 were relevant to the approach of the risk process of PPP in the water sector. When observing the 13 studies in detail, 11 are in developing countries and two in developed countries.

Literature contributions allowed identifying the main phases in risk management: risk assessment and risk treatment and mitigations measures. From the 13 identified studies, four (30%) addressed the two risk management phases.

The risk assessment phase can include risk categories, risk factors identification, risk analysis, evaluation and critical risk identification. The ISO (2018a), and Unkovski and Pienaar (2009) support the classification of risk into groups or categories. Under these categories it is possible to identify risk factors (Chan & Cheung, 2011; Nakhla, 2016; Yuan et al., 2015). The possible impact of risk factors on the project's objectives leads us to the risk concept. Risk analysis and evaluation are related to the probability of a particular event occur and its corresponding impact quantification (Marques & Berg, 2011a). These concept leads to the need to proceed with an adequate risk allocation (Ameyaw & Chan, 2015c; Wibowo & Mohamed, 2010).

Considering the characteristics of the water sector, risk factors and risks cannot be generalised (Ameyaw & Chan, 2015c). The study performed by the researcher had this literature contribution under consideration when assessing how PPP experts provided

their opinion regarding the PPP contracts risk approach in developing countries, as well as the results presented when assessing how a PPP water contract addressed risk issues (see Chapter 4 and 5).

The second stage in the risk management framework is risk treatment or mitigation measures (AXELOS, 2018; Nigel et al., 2017; OGC, 2009). Two major subgroups can be considered: risk acceptance and risk treatment (Silungwe & Khatleli, 2020). Risk treatment includes the risk transfer (Carpintero & Petersen, 2016), reduction (Ameyaw & Chan, 2016) and avoidance (Zhang et al., 2019). Nevertheless, in the previous literature contributions, scholars failed to identify a coherent risk management framework.

Literature contributes with a different possible classification of project risk management techniques, where their application can be tailored to the specific assignment requirements (Cagliano et al., 2015). Risk management is considered to be a tool to support projects, objectives and outcomes (Paltrinieri et al., 2015). There is not a consensual terminology and approach to be applied in PPP water contracts in developing countries.

This thesis contributes to a new and integrated approach to risk management in PPP water contracts in developing countries (see Chapter 4 and 5).

The research's outputs also allowed to identify improvement measures to monitoring in the PPP contracts risk management. The introduction of a risk approach that prevents conflicts between partners is relevant (see Chapter 5). This can be done by introducing a paradigm shift in the current risk management framework through the introduction of the key risk indicators concept in PPP contracts (see Chapter 4).

Key risk indicators are based on a set of basic indicators that support the effectiveness and reliability when assessing and measuring risks (Shi et al., 2018). This concept is not new and has already been used in management (Blokdyk, 2020; Luís et al., 2016; Yuan et al., 2015). Literature supports the use of key risk indicators in monitoring tasks and as a useful tool to the risk management framework (Timmermans et al., 2016).

Finally, the need to tailor the government's policies and adapt them to developing countries to ensure the success of the PPP water contracts was proposed.

6.2.2 Managerial and societal implications

This thesis' contribution was focused on improving this unbalanced relationship by accessing the current PPP risk management framework, especially in the water sector in developing countries.

The water sector is characterised by a vertical and horizontal fragmentation and it is strongly exposed to institutional and political factors (ADB, 2009). The PPP business model can reduce the exposure to several macroeconomic effects, such as economic externalities, climate change, calamities and factors that can affect the society (Ameyaw & Chan, 2013). The private initiative can reduce the sector's exposure to this risk category and increase social well-being. Idelovitch and Ringskog (1995) argue that when applied to the water sector, and in particular in developing countries, PPP will increase performance and productivity. Weak operational efficiency influences the levels of access and the quality of the water, as well as wastewater services, impacting negatively on customers' tariffs (Marin, 2009). PPP can transfer the design, construction or maintenance of infrastructures to the private initiative, as well as share operation risks with the national government through the public partners (Ameyaw & Chan, 2013).

The private initiative resulting from PPP contracts brings initiative, innovation, specialised know-how and access to additional financial fund levels that are hard to deliver in the usual procurement process.

After assessing a PPP water contract and based on the research's outputs, there is evidence that risk allocation is unbalanced and reduces the attractiveness of PPP contracts to the private initiative. The lack of attractiveness to the private initiative will compromise the effectiveness of PPP contracts and consequently reduce the possibility to improve social well-being through the reduction of successful infrastructure projects.

Next, we provide the thesis' contributions and possible implications to the main stakeholders, namely, public, private, sector regulator, government and society.

Public partner

The main function of the public partner is to control and monitor the private partner's activity. The responsibility starts before the bidding phase, where they should ensure the definition of the contract's objectives, investments, economic and financial implications, including the best PPP model to be applied. In the case of the water sector, it also includes the infrastructures maintenance or a clear description of the contract's objectives

regarding these issues. The PPP case study showed how these objectives were not properly taken into account. The definition of the rules during the execution phase of the contract was not clear, which generated conflicts between partners. Inadequate control mechanisms resulted in insufficient data, namely operational quality and infrastructure preservation status which jeopardised the PPP contract's success. The formal introduction of a contract management document in PPP contracts (Marques, 2017) that incudes measurable objectives, could be an adequate answer.

Finally, the public partner should be able to attract and retain capable internal human resources, able to adequately control de private partner's activity during the contract's life cycle.

Private

The private partner should have the possibility to be immediately compensated in the case of significant changes in the PPP water contract. The critical risk factor political interference ranked in the top five. Government interference should be compensated (see Chapter 4).

On the other hand, private partners must ensure the adequate levels of experience in managing PPP water contracts in developing countries. The research's results supported this claim. According to the research's outputs, the lack of capable human resources was one of the mains reasons for the rise of conflicts between partners (see Chapter 5). The researcher suggested the introduction of a document to be added to the contract, where the critical roles of the PPP contract should attend to a minimum list of requisites.

Finally, the existence of an efficient contract supervision will benefit the private partner by improving efficiency and increasing the trust in the national water sector, which will contribute to the propensity to invest in future PPP. The existence of a PPP Unit that is responsible for monitoring and controlling the contract risk management concerns, for example, will prevent potential conflicts by anticipating future risks (key risk indicators).

Sector regulator

The sector regulator should have as a primary mission to find the best national and international practices and incorporate them on a second phase in the water sector, which will lead to a sustainable and consistent service quality improvement. It should provide alternative methods to ensure the reduction of the private exposure to the non-payment of

bills, such as pre-paid water meters or the introduction of pro-poor measures into future PPP contracts (see Chapter 4 and 5), or to develop awareness campaigns in partnership with the government and other stakeholders to the low-income population regarding the benefits of rational and efficient water resources.

Finally, the sector regulator should provide sector's policy guidance. The research's outputs showed how in the Mozambican case, the realignment of the role of the private initiative in the water sector is urgent, as currently it is the public partner who controls and provides the water service to the population.

Government and PPP Units

The government, sector regulators and public partners should be responsible for monitoring, reviewing and assessing the PPP contracts' effectiveness. The research's outputs showed that the introduction of risk management concerns is needed to improve PPP contracts, especially in developing countries.

The results from the PPP water contract's analysis performed by the researcher showed how there were few concerns about risk approach, as the control and monitoring activities were mainly under the responsibility of the public partner and focused on operational results. Additionally, we can add a clear conflict of interests in the monitoring activities, considering that part of the public partner's revenue results from the operational activities of the private partner. As a consequence, the public partner has an incentive to be focussed on monitoring the commercial, and technical and operational risks.

In the Mozambican case, PPP Law No. 15/2011, of 10 August, already predicts that during the PPP operations phase, the contract should be monitored and supervised by the public partner and by the sector regulator (Pequenino, 2017). Through the Ministry of Economy and Finance, the Mozambican government is only responsible for monitoring the contracts' financial performance. This supervision model was partially applied on the PPP water contract analysed by the researcher. The contract's risk allocation in the PPP water contract reinforces the previous claims. From a risk allocation perspective (i.e. risk owner), the researcher observed that the private partner was responsible for 47% of the contract risks, the public 23%, shared responsibilities 14%, sector regulator 14% and de the government with 2%.

Nevertheless, from the in-depth interviews we could observe that the current model did not prevent the conflicts between partners and the contract's early ending in 2010.

Under these circumstances, the researcher presented the introduction of an external and independent control unit as an alternative solution. The PPP Unit can bring balance to this unbalanced relationship. The PPP Units concept is already broadly used, although there still is space to improve (Neto et al., 2020).

The OECD (2010) identified several advantages regarding the existence of PPP Units, such as the separation of the policy formulation and implementation by acting as a centralised knowledge centre and saving money and resources by ensuring affordability, value for money and an adequate risk approach to PPP contracts. Quality control checks in new PPP contracts through the revision of the contract's terms and the introduction of additional measures to ensure an effective PPP contract management can be another advantage. As part of the PPP contract, the relations, actions and procedures between partners during the contract's execution should be defined, ensuring compliance with the contractual clauses and the project's objectives, and reducing the conflicts between partners (Marques, 2017).

A dedicated PPP Unit can contribute to increase the country's attractiveness to the private partner. These will perceive the existence of a sovereign country's PPP program that will provide transparency and accuracy. For example, the Public Integrity Centre of Mozambique recognised that there is a lack of published data regarding the PPP contracts' performance (Mabunda & Cavelane, 2014). This evidence shows how the lack of direct PPP contracts' control by the governments can have a negative impact on the project's success.

These advantages are particularly relevant in regions that operate in developing countries, such as Mozambique, where there is a high perception of lack of government's accountability and effectiveness (Macuane et al., 2018; World Bank, 2017b).

Society

Promoting human development has always been on the agendas of countries worldwide (Tortajada, 2014). To achieve this goal, governments must provide access to basic public services, such as water and other utilities (United Nations, 2013). Economic infrastructure projects that include facilities and services which contribute to reaching economic development targets have increasingly attracted researchers' interest (Cui et al., 2018). Improving and managing universal water services, in particular, is a core issue that presents major social, economic and environmental challenges (Marques et al., 2015).

The improvement of the quality of the service, especially in developing countries, has a significant impact on the population. More capable private partners will positively affect the population by improving social well-being and reducing poverty and exclusion levels through the increase of successful infrastructure projects.

6.3 Thesis limitations and adventures for future research

Review of studies for PPP in the water sector – first thesis' objective

Although the results cover all the studies published until the end of 2018, the sample was restricted to published articles listed by the Scopus search engine and published in top journals, as well as the nine keyword combinations used. Moreover, the themes covered in this paper are identified for the water sector. Due to the systematic literature review methodological approach, other topics that might be prominent in the PPP research are not meaningful for our search regarding the number of studies found specifically for the water sector as it is the case of the principal-agent theory (see Shrestha et al. [2019] and Smith et al. [2018]), regulation and contractual/management issues (Marques, 2017; Stern, 2012), or competition and market power (Mols, 2010; Pu et al., 2020) , which might have been highlighted by our research. Future research could thus benefit from choosing different combinations of keywords and widening the search to other search engines.

Risk management perception in PPP contracts – second thesis' objective

The results presented were based on the interviewees' opinion, which is, in itself, a limitation of the study, even if they were supported by literature and scholars' contributions. A different sample could produce different research outputs.

A second study limitation is still related to the researcher's content analysis provided by the interviewees as there is a subjectivity level in the risk factors identified.

A third study limitation is that results were based on the opinions provided by interviewees regarding risk approach in PPP contracts. The interviewees selection criteria were based on their working experience within the PPP contracts or extensive working experience within the governments, sector regulators and utilities sectors in developing countries. In the 15 interviews performed, 12 (80%) were from the public sector and three (20%) represented the private sector, mainly from private water developers and consulting firms. There is an unbalanced representation of PPP players in the sample. The

working experience of the interviewees was generally based on the Mozambican context, which can affect the PPP perspective. The sampling selection was based on a snowball approach that can induce biased results.

Therefore, in future research it will be important to choose a different combination of sampling criteria, including a different scope of PPP contracts experience (i.e. different sector, and social and economic context). Additionally, the key risk indicators introduction in the PPP contracts showed promising results. In future research it will be interesting to explore and test the research risk management framework that includes the key risk indicators concept in PPP contracts.

Risk approach in PPP water contracts in developing countries – third thesis' objective

Several limitations of this study should be recognised. The risk approach in PPP water contracts in developing countries was based on the analysis of a PPP water contract. The narrative analysis was based on secondary data. A considerable part of it was gathered when performing the semi-structured interviews. There is a risk of data contamination.

The researcher performed the contract's content analysis (risk matrix). Therefore, there is a subjectivity level in the risk factors identified. Additionally, the risk factors were based on the outputs of Chapter 2.7.

The selected contract was signed in 2004, before the introduction of Law No. 15/2011, of 10 August. Nevertheless, the research outputs showed that the contract was already broadly supervised according to the Law's principles.

The two in-depth interviews presented in the study were not randomly selected. A self-selected approach was applied to the sampling selection. The researcher only captured the public and private partners' opinions, nevertheless not the opinions of customers, sector regulator and the government.

Finally, the PPP water contract did not represent a PPP water contracts in developing countries. Although Mozambique gathers the criteria of belonging to the group of developing countries, we cannot claim that it represents the developing countries region.

Therefore, in future research it will be important to amplify the sampling to a different region and sector (utilities) in developing countries and compare the results with the ones obtained when assessing the PPP water contract.

The risk matrix model showed exciting results and it can be a useful tool to monitor and evaluate PPP contracts. For future research, we suggest that this evaluation model

should be applied to both PPP partners. The results will allow assessing the risks matrix results from different perspectives.

Finally, it would also be valuable to assess the role of the PPP Units in countries where they already exist and verify how the introduction of the key risk indicators and adequate regulations could improve the PPP contracts' outputs.

SOURCES

Decreto nº 74/98 de 28 de dezembro - Cria o Conselho de Regulação de Abastecimento de Água- CRA. Boletim da República – Publicação Oficial da República de Moçambique - I Série, número 51, 2º suplemento. Conselho de Ministros. Maputo.

Resolução nº 46/2007 de 30 de outubro - Aprova a Política de Águas. Boletim da República – Publicação Oficial da República de Moçambique - I Série, número 43, 5º suplemento. Conselho de Ministros. Maputo.

Decreto nº 18/2009 de 13 de maio – Alarga o âmbito de abrangência do quadro da Gestão Delegada do abastecimento de água aos sistemas públicos de distribuição de água e de drenagem de águas residuais. Boletim da República – Publicação Oficial da República de Moçambique - I Série, número 19. Conselho de Ministros. Maputo.

Decreto nº 19/2009 de 13 de maio – Cria a Administração de infraestruturas de Água e Saneamento. Boletim da República – Publicação Oficial da República de Moçambique - I Série, número 19. Conselho de Ministros. Maputo.

Diploma Ministerial nº 237/2010 de 27 de dezembro – Transferência da gestão dos sistemas públicos de distribuição de água. Boletim da República – Publicação Oficial da República de Moçambique - I Série, número 51, 3º suplemento. Assembleia da República. Maputo.

Lei nº 15/2011 de 10 de agosto – Normas orientadoras do processo de contratação de parcerias público-privadas. Boletim da República – Publicação Oficial da República de Moçambique - I Série, número 32. Assembleia da República. Maputo.

Decreto nº 16/2012 de 4 de julho – Aprova a Lei nº 15/2011 de 10 de agosto. Boletim da República – Publicação Oficial da República de Moçambique - I Série, número 27. Conselho de Ministros. Maputo.

REFERENCES

Abednego, M., & Ogunlana, S. (2006). Good project governance for proper risk allocation in public-private partnerships in Indonesia. *International Journal of Project Management*, *24*, 622–634. https://doi.org/10.1016/j.ijproman.2006.07.010

Al-beity, F., Pembe, A., Kwezi, H., Massawe, S., Hanson, C., & Baker, U. (2020). "We do what we can do to save a woman" health workers' perceptions of health facility readiness for management of postpartum haemorrhage. *Global Health Action*, *13*(1). https://doi.org/10.1080/16549716.2019.1707403

Amankwaa, E., & Blay, K. (2018). Cities at risk? Exploring the synergies between smartphones and everyday vulnerabilities. *Cities*, *83*, 129–139. https://doi.org/10.1016/j.cities.2018.06.015

Ameyaw, E., & Chan, A. (2013). Identifying public-private partnership (PPP) risks in managing water supply projects in Ghana. *Journal of Facilities Management*, *11*(2), 152–182. https://doi.org/10.1108/14725961311314651

Ameyaw, E., & Chan, A. (2015a). Evaluating key risk factors for PPP water projects in Ghana: a Delphi study. *Journal of Facilities Management*, *13*(2), 133–155. https://doi.org/10.1108/JFM-10-2013-0051

Ameyaw, E., & Chan, A. (2015b). Evaluation and ranking of risk factors in public-private partnership water supply projects in developing countries using fuzzy synthetic evaluation approach. *Expert Systems with Applications*, *42*(12), 5102–5116. https://doi.org/10.1016/j.eswa.2015.02.041

Ameyaw, E., & Chan, A. (2015c). Risk allocation in public-private partnership water supply projects in Ghana. *Construction Management and Economics*, *33*(3), 187–208. https://doi.org/10.1080/01446193.2015.1031148

Ameyaw, E., & Chan, A. (2015d). Risk ranking and analysis in PPP water supply infrastructure projects: An international survey of industry experts. *Facilities*, *33*(7/8), 428–453. https://doi.org/10.1108/EL-01-2014-0022

Ameyaw, E., & Chan, A. (2016). A Fuzzy Approach for the Allocation of Risks in Public–Private Partnership Water-Infrastructure Projects in Developing Countries. *Journal of Infrastructure Systems*, *17*(March), 395–408. https://doi.org/10.1061/(ASCE)IS

Ameyaw, E., Chan, A., & Owusu-Manu, G. (2017). A survey of critical success factors for attracting private sector participation in water supply projects in developing countries. *Journal of Facilities Management*, *15*(1), 35–61.

https://doi.org/10.1108/JFM-06-2016-0027

An, X., Li, H., Wang, L., Wang, Z., Ding, J., & Cao, Y. (2018). Compensation mechanism for urban water environment treatment PPP project in China. *Journal of Cleaner Production*, *201*, 246–253. https://doi.org/10.1016/j.jclepro.2018.08.003

Andon, P. (2012). Accounting-related research in PPPs/PFIs: present contributions and future opportunities. *Accounting, Auditing & Accountability Journal*, *25*(5), 876–924. https://doi.org/10.1108/09513571211234286

Appuhami, R., & Perera, S. (2016). Management controls for minimising risk in public-private partnerships in a developing country evidence from Sri Lanka. *Journal of Accounting and Organizational Change*, *12*(3), 408–431. https://doi.org/10.1108/JAOC-10-2013-0075

Appuhami, R., Perera, S., & Perera, H. (2011). Coercive policy diffusion in a developing country: The case of public-private partnerships in Sri Lanka. *Journal of Contemporary Asia*, *41*(3), 431–451. https://doi.org/10.1080/00472336.2011.582713

Asian Development Bank. (2009). *Asian Development Bank Guidance Note: Urban Water Supply Sector Risk Assessment*.

AXELOS. (2018). *Directing successful projects with PRINCE2®: the essential guide for project board members*. TSO.

Babatunde, S., Perera, S., & Adeniyi, O. (2019). Identification of critical risk factors in public-private partnership project phases in developing countries: A case of Nigeria. *Benchmarking*, *26*(2), 334–355. https://doi.org/10.1108/BIJ-01-2017-0008

Babatunde, S., Perera, S., Zhou, L., & Udeaja, C. (2015). Barriers to public private partnership projects in developing countries a case of Nigeria. *Engineering, Construction and Architectural Management*, *22*(6), 669–691. https://doi.org/10.1108/ECAM-12-2014-0159

Bagarić, L., & Žitinić, D. (2013). Competitiveness of kvarner region: Challenges for destination management and branding. *Tourism and Hospitality Management*, *19*(2), 217–231.

Bao, F., Chan, A., Chen, C., & Darko, A. (2018). Review of public-private partnership literature from a project lifecycle perspective. *Journal of Infrastructure Systems*, *24*(3), 04018008. https://doi.org/10.1061/(ASCE)IS.1943-555X.0000424

Beasley, M., Branson, B., & Hancock, B. (2010). *Developing key risk indicators to*

strengthen enterprise risk management - How Key Risk Indicators can Sharpen Focus on Emerging Risks. www.erm.ncsu.edu

Beato, P., & Vives, A. (1996). *Private Sector Participation in Infrastructure: Risk, Fiscal, and Efficiency Issues in Public-Private Arrangements for the Provision of Services*.

Beete, N. (2010). Quadro da Gestão Delegada: A Evolução dos Sistemas de Abastecimento de Água e a Regulação. *Conference 14º ENaSB*, 10.

Beisheim, M., & Campe, S. (2012). Transnational public-private partnerships' performance in water governance: Institutional design matters. *Environment and Planning C: Government and Policy*, *30*(4), 627–642. https://doi.org/10.1068/c1194

Benítez-Ávila, C., Hartmann, A., Dewulf, G., & Henseler, J. (2018). Interplay of relational and contractual governance in public-private partnerships: The mediating role of relational norms, trust and partners' contribution. *International Journal of Project Management*, *36*(3), 429–443. https://doi.org/10.1016/j.ijproman.2017.12.005

Berta, W., Teare, G., Gilbart, E., Ginsburg, L., Lemieux-Charles, L., Davis, D., & Rappolt, S. (2010). Spanning the know-do gap: Understanding knowledge application and capacity in long-term care homes. *Social Science and Medicine*, *70*(9), 1326–1334. https://doi.org/10.1016/j.socscimed.2009.11.028

Bing, L., Akintoye, A., Edwards, P., & Hardcastle, C. (2005). The allocation of risk in PPP/PFI construction projects in the UK. *International Journal of Project Management*, *23*(1), 25–35. https://doi.org/10.1016/j.ijproman.2004.04.006

Blokdyk, G. (2019). Key Risk Indicators: A Complete Guide - 2020 Edition. In 5STARCooks (Ed.), *The Art of Service*.

Blokdyk, G. (2020). Key Risk Indicator: A Complete Guide - 2020. In 5STARCooks (Ed.), *The Art of Service*. 5STARCooks.

Bogner, A., Litting, B., & Menz, W. (2009). Research Methods Series General - Interviewing Experts. In A. Bogner, B. Litting, & W. Menz (Eds.), *Palgrave Macmillan*. https://doi.org/10.5771/9783828872363-86

Braadbaart, O., Zhang, M., & Wang, Y. (2009). Managing urban wastewater in China: A survey of build-operate-transfer contracts. *Water and Environment Journal*, *23*(1), 46–51. https://doi.org/10.1111/j.1747-6593.2008.00108.x

Breytenbach, K., & Manning, C. (1999). Financing municipal BOOTs in South Africa: The lenders' perspective. *Development Southern Africa*, *16*(4), 707–728.

https://doi.org/10.1080/03768359908440109

Brooks, J., & King, N. (2014). Doing Template Analysis: Evaluating an End-of-Life Care Service. *Doing Template Analysis: Evaluating an End-of-Life Care Service*, *March 2016*. https://doi.org/10.4135/9781446273050135127 55

Brounéus, K. (2011). In-Depth interviewing: The process, skill and ethics of interviews in peace research. In K. Höglund & M. Öberg (Eds.), *Understanding Peace Research: Methods and Challenges* (Issue June, pp. 130–145). Routledge. https://doi.org/10.4324/9780203828557

Bylund, S., Målqvist, M., Peter, N., & Herzig van Wees, S. (2020). Negotiating social norms, the legacy of vertical health initiatives and contradicting health policies: A qualitative study of health professionals' perceptions and attitudes of providing adolescent sexual and reproductive health care in Arusha and Kiliman. *Global Health Action*, *13*(1), 1775992. https://doi.org/10.1080/16549716.2020.1775992

Cagliano, A. C., Grimaldi, S., & Rafele, C. (2015). Choosing project risk management techniques. A theoretical framework. *Journal of Risk Research*, *18*(2), 232–248. https://doi.org/10.1080/13669877.2014.896398

Carpintero, S., & Petersen, O. H. (2016). Public–private partnerships (PPPs) in local services: risk-sharing and private delivery of water services in Spain. *Local Government Studies*, *42*(6), 958–979. https://doi.org/10.1080/03003930.2016.1204297

Carvalho, B., Marques, R., & Netto, O. (2018). Regulatory Impact Assessment (RIA): an Ex-Post Analysis of Water Services by the Legal Review in Portugal. *Water Resources Management*, *32*(2), 675–699. https://doi.org/10.1007/s11269-017-1833-0

Casady, C., & Geddes, R. (2016). Private Participation in US Infrastructure: The Role of PPP Units. *SSRN Electronic Journal*, *June*. https://doi.org/10.2139/ssrn.3306259

Cavaye, A. (1996). Case study research: a multi-faceted research approach for IS. *Information Systems Journal*, *6*(3), 227–242. https://doi.org/10.1111/j.1365-2575.1996.tb00015.x

Chan, A., & Cheung, E. (2011). Risk Factors of Public-Private Partnership Projects in China: Comparison between the Water, Power, and Transportation Sectors. *Journal of Urban Planning and Development*, *137*(4), 409–415. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000086.

Chan, A., Lam, P., Wen, Y., Ameyaw, E., Wang, S., & Ke, Y. (2007). Cross-Sectional Analysis of Critical Risk Factors for PPP Water Projects in China. *Journal of Infrastructure Systems*, *21*(1), 1–10. https://doi.org/10.1061/(ASCE)IS.1943-555X.0000214

Chen, Z., Daito, N., & Gifford, J. (2016). Data Review of Transportation Infrastructure Public–Private Partnership: A Meta-Analysis. *Transport Reviews*, *36*(2), 228–250. https://doi.org/10.1080/01441647.2015.1076535

Chong, E., Huet, F., Saussier, S., & Steiner, F. (2006). Public-Private Partnerships and Prices: Evidences from water distribution in France. *Review of Industrial Organization*, *29*(1), 149–169.

Chou, J., & Pramudawardhani, D. (2015). Cross-country comparisons of key drivers, critical success factors and risk allocation for public-private partnership projects. *International Journal of Project Management*, *33*(5), 1136–1150. https://doi.org/10.1016/j.ijproman.2014.12.003

Coelho, J., Honwana, A., Gonçalves, F., Gonçalves, J., Mazzola, P., & Sengulane, M. (1998). The Mozambican Peace Process in Perspective. *Conciliation Resources*, *3*, 103. www.c-r.org

Coppel, G., & Schwartz, K. (2011). Water operator partnerships as a model to achieve the Millenium Development Goals for water supply? Lessons from four cities in Mozambique. *Water SA*, *37*(4), 575–584. https://doi.org/10.4314/wsa.v37i4.17

Cosgrave, J. (2001). Mozambique and the Great Flood of 2000. *Journal of Refugee Studies*, *14*(4), 452–453. https://doi.org/10.1093/jrs/14.4.452

Cronjé, S., & Beete, N. (2009). Achieving the MDG´S - a dream come true FIPAG ' s Journey of Success - The remarkable transformation of the water sector of Mozambique from 1999 to 2009. In *FIPAG* (Issue November).

Cruz, N., & Marques, R. (2012). Mixed companies and local governance: No man can serve two masters. *Public Administration*, *90*(3), 737–758. https://doi.org/10.1111/j.1467-9299.2011.02020.x

Cruz, N., & Marques, R. (2013). Flexible contracts to cope with uncertainty in public-private partnerships. *International Journal of Project Management*, *31*(3), 473–483. https://doi.org/10.1016/j.ijproman.2012.09.006

Cruz, N., & Marques, R. (2016). Endogenous determinants for renegotiating concessions: Evidence from local infrastructure. *Public-Private Partnerships: Infrastructure,*

Transportation and Local Services, *3930*, 50–72. https://doi.org/10.4324/9781315738659

Cui, C., Liu, Y., Hope, A., & Wang, J. (2018). Review of studies on the public–private partnerships (PPP) for infrastructure projects. *International Journal of Project Management*. https://doi.org/10.1016/j.ijproman.2018.03.004

D'Alessandro, L., Bailey, S., & Giorgino, M. (2014). PPPs as strategic alliances: from technocratic to multidimensional risk governance. *Managerial Finance*, *40*(11), 1095–1111. https://doi.org/10.1108/MF-07-2013-0165

Davis, J. (2005). Private-sector participation in the water and sanitation sector. *Annual Review of Environment and Resources*, *30*(1), 145–183. https://doi.org/10.1146/annurev.energy.30.050504.144635

Do, T., Le, L., & Phan, T. (2020). Factors affecting talent retention: Case study of universities in Ho Chi Minh City. *International Journal of Entrepreneurship*, *24*(1).

Elmuti, D., & Kathawala, Y. (2001). An overview of strategic alliances. *Management Decision*, *39*(3), 205–218. https://doi.org/10.1108/EUM0000000005452

Esteki, M., Javdani Gandomani, T., & Khosravi Farsani, H. (2020). A risk management framework for distributed scrum using PRINCE2 methodology. *Bulletin of Electrical Engineering and Informatics*, *9*(3). https://doi.org/10.11591/eei.v9i3.1905

European Commission. (2020). *The assessment of the application of the temporary restriction on non-essential travel to the EU*. www.eurocontrol.int

European Union. (2019). European Union Election Observation Mission - Mozambique 2019. In *European Union*. https://doi.org/10.1017/CBO9781107415324.004

Fang, S., Liu, L., Bao, J., & Fang, W. (2009). The Research on Multi-task Bundling of Public-Private Partnerships Based on Principal-Agent Model. *2009 International Conference on Information Management, Innovation Management and Industrial Engineering*, 384–388. https://doi.org/10.1109/ICIII.2009.100

Fantom, N., & Serajuddin, U. (2016). The World Bank's classification of countries by income. In *World Bank* (Issue January). https://doi.org/10.1596/1813-9450-7528

Fernandez, R. N., Saulo, H., Carraro, A., Tourrucôo, F., & Hillbrecht, R. (2018). Public-Private Partnership Contractual Design: A Computational Model of the Moral Hazard with Lotteries. *Public Organization Review*, *18*(1), 39–51. https://doi.org/10.1007/s11115-016-0359-x

Gioia, D., Corley, K., & Hamilton, A. (2013). Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organizational Research Methods*, *16*(1), 15–31. https://doi.org/10.1177/1094428112452151

Given, L. (2008). The SAGE Encyclopedia of Qualitative Research Methods - Volume 1 & 2. In K. S. Lisa M. Given (Ed.), *SAGE Publications, Inc.* SAGE Publications Inc.

Global Water Intelligence. (2016). *Global Water Market 2017: Volume 1* (Vol. 1).

Gopakumar, G. (2014). Experiments and counter-experiments in the Urban laboratory of water-supply partnerships in India. *International Journal of Urban and Regional Research*, *38*(2), 393–412. https://doi.org/10.1111/1468-2427.12076

Green, C., & Otto, L. (2014). *Resource Abundance in Mozambique : Avoiding Conflict , Ensuring Prosperity*.

Grimsey, D., & Lewis, M. (2002). Evaluating the risks of public private partnerships for infrastructure projects. *International Journal of Project Management*, *20*(2), 107–118. https://doi.org/10.1016/S0263-7863(00)00040-5

Grossman, S., & Hart, O. (1986). The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy*, *94*(4), 691–719. https://doi.org/10.1086/261404

Guasch, J., Benitez, D., Portabales, I., & Flor, L. (2014). The Renegotiation of PPP Contracts: An Overview of its Recent Evolution in Latin America. *OECD Discussion Paper 2014-18*, *October*. https://doi.org/10.1787/5jrw2xxlks8v-en

Guerrini, A., & Romano, G. (2017). Contract renegotiation by an Italian wastewater utility: Action research to promote effective tariff revision. *Utilities Policy*, *48*, 176–183. https://doi.org/10.1016/J.JUP.2017.08.004

Hajjej, I., Hillairet, C., Mnif, M., & Pontier, M. (2017). Optimal contract with moral hazard for Public Private Partnerships. *Stochastics*, *89*(6–7), 1015–1038. https://doi.org/10.1080/17442508.2017.1303068

Hart, O. (2017). Incomplete Contracts and Ownership. *American Economic Review*, *107*(7), 1731–1752. https://doi.org/10.1257/aer.107.7.1731

Hart, O., & Holmstrom, B. (1986). *The Theory of Contracts* (B. H. Oliver Hart (ed.)). Massachusetts Institute of Technology.

Hayne, C., & Free, C. (2014). Hybridized professional groups and institutional work: COSO and the rise of enterprise risk management. *Accounting, Organizations and Society*, *39*(5), 309–330. https://doi.org/10.1016/j.aos.2014.05.002

Ibrahim, A., Price, A., & Dainty, A. (2006). The analysis and allocation of risks in public private partnerships in infrastructure projects in Nigeria. *Journal of Financial Management of Property and Construction*, *11*(3), 149–164. https://doi.org/10.1108/13664380680001086

Idelovitch, E., & Ringskog, K. (1995). Private-Sector Participation in the Water-Supply and Sewerage Sector in Latin-America. In *Washington, D.C. : World Bank Group.* (Issue 3).

International Organization for Standardization. (2018a). *Asset management — Management systems — Guidelines for the application of ISO 55001 (ISO 55002:2018)*. https://www.iso.org/standard/70402.html

International Organization for Standardization. (2018b). *Guidance on the development of government asset management policy (ISO/CD 55011)*. https://www.iso.org/standard/72701.html

International Organization for Standardization. (2018c). *Risk management — Guidelines (ISO 31000:2018)*. *Second Edition*. https://www.iso.org/standard/65694.html

Irwin, T. (2007). *Allocating and Valuing Risk in Privately*. World Bank Publications.

Jalba, D., Cromar, N., Pollard, S., Charrois, J., Bradshaw, R., & Hrudey, S. (2014). Effective drinking water collaborations are not accidental: Interagency relationships in the international water utility sector. *Science of the Total Environment*, *470–471*(February), 934–944. https://doi.org/10.1016/j.scitotenv.2013.10.046

Javed, H., Imran, M., Nazir, Q., Fatima, I., & Humayun, A. (2019). Increased trend of unnecessary use of radiological diagnostic modalities in Pakistan: radiologists perspective. *International Journal for Quality in Health Care*, *31*(9), 712–716. https://doi.org/10.1093/intqhc/mzy234

Jin, L., Zhang, Z., & Song, J. (2020). Profit Allocation and Subsidy Mechanism for Public-Private Partnership Toll Road Projects. *Journal of Management in Engineering*, *36*(3). https://doi.org/10.1061/(ASCE)ME.1943-5479.0000766

Jin, X., & Wang, Y. (2014). Chinese Outbound Tourism Research: A Review. *Journal of Travel Research*, *55*(4), 440–453. https://doi.org/10.1177/0047287515608504

Jonsen, K., & Jehn, K. (2009). Using triangulation to validate themes in qualitative studies. *Qualitative Research in Organizations and Management: An International Journal*, *4*(2), 123–150. https://doi.org/10.1108/17465640910978391

Ke, Y., Wang, S., Chan, A., & Cheung, E. (2009). Research Trend of Public-Private

Partnership in Construction Journals. *Journal of Construction Engineering and Management*, *135*(10), 1076–1086. https://doi.org/10.1061/(ASCE)0733-9364(2009)135:10(1076)

Ke, Y., Wang, S., Chan, A., & Cheung, E. (2011). Understanding the risks in China's PPP projects: Ranking of their probability and consequence. *Engineering, Construction and Architectural Management*, *18*(5), 481–496. https://doi.org/10.1108/09699981111165176

King, N. (2012). Doing Template Analysis. In *Qualitative Organizational Research: Core Methods and Current Challenges* (pp. 426–450). SAGE Publications, Inc. https://doi.org/10.4135/9781526435620.n24

Krishnan, V., Bharanidharan, B., & Krishnamoorthy, G. (2017). Research Data Analysis with Power BI. *11th International CALIBER-2017 Anna University,Chennai, Tamil Nadu 02-04 August, 2017*. http://ir.inflibnet.ac.in/handle/1944/2116

Kuźmiński, Ł., Jalowiec, T., Maśloch, P., Wojtaszek, H., & Miciuła, I. (2020). Analysis of factors influencing the competitiveness of manufacturing companies. *European Research Studies Journal*, *23*(2), 217–227. https://doi.org/10.35808/ERSJ/1590

Kwak, Y., Chih, Y., & Ibbs, C. (2009). Towards a compre- hensive understanding of public private partnerships for infrastructure development. *California Management Review*, *51 (2)*, 51–78.

Kwofie, T., Afram, S., & Botchway, E. (2016). A critical success model for PPP public housing delivery in Ghana. *Built Environment Project and Asset Management*, *6*(1), 58–73. https://doi.org/10.1108/BEPAM-04-2014-0026

Lee, C., & Yu, Y. (2012). Characteristics of public-private partnerships for municipal wastewater treatment in Taiwan. *Journal of the Chinese Institute of Engineers, Transactions of the Chinese Institute of Engineers,Series A*, *35*(2), 245–258. https://doi.org/10.1080/02533839.2012.638535

Li, J., & Zou, P. (2011). Fuzzy AHP-Based Risk Assessment Methodology for PPP Projects. *Journal of Construction Engineering and Management*, *137*(12), 1205–1209. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000362

Loë, L., & Mitchell, B. (1993). Public-Private partnerships: Water and wastewater services in France. *Water International*, *18*(3), 137–146. https://doi.org/10.1080/02508069308686170

Lombardi, R., Cano-Rubio, M., Trequattrini, R., & Fuentes-Lombardo, G. (2020).

Exploratory evidence on anticorruption activities in the Spanish context: A sustainable governance approach. In *Journal of Cleaner Production* (Vol. 249). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2019.119424

Love, P. (2002). Influence of project type and procurement method on rework costs in building construction projects. *Journal of Construction Engineering and Management*, *128*(1), 18–29. https://doi.org/10.1061/(ASCE)0733-9364(2002)128:1(18)

Luís, A., Lickorish, F., & Pollard, S. (2015). Assessing interdependent operational, tactical and strategic risks for improved utility master plans. *Water Research*, *74*(0), 213–226. https://doi.org/10.1016/j.watres.2015.02.021

Luís, A., Lickorish, F., & Pollard, S. (2016). Evolution of strategic risks under future scenarios for improved utility master plans. *Water Research*, *88*, 719–727. https://doi.org/10.1016/j.watres.2015.10.057

Lupu, C., Brochado, A., & Stoleriu, O. (2018). Visitor experiences at UNESCO monasteries in Northeast Romania. *Journal of Heritage Tourism*, *0*(0), 1–16. https://doi.org/10.1080/1743873X.2018.1506458

Mabunda, L., & Cavelane, B. (2014). Um Olhar Sobre a Despesa Pública Governo - Transparência Orçamental em Moçambique Governo e TA não publicam informação sobre as PPP. *Public Integrity Center of Mozambique*, 1–2.

Macuane, J., Buur, L., & Monjane, C. (2018). Power, conflict and natural resources: The Mozambican Crisis revisited. In *South African Institute of International Affairs* (Vol. 117, Issue 468). https://doi.org/10.1093/afraf/adx029

Mahalingam, A., Devkar, G., & Kalidindi, S. (2011). A comparative analysis of public-private partnership (PPP) coordination agencies in India: What works and what doesn't. *Public Works Management and Policy*, *16*(4), 341–372. https://doi.org/10.1177/1087724X11409215

Mahamid, I. (2011). Risk matrix for factors affecting time delay in road construction projects: Owners' perspective. *Engineering, Construction and Architectural Management*, *18*(6), 609–617. https://doi.org/10.1108/09699981111180917

Malhotra, N., & Birks, D. (2007). *Marketing research : an applied approach* (Third edit). Prentice Hall, Inc. https://doi.org/41261293

Marin, P. (2009). *Public-Private Partnerships for Urban Water Utilities: A Review of Experiences in Developing Countries* (Issue 8).

Marques, R. (2016). PPP arrangements in the Brazilian water sector: A double-edged sword. *Water Policy*, *18*(2), 463–479. https://doi.org/10.2166/wp.2015.115

Marques, R. (2017). Why not regulate PPPs? *Utilities Policy*, *48*, 141–146. https://doi.org/10.1016/j.jup.2017.04.003

Marques, R. (2018). Is Arbitration the Right Way to Settle Conflicts in PPP Arrangements? *Journal of Management in Engineering*, *34*(1), 05017007(1-7). https://doi.org/10.1061/(ASCE)ME.1943-5479.0000564

Marques, R., & Berg, S. (2010). Revisiting the Strengths and Limitations of Regulatory Contracts in Infrastructure Industries. *Journal of Infrastructure Systems*, *16*(4), 334–342. https://doi.org/10.1061/(asce)is.1943-555x.0000029

Marques, R., & Berg, S. (2011a). Public-private partnership contracts: A tale of two cities with different contractual arrangements. *Public Administration*, *89*(4), 1585–1603. https://doi.org/10.1111/j.1467-9299.2011.01944.x

Marques, R., & Berg, S. (2011b). Risks, Contracts and Private Sector Participation in Infrastructure. *Journal of Construction Engineering and Management*, 925–933. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000347

Marques, R., Cruz, N., & Pires, J. (2015). Measuring the sustainability of urban water services. *Environmental Science and Policy*, *54*, 142–151. https://doi.org/10.1016/j.envsci.2015.07.003

Marsilio, M., Cappellaro, G., & Cuccurullo, C. (2011). The intellectual structure of research into PPPS: A bibliometric analysis. *Public Management Review*, *13*(6), 763–782. https://doi.org/10.1080/14719037.2010.539112

Meister, A., Sinclair, A., & Jehn, K. (2017). Identities under scrutiny : How women leaders navigate feeling misidentified at work. *The Leadership Quarterly*, *28*(5), 672–690. https://doi.org/10.1016/j.leaqua.2017.01.009

Meltzoff, J., & Cooper, H. (2017). *Critical thinking about research: Psychology and related fields* (2nd ed.). American Psychiatric Association. https://doi.org/10.1037/0000052-000

Moeller, R. (2007). *COSO Enterprise Risk Management: Understanding the New Integrated ERM Framework*. Jonh Wiley & Sons, Inc.

Moody's. (2020). *Rating symbols and definitions*.

Mouraviev, N., & Kakabadse, N. K. (2015). Legal and regulatory barriers to effective public-private partnership governance in Kazakhstan. *International Journal of*

Public Sector Management, *28*(3), 181–197. https://doi.org/10.1108/IJPSM-09-2014-0116

Nakhla, M. (2016). Innovative regulations, incomplete contracts and ownership structure in the water utilities. *European Journal of Law and Economics*, *42*(3), 445–469. https://doi.org/10.1007/s10657-015-9480-5

Neto, D., Cruz, C., Rodrigues, F., & Silva, P. (2016). Bibliometric Analysis of PPP and PFI Literature: Overview of 25 Years of Research. *Journal of Construction Engineering and Management*, *142*(10), 06016002. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001163

Neto, D., Cruz, C., Rodrigues, F., & Silva, P. (2020). PPP Development and Governance in Latin America: Analysis of Brazilian State PPP Units. *Journal of Infrastructure Systems*, *26*(2). https://doi.org/10.1061/(ASCE)IS.1943-555X.0000544

Nigel, B., Buttrick, R., & Stanton, P. (2017). *Managing Succesfull Projects with PRINCE2*. Axelos Limited.

OGC. (2009). *Managing successful projects with PRINCE2*. 327. https://doi.org/10.1017/CBO9781107415324.004

Organisation for Economic Co-operation and Development. (2010). Dedicated Public-Private Partnership Units-A Survey of Institucional and Governance Structure. In *Dedicated Public-Private Partnership Units*. https://doi.org/10.1787/9789264064843-en

Osei-Kyei, R., & Chan, A. (2015). Review of studies on the critical success factors for public-private partnership (PPP) projects from 1990 to 2013. *International Journal of Project Management*, *33*(6), 1335–1346. https://doi.org/10.1016/j.ijproman.2015.02.008

Osei-Kyei, R., & Chan, A. (2016). Developing Transport Infrastructure in Sub-Saharan Africa through Public–Private Partnerships: Policy Practice and Implications. *Transport Reviews*, *36*(2), 170–186. https://doi.org/10.1080/01441647.2015.1077288

Osei-Kyei, R., & Chan, A. (2017). Perceptions of stakeholders on the critical success factors for operational management of public-private partnership projects. *Facilities*, *35*(1/2), 21–38. https://doi.org/10.1108/F-10-2015-0072

Osei-Kyei, R., Chan, A., Dansoh, A., Ofori-Kuragu, J., & Oppong, G. (2018). Strategies for Effective Management of Unsolicited Public–Private Partnership Proposals.

Journal of Management in Engineering, *34*(3), 04018006. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000598

Osei-Kyei, R., Chan, A., Javed, A., & Ameyaw, E. (2017). Critical success criteria for public-private partnership projects: international experts' opinion. *International Journal of Strategic Property Management*, *21*(1), 87–100. https://doi.org/10.3846/1648715X.2016.1246388

Owen, D. (2016). Public-private partnerships in the water reuse sector: a global assessment. *International Journal of Water Resources Development*, *32*(4), 526–535. https://doi.org/10.1080/07900627.2015.1137211

Owusu-Manu, D., Edwards, D., Kukah, A., Parn, E., El-Gohary, H., & Hosseini, M. (2018). An empirical examination of moral hazards and adverse selection on PPP projects. *Journal of Engineering, Design and Technology*, *16*(6), 910–924. https://doi.org/10.1108/JEDT-01-2018-0001

Paltrinieri, N., Khan, F., & Cozzani, V. (2015). Coupling of advanced techniques for dynamic risk management. *Journal of Risk Research*, *18*(7), 910–930. https://doi.org/10.1080/13669877.2014.919515

Peček, B., & Kovačič, A. (2019). Methodology of monitoring key risk indicators. *Economic Research-Ekonomska Istrazivanja* , *32*(1), 3485–3501. https://doi.org/10.1080/1331677X.2019.1658529

Pequenino, B. (2017). *O contrato de Parceria Público-Privada em Moçambique* (J. Costa (ed.); 1st ed.). Escolar Editora.

Poppleton, S., Briner, R., & Kiefer, T. (2008). The roles of context and everyday experience in understanding work-non-work relationships: A qualitative diary study of white- and blue-collar workers. *Journal of Occupational and Organizational Psychology*, *81*(3), 481–502. https://doi.org/10.1348/096317908X295182

PPIAF. (2004). *New Designs for Water and Sanitation Transactions : Making Private Sector Participation Work for the Poor* (Issue May 2018).

Pradhan, R., Verma, A., Dash, S., Maradana, R., & Gaurav, K. (2017). Critical success factors for PPP infrastructure projects in India. *Journal of the Chinese Institute of Engineers*, *40*(5), 485–491. https://doi.org/10.1080/02533839.2017.1335619

Pu, W., Xu, F., Chen, R., & Marques, R. (2020). PPP project procurement model selection in China: does it matter? *Construction Management and Economics*, *38*(2), 126–139. https://doi.org/10.1080/01446193.2019.1596291

Qin, Y., Ding, X., & Chen, C. (2019). Contract Realization of Risk Allocation Plan for PPP Municipal Infrastructure Projects in China: A Case Study. *IOP Conference Series: Earth and Environmental Science*, *376*(1). https://doi.org/10.1088/1755-1315/376/1/012014

Quinn, K., Murphy, M., Nigogosyan, Z., & Petroll, A. (2019). Stigma, isolation and depression among older adults living with HIV in rural areas. *Ageing and Society*. https://doi.org/10.1017/S0144686X18001782

Radojković, I., Milosavljevic, P., Janaćković, G., & Grozdanović, M. (2019). The key risk indicators of road traffic crashes in Serbia, Niš region. *International Journal of Injury Control and Safety Promotion*, *26*(1), 45–51. https://doi.org/10.1080/17457300.2018.1476384

Reynaud, A. (2015). *Public–Private Partnerships and Their Ownership in the Urban Water Sector* (pp. 447–461). Springer, Dordrecht. https://doi.org/10.1007/978-94-017-9801-3_21

Rezaeenour, J., Mousavi-Saleh, M., & Kolahkaj, A. (2018). Analyzing the risk factors of private–public partnerships for water supply projects using fuzzy synthetic evaluation: a case study of Iranian water supply projects. *Water Science and Technology: Water Supply*, *18*(3), 1005–1019. https://doi.org/10.2166/ws.2017.174

Rock, E., & Wu, S. (2020). The Nacala Corridor Railway and Port PPP project Risks identification research. *IOP Conference Series: Earth and Environmental Science*, *474*, 042001. https://doi.org/10.1088/1755-1315/474/4/042001

Roehrich, J., Lewis, M., & George, G. (2014). Are public-private partnerships a healthy option? A systematic literature review. *Social Science and Medicine*, *113*(MAY), 110–119. https://doi.org/10.1016/j.socscimed.2014.03.037

Sabry, M. I. (2015). Good governance, institutions and performance of public private partnerships. *International Journal of Public Sector Management*, *28*(7), 566–582. https://doi.org/10.1108/IJPSM-01-2015-0005

Sedmak, A. (2020). *Risk based analysis of RHPP penstock structural integrity*. *53*, 345–352. https://doi.org/10.3221/IGF-ESIS.53.27

Senot, C., Chandrasekaran, A., & Ward, P. (2016). Collaboration between service professionals during the delivery of health care : Evidence from a multiple-case study in U . S . hospitals. *Journal of Operations Management*, *42–43*, 62–79. https://doi.org/10.1016/j.jom.2016.03.004

Shen, L., Platten, A., & Deng, X. (2006). Role of public private partnerships to manage risks in public sector projects in Hong Kong. *International Journal of Project Management*, *24*, 587–594. https://doi.org/10.1016/j.ijproman.2006.07.006

Shi, X., Wong, Y., Li, M., & Chai, C. (2018). Key risk indicators for accident assessment conditioned on pre-crash vehicle trajectory. *Accident Analysis and Prevention*, *117*(May), 346–356. https://doi.org/10.1016/j.aap.2018.05.007

Shrestha, A., Chan, T., Aibinu, A., & Chen, C. (2017). Efficient risk transfer in PPP wastewater treatment projects. *Utilities Policy*, *48*, 132–140. https://doi.org/10.1016/j.jup.2017.03.003

Siemiatycki, M. (2013). The Global Production of Transportation Public–Private Partnerships. *International Journal of Urban and Regional Research*, *37*, 1254–1272. https://doi.org/10.1016/J.TRANPOL.2012.06.014

Silungwe, C., & Khatleli, N. (2020). An analysis of the allocation of pertinent risks in the Zambian building sector using Pareto analysis. *International Journal of Construction Management*, *20*(4), 321–334. https://doi.org/10.1080/15623599.2018.1484853

Sim, T., Wright, B., Hattingh, L., Parsons, R., Sunderland, B., & Czarniak, P. (2020). A cross-sectional survey of enhanced and extended professional services in community pharmacies: A pharmacy perspective. *Research in Social and Administrative Pharmacy*, *16*(4), 511–521. https://doi.org/10.1016/j.sapharm.2019.07.001

Son, H., & Trai, N. (2020). Social responsibility affecting operational efficiency: A case of enterprises In Ho Chi Minh City. *International Journal of Entrepreneurship*, *24*(1).

Sun, L. (2019). Journals removed from DOAJ appearing within SCImago's ranks: A study of excluded journals. *Learned Publishing*, *32*(3), 207–211. https://doi.org/10.1002/leap.1216

Taylor, I. (2000). Public-Private Partnerships- Lessons from the MDC Toll Road. *DPRU Working Paper No. 00/44-Development Policy Research Unit University of Cape Town*, *00*, 1–18.

Timmermans, C., Venet, D., & Burzykowski, T. (2016). Data-driven risk identification in phase III clinical trials using central statistical monitoring. In *International Journal of Clinical Oncology* (Vol. 21, Issue 1, pp. 38–45). Springer-Verlag Tokyo. https://doi.org/10.1007/s10147-015-0877-5

Tkaczynski, A., Rundle-Thiele, S. R., & Cretchley, J. (2015). A vacationer-driven approach to understand destination image. *Journal of Vacation Marketing*, *21*(2), 151–162. https://doi.org/10.1177/1356766714567796

Tober, M. (2011). PubMed, ScienceDirect, Scopus or Google Scholar – Which is the best search engine for an effective literature research in laser medicine? *Medical Laser Application*, *26*(3), 139–144. https://doi.org/10.1016/J.MLA.2011.05.006

Tortajada, C. (2014). Water infrastructure as an essential element for human development. In *International Journal of Water Resources Development* (Vol. 30, Issue 1, pp. 8–19). Taylor & Francis. https://doi.org/10.1080/07900627.2014.888636

Tserng, H., Russell, J., Hsu, C., & Lin, C. (2012). Analyzing the role of national PPP units in promoting PPPs: Using new institutional economics and a case study. *Journal of Construction Engineering and Management*, *138*(2), 242–249. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000398

United Nations. (2013). Human development report 2013. The rise of the south: Human progress in a diverse world. In *United Nations Development Programme*. https://www.undp.org/content/undp/en/home/librarypage/hdr/human-development-report-2013.html

United Nations. (2019). World Economic Situation and Prospects. In *United Nations*.

Unkovski, I. and Pienaar, E. (2009). Public private partnerships in South Africa: analysis and management of risks.". *Proceedings of the Construction and Building Research Conference of the Royal Institute of Chartered Surveyors (CORBRA 2009)*, 10–11.

Välilä, T. (2020). An overview of economic theory and evidence of public-private partnerships in the procurement of (transport) infrastructure. *Utilities Policy*. https://doi.org/10.1016/j.jup.2019.100995

Vedachalam, S., Geddes, R., & Riha, S. (2016). Public–Private Partnerships and Contract Choice in India's Water and Wastewater Sectors. *Public Works Management and Policy*, *21*(1), 71–96. https://doi.org/10.1177/1087724X15596171

Villa, L., & Diron, M. (2020). *Moody's upgrades Mozambique's ratings to Caa2 , maintains stable outlook; assigns (P) Caa2 rating to the forthcoming bond; affirms the 2023 bond rating at Caa3*. 6.

Vinogradov, D., & Shadrina, E. (2018). Public-Private Partnerships as Collaborative Projects: Testing the Theory on Cases from EU and Russia. *International Journal of*

Public Administration, *41*(5–6), 446–459. https://doi.org/10.1080/01900692.2018.1426012

Wibowo, A., & Mohamed, S. (2010). Risk criticality and allocation in privatised water supply projects in Indonesia. *International Journal of Project Management*, *28*(5), 504–513. https://doi.org/10.1016/j.ijproman.2009.08.003

Williams, J. (2018). Assembling the water factory: Seawater desalination and the techno-politics of water privatisation in the San Diego–Tijuana metropolitan region. *Geoforum*, *93*(May), 32–39. https://doi.org/10.1016/j.geoforum.2018.04.022

Williamson, O. (1976). Franchise bidding for natural monopolies - in general and with respect to catv. *Bell J Econ*, *7*(1), 73–104. https://doi.org/10.2307/3003191

Willoughby, C. (2013). How much can public private partnership really do for urban transport in developing countries? *Research in Transportation Economics*, *40*(1), 34–55. https://doi.org/10.1016/J.RETREC.2012.06.038

Wilson, A., & Dias, M. (2016). *Peer Review of Water Supply and Sanitation Services Regulatory System In Mozambique-Final Report, 12th October 2016* (Issue October).

Word Bank. (2018). *Private participation in infrastructure (PPI) annual report 2017*. http://documents.worldbank.org/curated/en/658451524561003915/Private-participation-in-infrastructure-PPI-annual-report-2017

World Bank. (2009a). *Attracting Investors to African Public-Private Parthership: A project preparation guide*. https://doi.org/10.1596/978-0-8213-7730-7

World Bank. (2009b). *Delegated Management of Urban Water Supply Services in Mozambique: Summary of the case of FIPAG & CRA*. https://ppiaf.org/documents/2638?ref_site=kl

World Bank. (2016). *APMG PPP Certification Guide* (World Bank (ed.)). World Bank. https://ppp-certification.com/ppp-certification-guide/about-ppp-guide

World Bank. (2017a). International development association international finance corporation and multilateral investment guarantee agency country partnership framework for the Republic of Mozambique for the period FY17–FY21. In *World Bank*. http://documents1.worldbank.org/curated/es/540001493517702187/text/MZ-CPF-Final-clean-March-23-04052017.txt

World Bank. (2017b). *Public-Private Partnerships : Reference Guide Version 3* (World Bank (ed.); Version 3). https://openknowledge.worldbank.org/handle/10986/29052

License: CC BY 3.0 IGO

World Bank. (2018). *2017 Water & Sewerage Sector-Private Participation in Infrastructure (PPI)*. http://hdl.handle.net/10986/31036

World Bank. (2020). Private Participation in Infrastructure (PPI) - Annual Report 2019. In *World bank* (Vol. 5, Issue 1). https://doi.org/10.3934/math.2020i

Xia, B., Chan, A., Molenaar, K., & Skitmore, M. (2012). Determining the Appropriate Proportion of Owner-Provided Design in Design-Build Contracts: Content Analysis Approach. *Journal of Construction Engineering and Management*, *138*(9), 1017–1022. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000522

Xu, Y., Yeung, J., Chan, A., Chan, D., Wang, S., & Ke, Y. (2010). Developing a risk assessment model for PPP projects in China-A fuzzy synthetic evaluation approach. *Automation in Construction*, *19*(7), 929–943. https://doi.org/10.1016/j.autcon.2010.06.006

Yang, J., Wang, M., Guo, D., Zhang, B., & Yang, M. (2020). Use of a success-oriented GO-FLOW method for system configuration risk management at NPPs. *Annals of Nuclear Energy*, *143*, 107452. https://doi.org/10.1016/j.anucene.2020.107452

Yescombe. (2007). Public-Private Partnerships: Principles of Policy and Finance. In E. R. E. Yescombe (Ed.), *Public–Private Partnerships: Principles of Policy and and Finance* (First edit, Vol. 1). Elsevier Ltd. https://doi.org/10.1017/CBO9781107415324.004

Yi, W., & Chan, A. (2014). Critical Review of Labor Productivity Research in Construction Journals. *Journal of Management in Engineering*, *30*(2), 214–225. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000194

Yin, R. (2009). Case study research: Design and methods. In *The Canadian Journal of Action Research* (4th ed., Vol. 14, Issue 1). SAGE Publications Inc. https://doi.org/10.33524/cjar.v14i1.73

Yin, R. (2014). Case study methods design and research. In *Applied Social Research Methods Seiries*. https://doi.org/10.1097/FCH.0b013e31822dda9e

Yousaf, S., & Fan, X. (2020). Copysites / duplitectures as tourist attractions: An exploratory study on experiences of Chinese tourists at replicas of foreign architectural landmarks in China. *Tourism Management*, *81*. https://doi.org/10.1016/j.tourman.2020.104179

Yu, Y., Chan, A., Chen, C., & Darko, A. (2018). Critical Risk Factors of Transnational

Public–Private Partnership Projects: Literature Review. *Journal of Infrastructure Systems*, *24*(1), 04017042. https://doi.org/10.1061/(ASCE)IS.1943-555X.0000405

Yuan, J., Chan, A., Xiong, W., Skibniewski, M., & Li, Q. (2015). Perception of residual value risk in public private partnership projects: Critical review. *Journal of Management in Engineering*, *31*(3), 04014041. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000256

Zhang, B., Gao, M., & Sun, J. (2019). Implementation status and countermeasures of urban domestic waste treatment PPP project in China. *Ekoloji*, *28*(107), 427–431.

Zhang, L., Hu, J., Li, Y., & Pradhan, N. (2018). Public-private partnership in enhancing farmers' adaptation to drought: Insights from the Lujiang Flatland in the Nu River (Upper Salween) valley, China. *Land Use Policy*, *71*, 138–145. https://doi.org/10.1016/j.landusepol.2017.11.034

Zhong, L., Mol, A., & Fu, T. (2008). Public-private partnerships in China's urban water sector. *Environmental Management*, *41*(6), 863–877. https://doi.org/10.1007/s00267-008-9070-1

APPENDIX A – EURAM 19 TH EDITION CERTIFICATE

EURAM 19 TH EDITION ACCEPTED FOR PRESENTATION

Your submission to the EURAM 2019 Conference

Inbox

EURAM 2019 Submission <noreply@xcdsystem.com>
to Sonia_Lima, me

Paper: Public-Private Partnerships (PPP) in water sector: Review
Paper ID: 1406
Track: GT11_00 - Public and Non-Profit Management General Track

Dear sonia maria chin lima,

We are very pleased to inform you (and your co-authors, if any), that your paper has been accepted for presentation at the 2019 EURAM Conference in L 2019. With close to 2.000 papers submitted we had to be quite selective. Congratulations on being accepted for presentation!

You can view the reviewers' comments on the submission platform by login here https://www.xcdsystem.com/euram/abstract/index.cfm?ID=ahWxaZ5 (Clic

Any question you might have should be sent directly to the track chair http://www.euramonline.org/component/phocadownload/category/43-2019-confe

On 25 June, we wish to welcome you at ISCTE-IUL for the **Labs** offered to all participants. You can find preliminary information about the LABs here. T Reception at 18:30 at the university premises.

Please, book your hotel and register for the conference at your earliest convenience:
Lisbon is a very popular destination during June yet it offers many accommodation opportunities. Some hotels close to the premises are listed on our we made. Platforms such as expedia.com or booking.com will give you a wide range of prices and choices for your stay at the conference.

The presenting author must be registered to attend the conference by **25 April 2019** (to benefit from the early bird rate, register by **18 April 2019).** Fa the paper being withdrawn from the conference programme.

Please, check out the website as it will be updated frequently. If you have questions take a look at the FAQ (http://www.euramonline.org/annual-confere questions have an answer there.

Presenting author and final schedule:
One of the conditions of accepting your paper for the 2019 EURAM conference is your availability for the entire scholarly programme from **Wednesday 2 (18:00).** It will not be possible to make any changes to the programme in order to accommodate participants' travel plans or personal preferences. We authors should be available to present the paper at the conference. A **presenting author** can only present one paper at the conference.

Publication of your paper on the conference website:
All accepted papers will be published on the conference's app. The app is accessible to registered participants only. If you do not wish your paper to be p link https://www.xcdsystem.com/euram/abstract/index.cfm?ID=ahWxaZ5 and tick "NO Publish".

Conference programme:
The conference programme is still being finalised and will be available in due course. A preliminary programme at a glance is available on the EURAM 201

Conference App:
You will be able to download the app to your smartphone/tablet. The conference app will allow you to navigate through the programme. We will send you June.

Social media:
Last but not least, join us on our social media where we will be posting more news about the programme – and check in at www.facebook.com/euram.aeo news about the conference or on the academy.

Updating of your paper

You may update your paper title and abstract yourself, as well as upload a new version of your paper **until 25 April 2019 included**. To do this, please c link:https://www.xcdsystem.com/euram/abstract/index.cfm?ID=ahWxaZ5

Presenting Author checklist:

APPENDIX B – SUSTAINABLE TARIFFS FOR WATER SERVICES CONFERENCE 2019 [ACCEPTED FOR PRESENTATION]

Reply all | Delete Junk | •••

Letter of abstract acceptance to Sustainable Tariffs for Water Services Conference 2019

PN Patricia Nunes <patricia.nunes@tecnico.ulisboa.pt> Reply all |
Tue 2/5/2019 5:57 AM
To: Sonia Lima

1.2-Paper-water pricing

Dear Sónia Lima,

We are pleased to inform you that your abstract "**The tariff systems in PPP water contracts: is this the solution to save this marriage?**" has been accepted by the Scientific Committee for presentation in the Sustainable Tariffs for Water Services Conference. Thus, we invite you to participate as a speaker.

For general information, please check the following website:

https://www.waterwastelisbon.com/

Looking forward to seeing you in Lisbon next March, with best regards,

Rui Cunha Marques

Conference committee President

João Miranda

Conference committee Vice-President

APPENDIX C – STUDY ACCEPTED FOR PUBLICATION

From: em.juip.0.70e231.69b0eb22@editorialmanager.com <em.juip.0.70e231.69b0eb22@editorialmanager.com> on behalf of Utilities Policy <em@editorialmanager.com>
Sent: Monday, January 25, 2021 1:27:33 AM
To: Ana Brochado <Ana.Brochado@iscte-iul.pt>
Subject: Decision on submission to Utilities Policy

Manuscript Number: JUIP-D-20-00015R4

Public-Private Partnerships in the Water Sector: A Review

Dear Dr. Brochado,

I am pleased to inform you that your manuscript has been accepted for publication and will now be transferred to our production department. You will receive a proof copy that we ask you to check very carefully.

We will also contact you about completing a number of online forms required for publication and for additional information as needed.

Thank you for sharing your work through Utilities Policy and the additional effort. We hope you will consider us for future submissions.

Kind regards,
Janice Beecher, Ph.D.
Editor-in-Chief

Utilities Policy

Editor and Reviewer comments:

APPENDIX D – STUDY SUBMITED FOR PUBLICATION

De: em.juip.0.710c46.4f502600@editorialmanager.com <em.juip.0.710c46.4f502600@editorialmanager.com> em nome de Utilities Policy <em@editorialmanager.com>
Enviado: 1 de fevereiro de 2021 05:00
Para: Ana Brochado <Ana.Brochado@iscte-iul.pt>
Assunto: Confirming submission to Utilities Policy

This is an automated message.

A paradigm shift in risk management in public-private partnership arrangements

Dear Dr. Brochado,

We have received the above referenced manuscript you submitted to Utilities Policy.

To track the status of your manuscript, please log in as an author at https://eur01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.editorialmanager.com%2Fjuip%2F&data=04%7C01%7Cana.brochado%40iscte-iul.pt%7C7be211a19785442cc5e708d8c6b14829%7C6230e860bfc54095a6bc104721add6e6%7C0%7C0%7C637477812010768320%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=G6lN6CmK2PWTNjJKtvTM5%2FBUa0%2FmXiZ6Vs9UL%2FoOUv8%3D&reserved=0, and navigate to the "Submissions Being Processed" folder.

Thank you for submitting your work to this journal.

Kind regards,
Utilities Policy

More information and support

You will find information relevant for you as an author on Elsevier's Author Hub: https://eur01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.elsevier.com%2Fauthors&data=04%7C01%7Cana.brochado%40iscte-iul.pt%7C7be211a19785442cc5e708d8c6b14829%7C6230e860bfc54095a6bc104721add6e6%7C0%7C0%7C637477812010768320%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=u1v2mR4ZrQlYUGi%2F3c2KpnreYVvYnTp%2BLpNDLg8%2FHr8%3D&reserved=0

FAQ: How can I reset a forgotten password?

APPENDIX E – PPP WATER STUDIES

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Carpintero & Petersen (2016)	Public-private partnerships (PPPs) in local services: risk-sharing and private delivery of water services in Spain	2016	Local Government Studies	Department of Civil Engineering, Polytechnic University of Madrid, Madrid, Spain; Department of Social Sciences and Business, Roskilde University, Roskilde, Denmark	Polytechnic University of Madrid; University, Roskilde
Owen (2016)	Public-private partnerships in the water reuse sector: A global assessment	2016	International Journal of Water Resources Development	Envisager Limited, Ceredigion, United Kingdom	Envisager Limited
Vedachalam et al. (2016)	Public-private Partnerships and Contract Choice in India's Water and Wastewater Sectors	2016	Public Works Management and Policy	Cornell University, Ithaca, NY, United States; Johns Hopkins Water Institute, 615 N Wolfe St, E6638, Baltimore, MD, United States	Cornell University, Ithaca; Cornell University, Ithaca; Cornell University, Ithaca;
Lee et al. (2012)	Characteristics of Public-private partnerships for municipal wastewater treatment in Taiwan	2012	Journal of the Chinese Institute of Engineers	Graduate Institute of Environmental Engineering, National Taiwan University, 71 Chou-Shan Rd., Taipei 106, Taiwan	National Taiwan University; National Taiwan University
Braadbaar et al.. (2009)	Managing urban wastewater in China: A survey of build-operate-transfer contracts	2009	Water and Environment Journal	Urban Environment Group, Landscape Centre, Wageningen University, Droevendaalsesteeg 3, 6708 BJ Wageningen, Netherlands	Wageningen University; Wageningen University

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Abu-Shams, I., Rabadi, A.	Commercialization and Public-private partnership in Jordan	2003	International Journal of Water Resources Development	Planning and Management Unit, Jordan Ministry of Water/Irrigation, PO Box 2412, Amman 11183, Jordan; Planning and Management Unit, Jordan Ministry of Water/Irrigation, PO Box 540545, Amman 11937, Jordan	Planning and Management Unit, Jordan Ministry of Water/Irrigation Planning and Management Unit, Jordan Ministry of Water/Irrigation
Breytenbach, K., Manning, C.	Financing municipal BOOTs in South Africa: The lenders' perspective	1999	Development Southern Africa	Project Manager, Private Sector Investment Unit Development Bank of Southern Africa, Midrand	Development Bank of Southern Africa; Development Bank of Southern Africa
Loë, L.M., Mitchell, B.	Public-private partnerships: Water and wastewater services in France	1993	Water International	Department of Geography, University of Waterloo, Waterloo, ON, N2L 3G1, Canada	University of Waterloo; University of Waterloo
Cheng, S., Li, Z., Uddin, S.M.N., Mang, H.-P., Zhou, X., Zhang, J., Zheng, L., Zhang, L.	Toilet revolution in China	2018	Journal of Environmental Management	School of Energy and Environmental Engineering, Beijing Key Laboratory of Resource-oriented Treatment of Industrial Pollutants, University of Science and Technology Beijing, Beijing, China Department of Geography, Faculty of Social Sciences, University of Victoria, PO Box 1700 STN CSC, Victoria, BC, Canada; Enviro Systems Engineering & Technology Co., Ltd., Tiangong	University of Science and Technology. University of Victoria; Enviro Systems Engineering & Technology Co., Ltd

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Cheung, E., Chan, A.P.C.	Risk Factors of Public-private Partnership Projects in China: Comparison between the Water, Power, and Transportation Sectors	2012	Journal of the Urban Planning and Development Division, ASCE	Plaza A501, Xueyuan Road 30, Haidian District, Beijing, China College of Humanities and Law, HKU School of Professional and Continuing Education, 10/F, Fortress Tower, 250 King's Road, North Point, Hong Kong; Dept. of Building and Real Estate, Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong	College of Humanities and Law, HKU School of Professional and Continuing Education; Hong Kong Polytechnic University
Liu, J., Cheah, C.Y.J.	Real option application in PPP/PFI project negotiation	2009	Construction Management and Economics	Southwest Jiaotong University; Nanyang Technological University	Chengdu, China; Nanyang Technological University, Singapore, Singapore
Tsiourtis, N.X.	Criteria and procedure for selecting a site for a desalination plant	2008	Desalination	Epidavrou 4, PC 2114 Platy Aglantzia, Nicosia, Cyprus	PC 2114 Platy Aglantzia
Russell, A.D., Tawiah, P., De Zoysa, S.	Project innovation - A function of procurement mode?	2006	Canadian Journal of Civil Engineering	Department of Civil Engineering, The University of British Columbia, 6250 Applied Science Lane, Vancouver, BC V6T 1Z4, Canada	The University of British Columbia; The University of British Columbia
Khalifa, N., Essaouabi, D.	Public-private partnership: Which strategy for the drinking water and sanitation sector in Morocco?	2003	International Journal of Water Resources Development	Office Natl. de l'Eau Potable, Station de Traitement, Avenue Oued Akrach, Rabat, Morocco	Office Natl. de l'Eau Potable, Station de Traitement, Avenue Oued Akrach; Office Natl. de l'Eau Potable, Station de

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
					Traitement, Avenue Oued Akrach
Grimsey, D., Lewis, M.K.	Evaluating the risks of Public-private partnerships for infrastructure projects	2002	International Journal of Project Management	PricewaterhouseCoopers, Spring Street, Melbourne Vic., Australia; School of International Business, University of South Australia, North Terrace, Adelaide, SA, Australia	PricewaterhouseCoopers, Spring Street, Melbourne Vic.; University of South Australia
Lemos, M.C., Austin, D., Merideth, R., Varady, R.G.	Public-private partnerships as catalysts for community-basedwater infrastructure development: The Border Water Works program in Texas and New Mexico colonias	2002	Environment and Planning C: Politics and Space	Centre for Latin American Studies, The University of Arizona, 103 Douglass Building, Tucson, AZ 85721-0028, United States	The University of Arizona; The University of Arizona; The University of Arizona; The University of Arizona
Bertoméu-Sánchez, S., Camos, D., Estache, A.	Do economic regulatory agencies matter to private-sector involvement in water utilities in developing countries?	2018	Utilities Policy	ECARES at the Université libre de Bruxelles, Belgium; The World Bank, Washington, DC, United States	Université libre de Bruxelles The World Bank, Washington,
Cobbinah, P.B., Addaney, M., Agyeman, K.O.	Locating the role of urbanites in solid waste management in Ghana	2017	Environmental Development	Department of Planning, Faculty of Built Environment, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana; Stellenbosch Institute for Advanced Study (STIAS), Wallenberg Research Centre at	University of Science and Technology, Kumasi, Ghana; Stellenbosch Institute for Advanced Study; Charles Sturt University; University of Energy and Natural Resources

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
				Stellenbosch University, Stellenbosch, South Africa; Institute for Land Water and Society, Charles Sturt University, Albury, New South Wales, Australia Quality Assurance and Planning Unit, University of Energy and Natural Resources, Sunyani, Ghana	
Vedachalam, S., Geddes, R.R., Riha, S.J.	Public-private Partnerships and Contract Choice in India's Water and Wastewater Sectors	2016	Public Works Management and Policy	Cornell University, Ithaca, NY, United States; Johns Hopkins Water Institute, 615 N Wolfe St, E6638, Baltimore, MD, United States	Cornell University; Cornell University; Cornell University;
Carron, D., Janssens, J.G., Castro-Wooldridge, V.	Evolution of contract structures in water supply and sanitation	2013	Journal of Water Sanitation and Hygiene for Development	Pöyry SAS, 55 rue de la Villette, 69425 Lyon Cedex 03, France; JJC Advisory Services, 9 Route des Liches, BP819 Vercorin 3967, Switzerland; Asian Development Bank, 6 ADB Avenue, Mandaluyong City 1550, Philippines	55 rue de la Villette; JJC Advisory Services; Asian Development Bank
Kanakoudis, V., Tsitsifli, S.	Urban water services public infrastructure projects: Turning the high level of the NRW into an attractive financing opportunity using the PBSC tool	2012	Desalination and Water Treatment	Department of Civil Engineering, University of Thessaly, Pedion Areos, Volos, 38334, Greece	University of Thessaly; University of Thessaly
Lonsdale, C., Kirkpatrick, I.,	Supplier behaviour and public contracting	2010	Public Administration	The Business School, University of Birmingham,	University of Birmingham;

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Hoque, K., De Ruyter, A.	in the English agency nursing market			United Kingdom; The Business School, University of Leeds, United Kingdom; The Business School, University of Nottingham, United Kingdom; The Business School, University of the West of Scotland, United Kingdom	University of Leeds; University of Nottingham; University of the West of Scotland
Lobina, E.	Problems with private water concessions: A review of experiences and analysis of dynamics	2005	International Journal of Water Resources Development	PSIRU, Business School, University of Greenwich, 30 Park Row, London SE10 9LS, United Kingdom	University of Greenwich
Hall, D., Lobina, E.	Private and public interests in water and energy	2004	Natural Resources Forum	PSIRU, Business School, University of Greenwich, London, United Kingdom	University of Greenwich; University of Greenwich
Franceys, R., Weitz, A.	Public-private community partnerships in infrastructure for the poor	2003	Journal of International Development	Cranfield University, Institute of Water and Environment, Bedford MK45 4DT, United Kingdom; Asian Development Bank, Manila 0980, Philippines	Cranfield University Asian Development Bank
Seppälä, O.T., Hukka, J.J., Katko, T.S.	Public-private partnerships in water and sewerage services: Privatization for profit or improvement of service and performance?	2001	Public Works Management and Policy	Tampere University of Technology, Institute of Environmental Engineering and Biotechnology, Tampere, Finland; University of Pristina, Serbia	Institute of Environmental Engineering and Biotechnology; University of Pristina
Bakker, K., Hemson, D.	Privatising water: BoTT and hydropolitics in the New South Africa	2000	Southern African Geographical Journal	Environmental Change Unit, School of Geography, University of Oxford, Mansfield Road, Oxford, OXI 3DW, United	University of Oxford; University of Durban-Wesville

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
				Kingdom; Social Policy Program, University of Durban-Wesville, Private Bag 54001, Durban, 4000, South Africa	
Kotze, R., Ferguson, A., Leigland, J.	Nelspruit and Dolphin Coast: Lessons from the first concession contracts	1999	Development Southern Africa	Chief executive and town cleark, Nelspruit; South Africa; Chief executive and town cleark, Dolphin Coast; Municipal Infrastruture Investiment Unit, Midrand; South Africa;	town cleark; town cleark; Municipal Infrastruture Investiment Unit
Porciuncula, A.D.	Creative financing solution for water supply and sanitation in the Philippines	2009	Ocean and Coastal Management	Ortigas Center, Unit	Development Alternatives Incorporated, Ortigas Center, Unit 2401 24/F Prestige Tower, Pasig City 1605, Metro Manila, Philippines
Gerhager, B., Sahooly, A.	Reforming the urban water supply and sanitation (UWSS) sector in Yemen	2009	International Journal of Water Resources Development	Yemeni-German Water Sector Program (GTZ), Technical Secretariat (TS), Reform of the Institutional Framework in the Urban Water Supply and Sanitation Sector, Sana'a, Yemen	Reform of the Institutional Framework in the Urban Water Supply and Sanitation Sector
Jamati, C.	Casablanca (Morocco): An example of Public-private partnership	2003	International Journal of Water Resources Development	Bureau de Liaison Maroc, 20 Boulevard Rachidi, Casablanca 20 000, Morocco	Bureau de Liaison Maroc
Ruiters, C., Matji, M.P.	Water institutions and governance models for the funding, financing and management of water	2015	Water S.A.	Council for Scientific and Industrial Research (CSIR), Built Environment, PO Box 395, Pretoria, South Africa; Graduate School of Business	Built Environment; University of South Africa

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
	infrastructure in South Africa			Leadership (GSBL), University of South Africa, UNISA, PO Box 392, South Africa	
Wentworth, L., Makokera, C.G.	Private sector participation in infrastructure for development	2015	South African Journal of International Affairs	Economic Diplomacy Programme, South African Institute of International Affairs, Johannesburg, South Africa; Tutwa Consulting, Johannesburg, South Africa	South African Institute of International Affairs; Tutwa Consulting
Bremer, J., Bhuiyan, S.H.	Community-led infrastructure development in informal areas in urban Egypt: A case study	2014	Habitat International	Department of Public Policy and Administration, School of Global Affairs and Public Policy, The American University in Cairo, New Cairo 11835, Egypt	The American University in Cairo; The American University in Cairo
Ioris, A.A.R	The persistent water problems of Lima, Peru: Neoliberalism, institutional failures and social inequalities	2012	Singapore Journal of Tropical Geography	School of Geosciences, University of Edinburgh, Scotland, United Kingdom	University of Edinburgh, Scotland
Mahalingam, A., Devkar, G.A., Kalidindi, S.N.	A comparative analysis of public-private partnership (PPP) coordination agencies in India: What works and what doesn't	2011	Public Works Management and Policy	Indian Institute of Technology, Chennai 600036, India	Indian Institute of Technology; Indian Institute of Technology; Indian Institute of Technology
Butala, N.M., VanRooyen, M.J., Patel, R.B.	Improved health outcomes in urban slums through infrastructure upgrading	2010	Social Science and Medicine	Yale School of Medicine, United States; Harvard School of Public Health, Harvard Humanitarian Initiative, Dept. of Emergency Medicine, Brigham and Women's Hospital, United States	Yale School of Medicine; Harvard School of Public Health; Harvard School of Public Health

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Gopakumar, G.	Transforming water supply regimes in India: Do Public-private partnerships have a role to play?	2010	Water Alternatives	Concordia University, Montreal, Canada	Concordia University
Osumanu, I.K.	Private sector participation in urban water and sanitation provision in Ghana: Experiences from the Tamale Metropolitan Area (TMA)	2008	Environmental Management	Department of Environmental and Resource Studies, University for Development Studies, Post Office Box 520, Wa Wa None, Ghana	University for Development Studies
Prasad, N.	Privatisation results: Private sector participation in water services after 15 years	2006	Development Policy Review	United Nations Research Institute for Social Development (UNRISD), Palais des Nations, 121 Geneva 10, Switzerland	United Nations Research Institute for Social Development (UNRISD)
Marson, M., Maggi, E.	Light Public-private partnerships in the water supply sector: Malawi and other case studies from sub-Saharan Africa	2018	Development Policy Review	Department of Economics, University of Insubria, Italy	University of Insubria; University of Insubria
Jensen, O., Wu, X.	The hybrid model for economic regulation of water utilities: Mission impossible?	2017	Utilities Policy	Lee Kuan Yew School of Public Policy, Institute of Water Policy, National University of Singapore, 469C Bukit Timah Road, Wing A, Level 2, Oei Tiong Ham Building, Singapore, Singapore; Division of Social Science and Division of Environment, Hong Kong University of Science and	Institute of Water Policy; Hong Kong University of Science and Technology

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
				Technology, Clear Water Bay, Kowloon, Hong Kong	
Ameyaw, E.E., Chan, A.P.C., Owusu-Manu, D.-G.	A survey of critical success factors for attracting private sector participation in water supply projects in developing countries	2017	Journal of Facilities Management	The Hong Kong Polytechnic University, Department of Building and Real Estate, Hong Kong; Kwame Nkrumah University of Science and Technology College of Science, Department of Building Technology, Kumasi, Ghana	The Hong Kong Polytechnic University; The Hong Kong Polytechnic University; Kwame Nkrumah University of Science and Technology College of Science
Nakhla, M.	Innovative regulations, incomplete contracts and ownership structure in the water utilities	2016	European Journal of Law and Economics	CGS-MINES ParisTech UMR I3 CNRS 9217, 60 Bd Saint Michel, Paris, France	CGS-MINES ParisTech UMR
Ameyaw, E.E., Chan, A.P.C.	A fuzzy approach for the allocation of risks in Public-private partnership water-infrastructure projects in developing countries	2016	Journal of Infrastructure Systems	Dept. of Building and Real Estate, Hong Kong Polytechnic Univ, 181 Chatham Rd, Hung Hom, Hong Kong	Hong Kong Polytechnic University; Hong Kong Polytechnic University
House, S.	Responsive regulation for water PPP: Balancing commitment and adaptability in the face of uncertainty	2016	Policy and Society	Institute of Water Policy, Lee Kuan Yew School of Public Policy, National University of Singapore, Singapore	National University of Singapore
Marques, R.	PPP arrangements in the Brazilian water	2016	Water Policy	University of Lisbon, Lisbon, Portugal	University of Lisbon

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
	sector: A double-edged sword				
Ray, D., Ing, L.Y.	Addressing Indonesia's Infrastructure Deficit	2016	Bulletin of Indonesian Economic Studies	Indonesia Infrastructure Initiative (IndII), Indonesia; Economic Research Institute for ASEAN and East Asia (ERIA), Indonesia	Indonesia Infrastructure Initiative (IndII); Economic Research Institute for ASEAN and East Asia (ERIA)
Andrews, R., Esteve, M., Ysa, T.	Public-private joint ventures: mixing oil and water?	2015	Public Money and Management	Cardiff Business School, Cardiff University, United Kingdom; School of Public Policy. University College London, United Kingdom; Department of Strategy and General Management, ESADE Business School, Ramon Llull University, Barcelona, Spain	Cardiff University; University College London; University
Ameyaw, E.E., Chan, A.P.C.	Risk allocation in Public-private partnership water supply projects in Ghana	2015	Construction Management and Economics	Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong	Hong Kong Polytechnic University; Hong Kong Polytechnic University
Pinto, F.S., Da Cruz, N.F., Marques, R.C.	Contracting water services with public and private partners: A case study approach	2015	Journal of Water Supply: Research and Technology - AQUA	Center for Urban and Regional Studies (CESUR), Instituto Superior Técnico (IST), University of Lisbon, Av. Rovisco Pais 1049-001, Lisbon, Portugal; Instituto Superior Técnico (IST), University of Lisbon, Av. Rovisco Pais 1049-001, Lisbon, Portugal	University of Lisbon; University of Lisbon; University of Lisbon;

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Ameyaw, E.E., Chan, A.P.	Risk ranking and analysis in PPP water supply infrastructure projects	2015	Facilities	Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong	Hong Kong Polytechnic University; Hong Kong Polytechnic University
Xu, Y., Yeung, J.F.Y., Jiang, S.	Determining appropriate government guarantees for concession contract: lessons learned from 10 PPP projects in China	2014	International Journal of Strategic Property Management	Department of Building and Real Estate, Zhejiang Sci-tech University, Hangzhou, China; Division of Business, College of International Education, School of Continuing Education, The Hong Kong Baptist University, China; Department of Engineering Management, Dalian University of Technology, Dalian, China	Zhejiang Sci-tech University; The Hong Kong Baptist University; Dalian University of Technology
Cruz, C.O., Marques, R.	Endogenous Determinants for Renegotiating Concessions: Evidence from Local Infrastructure	2013	Local Government Studies	Department of Civil Engineering and Architecture, Instituto Superior Técnico, Technical University of Lisbon, Avenida Rovisco Pais, 1049-001 Lisbon, Portugal; Department of Engineering and Management, Centre for Management Studies (CEG-IST), Instituto Superior Técnico, Technical University of Lisbon, Portugal	Technical University of Lisbon; Technical University of Lisbon;
Ameyaw, E., Chan, A.	Identifying Public-private partnership (PPP) risks in managing water	2013	Journal of Facilities Management	Building and Real Estate (BRE), The Hong Kong Polytechnic University, Hong Kong	Hong Kong Polytechnic University; Hong Kong Polytechnic University

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
	supply projects in Ghana				
Albalate, D., Bel, G., Geddes, R.	Recovery Risk and Labor Costs in Public-private Partnerships: Contractual Choice in the US Water Industry	2013	Local Government Studies	University of Barcelona, Departament de Política Economica, Av. Diagonal 690, 08034 Barcelona, Spain; Cornell University, Ithaca, NY, United States	University of Barcelona; University of Barcelona; Cornell University
Allès, C.	The Private Sector and Local Elites: The Experience of Public-private Partnership in the Water Sector in Tripoli, Lebanon	2012	Meditteranean Politics	Le Groupe de Recherches et d'Etudes sur la Méditerranée et le Moyen Orient (GREMMO), University of Lyon 2, France; L'Institut français du Proche-Orient (IFPO), Beirut, Lebanon	University of Lyon; L'Institut français du Proche-Orient (IFPO)
Marques, R., Berg, S.	Public-private partnership contracts: A tale of two cities with different contractual arrangements	2011	Public Administration	Center for Management Studies (CEG-IST), Technical University of Lisbon, Portugal; Public Utility Research Center (PURC), University of Florida, Gainsville, FL, United States	Technical University of Lisbon; University of Florida
Xu, Y., Yang, Y., Chan, A.P.C., Yeung, J.F.Y., Cheng, H.	Identification and allocation of risks associated with PPP water projects in China	2011	International Journal of Strategic Property Management	Department of Construction Management and Real Estate, Southeast University, Nanjing 210009, China; Department of Engineering Management, Zhejiang Sci-tech University, Hangzhou, China; School of Civil Engineering and Architecture, Zhejiang Sci-tech University, Hangzhou, China; Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung	Southeast University; Zhejiang Sci-tech University; Zhejiang Sci-tech University; The Hong Kong Polytechnic University; College of International Education;

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Marques, R., Berg, S.	Risks, contracts, and private-sector participation in infrastructure	2011	Journal of Construction Engineering and Management - ASCE	Hom, Kowloon, Hong Kong, Hong Kong; College of International Education, School of Continuing Education, Hong Kong Baptist University, Hong Kong, China Center for Management Studies, IST, Technical Univ. of Lisbon, Ave. Rovisco Pais, 1049-001 Lisbon, Portugal; Center of Urban and Regional Systems (CESUR), IST, Technical Univ. of Lisbon, Ave. Rovisco Pais, 1049-001 Lisbon, Portugal; Public Utilities Research Center (PURC), Univ. of Florida, P.O. Box 117142, Gainesville, FL 32611-7142, United States; Department of Water Studies, Univ. of Florida, Public Utilities Research Center (PURC), P.O. Box 117142, Gainesville, FL 32611-7142, United States	Technical University of Lisbon; University of Florida
Boudet, H.S., Jayasundera, D.C., Davis, J.	Drivers of conflict in developing country infrastructure projects: Experience from the water and pipeline sectors	2011	Journal of Construction Engineering and Management - ASCE	Stanford Univ., Stanford Prevention Research Center, MC 5559, Stanford, CA 94304, United States; 30 Wickramasinghapura, Battaramulla, CO 10120, Sri Lanka; Stanford Univ., Dept. of Civil and Environmental Engineering,	Stanford University; Battaramulla; Stanford University;

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
				Woods Institute for the Environment, MC 4020, Stanford, CA 94305, United States	
Neville, K.J.	Adversaries versus partners: Urban water supply in the Philippines	2011	Pacific Affairs	University of Philippines, Philippines;	University of Philippines
Cocq, K., McDonald, D.A.	Minding the undertow: Assessing water "Privatization" in Cuba	2010	Antipode	InterPares, Ottawa, Ontario, Canada; Global Development Studies, Queen's University, Kingston, Ontario, Canada	InterPares; Queen's University
Fuesta, V., Haffnerb, S.A.	PPP - policies, practices and problems in Ghana's urban water supply	2007	Water Policy	Max Planck Institute for Social Anthropology, Advokatenweg, 36, 06114, Halle/Saale, Germany; Center for Development Research, University of Bonn, Walter-Flex-Str.3, 53113, Bonn, Germany	Max Planck Institute for Social Anthropology; University of Bonn
Chong, E., Huet, F., Saussier, S.	Auctions, ex post competition and prices: The efficiency of Public-private partnerships	2006	Annals of Public and Cooperative Economics	ADIS, University of Paris 11, France; ATOM, University of Paris 1 Sorbonne, France; CERESUR, University of Reunion, France	University of Paris 11; University of Paris 1; University of Reunion
Kurian, M., Dietz, T., Murali, K.S.	Public-private partnerships in watershed management - Evidence from the Himalayan foothills	2004	Water Policy	Institutions and Policy Studies, Intl. Water Management Institute, Kasetsart University Campus, Jatujak District, Bangkok, Thailand;	Kasetsart University Campus; Kasetsart University Campus; Kasetsart University Campus

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Voivontas, D., Xenos, D., Xanthakis, A., Pisias, E., Assimacopoulos, D.	Public-private partnerships in the water sector: A case study in the Cyclades Islands, Greece	2002	Water International	National Technical University of Athens, Greece; Water Supply and Sewage Company of Athens, Greece; Technical Educational Institute of Athens, Greece	National Technical University of Athens; Water Supply and Sewage Company of Athens; Water Supply and Sewage Company of Athens; Water Supply and Sewage Company of Athens; Technical Educational Institute of Athens
Cairo, P.R.	Delegated municipal services for the water system industry in France	1992	Canadian Water Resources Journal	General Water Works, King of Prussia, PA, United States	General Water Works
Suleiman, L., Khakee, A.	Rethinking water reform policies as a 'wicked problem' the case of urban water supply in Ghana	2017	International Planning Studies	Division of Urban and Regional Studies, Department of Urban Planning & Environment, Royal Institute of Technology, Stockholm, Sweden	Royal Institute of Technology; Royal Institute of Technology
Porcher, S.	The 'hidden costs' of water provision: New evidence from the relationship between contracting-out and price in French water public services	2017	Utilities Policy	IAE Paris, Sorbonne Business School, 8 bis rue de la Croix Jarry, Paris, France	Sorbonne Business School
Fonjong, L., Fokum, V.	Water Crisis and Options for Effective Water Provision in Urban and Peri-Urban Areas in Cameroon	2017	Society and Natural Resources	Faculty of Social and Management Sciences, University of Buea, Buéa, Cameroon; Department of Political Science, University of Buea, Buéa, Cameroon	University of Buea, Buéa; University of Buea, Buéa

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Romano, G., Molinos-Senante, M., Guerrini, A.	Water utility efficiency assessment in Italy by accounting for service quality: An empirical investigation	2017	Utilities Policy	Department of Economics and Management, University of Pisa, Via C. Ridolfi, 10, Pisa, Italy; Departamento de Ingeniería Hidráulica y Ambiental, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna, Santiago, Chile; Escuela de Arquitectura e Instituto de Estudios Urbanos, Pontificia Universidad Católica de Chile, El Comendador, Santiago, Chile; Centro de Desarrollo Urbano Sustentable CONICYT/FONDAP/15110020, Av. Vicuña Mackenna, Santiago, Chile; Department of Business Administration, University of Verona, Via dell'Artigliere, 19, Verona, Italy	University of Pisa; Pontificia Universidad Católica de Chile; University of Verona;
Jensen, O.	Public-private partnerships for water in Asia: a review of two decades of experience	2017	International Journal of Water Resources Development	Institute of Water Policy, Lee Kuan Yew School of Public Policy, National University of Singapore, Singapore	National University of Singapore
Molinos-Senante, M., Sala-Garrido, R.	Performance of fully private and concessionary water and sewerage companies: a metafrontier approach	2016	Environmental Science and Pollution Research	Departamento de Ingeniería Hidráulica y Ambiental, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, Santiago, Chile; Instituto de Estudios Urbanos y	Pontificia Universidad Católica de Chile; University of Valencia

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
				Territoriales, Pontificia Universidad Católica de Chile, El Comendador 1916, Santiago, Chile; Centro de Desarrollo Urbano Sustentable CONICYT/FONDAP/15110020, Av. Vicuña Mackenna 4860, Santiago, Chile; Department of Mathematics for Economics, University of Valencia, Avd. Tarongers S/N, Valencia, Spain	
Chan, A.P.C., Lam, P.T.I., Wen, Y., Ameyaw, E.E., Wang, S., Ke, Y.	Cross-sectional analysis of critical risk factors for PPP water projects in China	2015	Journal of Infrastructure Systems	Faculty of Construction and Environment, Hong Kong Polytechnic Univ., Hong Kong Special Administrative Region, Hung Hom, Kowloon, China; Dept. of Building and Real Estate, Hong Kong Polytechnic Univ., Hong Kong Special Administrative Region, Hung Hom, Kowloon, China; Dept. of Construction Management, Tsinghua Univ., Beijing, China; School of Architecture and Built Environment, Univ. of Newcastle, Callaghan, NSW, Australia	Hong Kong Polytechnic University; Hong Kong Polytechnic University; Tsinghua University; University of Newcastle
Harutyunyan, N.	Metering drinking water in Armenia: The process and impacts	2015	Sustainable Cities and Society	Central European University, Environmental Sciences and	Central European University

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
				Policy, 9 Nador ut., Budapest, Hungary	
Hossain, K.Z., Ahmed, S.A.	Non-conventional Public-private partnerships for water supply to urban slums	2015	Urban Water Journal	703-75 Halsey Avenue, Toronto, ON, Canada; 11 Greendowns rive, Toronto, ON, Canada	Toronto, ON; 11 Greendowns Drive
Wibowo, A., Alfen, H.W.	Predicting the Probability of Default for Municipal Water Utilities in Indonesia	2015	Public Works Management and Policy	Agency for Research and Development, Ministry of Public Works, Indonesia; Bauhaus University in Weimar, Germany	Ministry of Public Works, Bauhaus University in Weimar
Moszoro, M.	Efficient Public-private capital structures	2014	Annals of Public and Cooperative Economics	IESE Business School, Barcelona, Spain and Kozminski University, Warsaw, Poland	IESE Business School; Kozminski University
Porcher, S.	Efficiency and equity in two-part tariffs: the case of residential water rates	2014	Applied Economics	IAE Sorbonne Business School, GREGOR, Paris, France	IAE Sorbonne Business School
Lannier, A.L., Porcher, S.	Efficiency in the public and private French water utilities: prospects for benchmarking	2014	Applied Economics	Economics of Public-private Partnerships Chair (EPPP), IAE Sorbonne Business School, Paris, France	IAE Sorbonne Business School
Jalba, D.I., Cromar, N.J., Pollard, S.J.T., Charrois, J.W., Bradshaw, R., Hrudey, S.E.	Effective drinking water collaborations are not accidental: Interagency relationships in the international water utility sector	2014	Science of the Total Environment	School of Medicine, Flinders University, GPO 2100, Adelaide, SA 5001, Australia; School of the Environment, Flinders University, GPO 2100, Adelaide, SA 5001, Australia; Cranfield Water Science Institute, Cranfield University, Bedfordshire, MK43 0AL, United Kingdom;	Flinders University; Cranfield University; Curtin University; University of Alberta

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
				Curtin Water Quality Research Centre, Curtin University, GPO Box U1987, Perth, WA 6845, Australia; Analytical and Environmental Toxicology Division, Faculty of Medicine and Dentistry, University of Alberta, 10-102 Clinical Sciences Building, Edmonton, AB T6G 2G3, Canada	
Owen, D.L.	Glas Cymru: Lessons from nine years as a not-for-profit Public-private partnership	2013	International Journal of Water Resources Development	Envisager Limited, Ceredigion, United Kingdom	Envisager Limited
Araral, E., Wang, Y.	Water Governance 2.0: A Review and Second Generation Research Agenda	2013	Water Resources Management	Lee Kuan Yew School of Public Policy, National University of Singapore, 469C Bukit Timah Road, Singapore, 259772, Singapore; School of Public Policy and Management, Tsinghua University, Beijing, 100084, China	National University of Singapore; Tsinghua University
García-Valiñas, M.D.L.T., González-Gómez, F., Picazo-Tadeo, A.J.	Is the price of water for residential use related to provider ownership? Empirical evidence from Spain	2013	Utilities Policy	Oviedo Efficiency Group, Department of Economics, University of Oviedo, Spain; LERNA, Toulouse, France; Water Research Institute, Department of Applied Economics, University of Granada, Spain; Department of Applied	University of Oviedo LERNA; University of Granada; University of Valencia

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
				Economics II, University of Valencia, Spain	
lo Storto, C.	Are Public-private partnerships a source of greater efficiency in water supply? Results of a non-parametric performance analysis relating to the Italian industry	2013	Water (Switzerland)	Department of Industrial Engineering, University of Naples Federico II, Piazzale V. Tecchio n. 80, Naples 80125, Italy	University of Naples Federico II
González-Gómez, F., García-Rubio, M.A., Alcalá-Olid, F., Ortega-Díaz, M.I.	Outsourcing and Efficiency in the Management of Rural Water Services	2013	Water Resources Management	Department of Applied Economics and Institute of Water Research, University Of Granada, Granada, Spain; Department of Economics, University of Jaén, Jaén, Spain	University Of Granada; University of Jaén; University of Jaén; University of Jaén
Harutyunyan, N.	State versus private sector provision of water services in Armenia	2012	Frontiers of Environmental Science & Engineering	Department of Environmental Sciences and Policy, Central European University, Nador u. 9, H-1051 Budapest, Hungary	Central European University
Coppel, G.P., Schwartz, K.	Water operator partnerships as a model to achieve the Millenium Development Goals for water supply? Lessons from four cities in Mozambique	2011	Water S.A.	Department of Management and Institutions, UNESCO-IHE Institute for Water Education, PO Box 3015, 2601 DA Delft, Netherlands	UNESCO-IHE Institute for Water Education; UNESCO-IHE Institute for Water Education
Barjot, D.	Public utilities and private initiative: The French concession model in historical perspective	2011	Business History	Department of History, Paris-Sorbonne (Paris IV) University, Paris, France	Paris-Sorbonne (Paris IV) University

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Mugisha, S.	Effects of incentive applications on technical efficiencies: Empirical evidence from Ugandan water utilities	2007	Utilities Policy	National Water and Sewage Corporation, Institutional Development and External Services, Uganda	Institutional Development and External Services, Uganda
Rodriguez, R.	The debate on privatization of water utilities: A commentary	2004	International Journal of Water Resources Development	North American Development Bank, 203 South St. Mary's, San Antonio, TX, United States	North American Development Bank
Njiru, C., Smout, I.K., Sansom, K.	Managing water services through service differentiation and pricing in an african city	2001	Water and Environment Journal	Institute of Development Engineering, Loughborough University, Loughborough, United Kingdom	Institute of Development Engineering, Loughborough University; Institute of Development Engineering, Loughborough University
Boadu, F.O.	Policy on private water sales in rural Ghana	1994	Journal of Water Resources Planning and Management - ASCE	Texas A and M Univ., College Station, TX, 77843-2124, United States	Texas A and M University
Williams, J.	Assembling the water factory: Seawater desalination and the techno-politics of water privatisation in the San Diego?Tijuana metropolitan region	2018	Geoforum	Department of Geography, Durham University, Lower Mountjoy, South Road, Durham, United Kingdom	Durham University
Rezaeenour, J., Mousavi-Saleh, M., Kolahkaj, A.R.	Analyzing the risk factors of private-public partnerships for water supply projects	2018	Water Science and Technology	Department of Industrial Engineering, Faculty of Technology and Engineering,	University of Qom; University of Qom; University of Qom;

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
	using fuzzy synthetic evaluation: a case study of Iranian water supply projects			University of Qom, Qom, Iran; University of Qom, Qom, Iran	
Hoffmann, C.	From Small Streams to Pipe Dreams?The Hydro-Engineering of the Cyprus Conflict	2018	Mediterranean Politics	Division of History and Politics, University of Stirling, Stirling, United Kingdom	University of Stirling
Zhang, L., Hu, J., Li, Y., Pradhan, N.S.	Public-private partnership in enhancing farmers' adaptation to drought: Insights from the Lujiang Flatland in the Nu River (Upper Salween) valley, China	2018	Land Use Policy	Yunnan Key Laboratory of International Rivers and Transboundary Eco-Security, Yunnan University, No.2 Green Lake North Road, Kunming, Yunnan, China; Institute of International Rivers and Eco-Security, Yunnan University, No.2 Green Lake North Road, Kunming, Yunnan, China; Collaborative Innovation Center for Territorial Sovereignty and Maritime Rights, No.299, Bayi Road, Wuchang District, Wuhan, Hubei, China; International Centre for Integrated Mountain Development, GPO Box 3226, Kathmandu, Nepal	Yunnan University; Yunnan University; International Centre for Integrated Mountain Development
Carvalho, B.E., Marques, R.C., Netto, O.C.	Regulatory Impact Assessment (RIA): an Ex-Post Analysis of Water Services by the	2018	Water Resources Management	CERIS-IST, University of Lisbon, Av. Rovisco Pais, Lisbon, Portugal; FT, University of Brasília,	University of Lisbon; University of Brasília; University of Brasília;

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
	Legal Review in Portugal			Anexo SG-12, Térreo, Asa Norte, Brasília, DF, Brazil	
Swamy, R.R.D.T.V., Tiwari, P., Sawhney, A.	Assessing determinants of PPP project performance: Applying AHP to urban drinking water sector in India	2018	Property Management	RICS School of the Built Environment, Amity University, Noida, India; Faculty of Architecture, Building and Planning, Melbourne University, Melbourne, Australia	Amity University; Amity University; Melbourne University
Ebhota, W.S., Inambao, F.L.	Facilitating greater energy access in rural and remote areas of sub-Saharan Africa: Small hydropower	2017	Energy and Environment	Discipline of Mechanical Engineering, University of KwaZulu-Natal, Durban, South Africa	University of KwaZulu-Natal; University of KwaZulu-Natal
Pincetl, S., Porse, E., Cheng, D.	Fragmented Flows: Water Supply in Los Angeles County	2016	Environmental Management	California Center for Sustainable Communities, Institute of the Environment, UCLA, Los Angeles, United States; Social Science Research Council, New York, United States	Institute of the Environment; Institute of the Environment; Social Science Research Council
Ruiters, C., Matji, M.P.	Public-private partnership conceptual framework and models for the funding and financing of water services infrastructure in municipalities from selected provinces in South Africa	2016	Water S.A.	Council for Scientific and Industrial Research (CSIR), Built Environment, P.O. Box 395, Pretoria, South Africa; University of South Africa UNISA, P.O. Box 392, South Africa	University of South Africa UNISA; University of South Africa UNISA;
Ameyaw, E.E., Chan, A.P.C.	Evaluation and ranking of risk factors	2015	Expert Systems with Applications	Department of Building and Real Estate, Hong Kong	Hong Kong Polytechnic University;

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
	in Public-private partnership water supply projects in developing countries using fuzzy synthetic evaluation approach			Polytechnic University, 181 Chatham Road South, Hung Hom, Kowloon, Hong Kong	Hong Kong Polytechnic University
Ameyaw, E.E., Chan, A.P.C.	Evaluating key risk factors for PPP water projects in Ghana: a Delphi study	2015	Journal of Facilities Management	Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong	Hong Kong Polytechnic University; Hong Kong Polytechnic University
Gopakumar, G.	Experiments and counter-experiments in the Urban laboratory of water- supply partnerships in India	2014	International Journal of Urban and Regional Research	Centre for Engineering in Society, Concordia University, 1455 de Maisonneuve Blvd. W, Montreal, QC, H3G 1M8, Canada	Concordia University
Jefferies, M., Brewer, G.J., Gajendran, T.	Using a case study approach to identify critical success factors for alliance contracting	2014	Engineering, Construction and Architectural Management	School of Architecture and Built Environment, University of Newcastle, Newcastle, Australia	University of Newcastle
Ruiters, C.	Funding models for financing water infrastructure in South Africa: Framework and critical analysis of alternatives	2013	Water S.A.	Graduate School of Business Leadership (SBL), University of South Africa, UNISA, PO Box 392, 0003, South Africa; Department of Water Affairs, National Water Resources Infrastructure, Private Bag X313, Pretoria, 0001, South Africa	University of South Africa
Golooba-Mutebi, F.	In search of the right formula: Public, private and community-driven	2012	Public Administration and Development	Africa Power and Politics Programme, United Kingdom	Africa Power and Politics Programme

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
	provision of safe water in rwanda and uganda				
Da Cruz, N.F., Marques, R.C.	Mixed companies and local governance: No man can serve two masters	2012	Public Administration	Center for Management Studies, Lisbon, Portugal	Center for Management Studies; Center for Management Studies;
Olusola Babatunde, S., Opawole, A., Emmanuel Akinsiku, O.	Critical success factors in Public-private partnership (PPP) on infrastructure delivery in Nigeria	2012	Journal of Facilities Management	Department of Quantity Surveying, Obafemi Awolowo University, Ile-Ife, Nigeria; Department of Building, University of Lagos, Lagos, Nigeria	Obafemi Awolowo University; University of Lagos
Li, J., Zou, P.X.W.	Fuzzy AHP-based risk assessment methodology for PPP projects	2011	Journal of Construction Engineering and Management - ASCE	Department of Construction Management, Nanjing Forestry Univ., Civil Engineering School, Nanjing, China; Department of Building and Construction Management, Faculty of Business and Government, Univ. of Canberra, Canberra, ACT, Australia; Department of Construction Management, Faculty of the Built Environment, Univ. of New South Wales, Sydney, Australia Department of Risk Management, College of Civil Engineering, Changsha City, Hunan Province, China	Nanjing Forestry University; Faculty of the Built Environment, University;
Reeves, E.	The only game in town: Public private partnerships in the	2011	Economic and Social Review	University of Limerick, Irland	University of Limerick;

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
	Irish water services sector				
Xu, Y., Yeung, J.F.Y., Chan, A.P.C., Chan, D.W.M., Wang, S.Q., Ke, Y.	Developing a risk assessment model for PPP projects in China-A fuzzy synthetic evaluation approach	2010	Automation in Construction	Department of Construction Management and Real Estate, Southeast University, Nanjing 100084, China; Department of Building and Real Estate, Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong; Department of Construction Management, Tsinghua University, Beijing, China	Southeast University; Hong Kong Polytechnic University; Hong Kong Polytechnic University; Tsinghua University; Tsinghua University;
Wibowo, A., Mohamed, S.	Risk criticality and allocation in privatised water supply projects in Indonesia	2010	International Journal of Project Management	Research Institute for Human Settlements, The Ministry of Public Works, Catholic Parahyangan University, Post Graduate Program in Civil Engineering, Jalan Panyawangan, Cileunyi Wetan, Kabupaten Bandung 40393, Indonesia; Centre for Infrastructure Engineering and Management, Griffith University, Queensland, QLD 4222, Australia	Catholic Parahyangan University; Griffith University
Bel, G., Fageda, X.	Partial privatisation in local services delivery: An empirical analysis of the choice of mixed firms	2010	Local Government Studies	Dep. de Polìtica Econòmica i EEM, Universitat de Barcelona, Avd. Diagonal 690, 08034 Barcelona, Spain	Universitat de Barcelona; Universitat de Barcelona

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Khan, S., Mushtaq, S.	Regional partnerships to assist Public-private investments in irrigation systems	2009	Agricultural Water Management	Commonwealth Scientific and Industrial Research Organization, Land and Water, Wagga Wagga, NSW, Australia; Charles Sturt University, Wagga Wagga, NSW 2650, Australia; Cooperative Research Centre for Irrigation Futures, Australia	Charles Sturt University; Charles Sturt University; Charles Sturt University
Tecco, N.	Financially sustainable investments in developing countries water sectors: What conditions could promote private sector involvement?	2008	International Environmental Agreements: Politics, Law and Economics	Programme in Analysis and Governance of Sustainable Development, School for Advanced Studies in Venice Foundations (SSAV), University Ca' Foscari, Island of San Servolo, Venice 30100, Italy	University Ca' Foscari
Crane, D.	California's Infrastructure Deficit	2008	Public Works Management and Policy	Schwarzenegger Administration; United States	Schwarzenegger Administration
Yamout, G., Jamali, D.	A critical assessment of a proposed Public-private partnership (PPP) for the management of water services in Lebanon	2007	Water Resources Management	Suliman S. Olayan School of Business, American University of Beirut, Bliss Street, Beirut, Lebanon	American University of Beirut; American University of Beirut
Zouggari, M.	Public-private partnership: Major hindrances to the private sector's participation in the financing and management of public	2003	International Journal of Water Resources Development	Natl. Office of Potable Water (ONEP), ONEP Station de traitement, Avenue Oued Akrach, Rabat, Morocco	ONEP Station de traitement

AUTHOR'S	TITLE	YEAR	SOURCE TITLE JOURNAL	AFFILIATIONS	UNIVERSITY
Rosell, E.	infrastructures via delegated management The chickens can come home to roost: The anatomy of a local infrastructure crisis	1994	Urban Affairs Review	New Mexico State University, United States	New Mexico State University

APPENDIX F – INITIAL FULL SEARCH CODES SEARCH

1. TITLE-ABS-KEY (“public private partnerships”) AND TITLE-ABS-KEY (“wastewater”) AND TITLE-ABS-KEY (“contracts”) AND LIMIT-TO (DOCTYPE, “ar”) AND LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “ENGI”) OR LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “ENER”) OR LIMIT-TO (SUBJAREA, “BUSI”) AND LIMIT-TO (LANGUAGE, “English”) AND LIMIT-TO (SRCTYPE, “j”)

2. TITLE-ABS-KEY (“public private partnerships”) AND TITLE-ABS-KEY (“wastewater”) AND TITLE-ABS-KEY (“utilities”) AND LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “ENGI”) OR LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “ENER”) OR LIMIT-TO (SUBJAREA, “SOCI”) AND LIMIT-TO (DOCTYPE, “ar”) AND LIMIT-TO (LANGUAGE, “English”) AND LIMIT-TO (SRCTYPE, “j”)

3. TITLE-ABS-KEY (“public private partnerships”) AND TITLE-ABS-KEY (“wastewater”) AND TITLE-ABS-KEY (“infrastructure”) AND LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “ENGI”) OR LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “ECON”) AND LIMIT-TO (DOCTYPE, “ar”) AND LIMIT-TO (LANGUAGE, “English”) AND LIMIT-TO (SRCTYPE, “j”)

4. TITLE-ABS-KEY (“public private partnerships”) AND TITLE-ABS-KEY (“sanitation”) AND TITLE-ABS-KEY (“contracts) AND LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “ENGI”) AND LIMIT-TO (DOCTYPE, “ar”) AND LIMIT-TO (LANGUAGE, “English”) AND LIMIT-TO (SRCTYPE, “j”)

5. TITLE-ABS-KEY (“public private partnerships”) AND TITLE-ABS-KEY (“sanitation”) AND TITLE-ABS-KEY (“utilities”) AND LIMIT-TO (DOCTYPE, “ar”) AND LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “ENGI”) OR LIMIT-TO (SUBJAREA, “ENER”) AND LIMIT-TO (LANGUAGE, “English”) AND LIMIT-TO (SRCTYPE, “j”)

6. TITLE-ABS-KEY (“public private partnerships”) AND TITLE-ABS-KEY (“sanitation”) AND TITLE-ABS-KEY (“infrastructure”) AND LIMIT-TO (DOCTYPE, “ar”) AND LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO

(SUBJAREA, “ENGI”) OR LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “ENER”) AND LIMIT-TO (LANGUAGE, “English”) OR LIMIT-TO (LANGUAGE, “Spanish”) AND LIMIT-TO (SRCTYPE, “j”)

7. TITLE-ABS-KEY (“public private partnerships”) AND TITLE-ABS-KEY (“contracts”) AND TITLE-ABS-KEY (“water”) AND LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “ENGI”) OR LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “ECON”) OR LIMIT-TO (SUBJAREA, “ENER”) AND LIMIT-TO (DOCTYPE, “ar”) AND LIMIT-TO (LANGUAGE, “English”) OR LIMIT-TO (LANGUAGE, “Spanish”) AND LIMIT-TO (SRCTYPE, “j”)

8. TITLE-ABS-KEY (“public private partnerships”) AND TITLE-ABS-KEY (“utilities”) AND TITLE-ABS-KEY (“water”) AND LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “ENGI”) OR LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “ENER”) OR LIMIT-TO (SUBJAREA, “ECON”) AND LIMIT-TO (DOCTYPE, “ar”) AND LIMIT-TO (LANGUAGE, “English”) OR LIMIT-TO (LANGUAGE, “French”) AND LIMIT-TO (SRCTYPE, “j”)

9. TITLE-ABS-KEY (“public private partnerships”) AND TITLE-ABS-KEY (“infrastructure”) AND TITLE-ABS-KEY (“water”) AND LIMIT-TO (DOCTYPE, “ar”) AND LIMIT-TO (LANGUAGE, “English”) OR LIMIT-TO (LANGUAGE, “French”) OR LIMIT-TO (LANGUAGE, “Spanish”) AND LIMIT-TO (SRCTYPE, “j”) AND LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “ENGI”) OR LIMIT-TO (SUBJAREA, “ECON”) OR LIMIT-TO (SUBJAREA, “ENER”)

APPENDIX G - INTERVIEW GUIDE

INTERVIEW GUIDE	
Research purpose	This interview aims to collect the opinion of specialists with relevant and extensive experience in PPP contracts in utilities sector in developing countries context
Institution	University Institute of Lisbon (ISCTE)
Ethical questions	The answers provided will not be recorded. The interviewees had knowledge that the provided information will be exclusively used under the research objectives.
Definitions of risk categories	▪ Financial risk category is related with the ability (or not) to secure the necessary funds from both partners for the success of the PPP projects. ▪ Context risk category is related to the macroeconomic, political and social-cultural and economic background elements that can have an impact or constrain the PPP projects. ▪ Technical and operational risk category is related to technical risks and operational issues that can affect (positively or negatively) the project's success. It is connected to the PPP performance and their ability to provide the service in a timely and efficient way. ▪ Commercial risk category is related to the commercial provision of water supply services to customers, including the collection capacity in PPP projects. ▪ The infrastructure risk category is related to the impact that a good or bad preservation and awareness of PPP assets can have in the success of the project's outcomes.
SECTION I - CLOSED QUESTIONS	
Objective	Rank of the risk categories
Question	Please rank the following risk categories (considering the scale of 1 to 5 - where 1 Less Important and 5 Very Important) ▪ Financial risk category ▪ Context risk category ▪ Technical and operational risk category ▪ Commercial risk category ▪ Infrastructure risk category
SECTION II – SEMI CLOSED QUESTIONS	
Objective	The identification of risk factors associated with risk categories in PPP projects
Question I	Please identify of risk factors associated to the risk categories in PPP projects in developing countries context ▪ Financial risk category ▪ Context risk category ▪ Technical and operational risk category ▪ Commercial risk category ▪ Infrastructure risk category
Question II	Please identify of potential risk treatment or mitigation measures to the risk categories in PPP projects in PPP projects in developing countries context ▪ Financial risk category ▪ Context risk category

INTERVIEW GUIDE	
	▪ Technical and operational risk category ▪ Commercial risk category ▪ Infrastructure risk category
SECTION III – OPEN QUESTIONS	
Objective	The key risk indicators concept improve the current risk management framework of the contracts
Question	How can the key risk indicators concept improve the current risk management framework of the contracts?

APPENDIX H – ANSWERS: RISK ASSESSMENT PHASE

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
Financial	1-Financial sustainability (related to the economic and financial equilibrium of both partners arising from the contract).
Financial	1- Risk of the private partner being unable to attract investment.
Financial	2-Currency risk.
Financial	3-Inflation risk.
Financial	4-The government should act as a guarantor of the loans contracted by the private partners.
Financial	1-Dependence on external financing.
Financial	2-Difficulty in obtaining funding for both sectors of activity (railways and ports), because both need the Government's support. Even when both sectors are financially healthy, they can face difficulties in obtaining funding due to the possible "snowball" effect caused by the fact that infrastructures are owned by the state.
Financial	1-Risk of the Mozambican internal markets being unable to sustain (capture) the necessary investments from the private sector.
Financial	2-Risk of lack of adequate financial incentives that ensure the incentive for an adequate level of infrastructure maintenance due to the fact that assets property is public property.
Financial	1-Risk of difficulties in obtaining the necessary investment and funding levels.
Financial	2-Risk of inadequate planning of financing needs as a result of lack of cohesive long-term planning.
Financial	3-Risk of national and sectoral instability.
Financial	4-Risk of lack of an adequate management framework in the water sector (e.g. in this case, the basic legislation of the sector, the FIPAG, that represents the Government, is the owner of 100% of the infrastructures and responsible for making the investments).
Financial	1-Risk of not gathering the necessary financial funds to perform the necessary investments. The investment components are under the direct responsibility of FIPAG as the holder of the Government. Therefore, it is expected that FIPAG is paid by the waters of Maputo region, through a fixed and variable monthly income. Fixed income was fixed in terms of specifications and variable rent depend on the cubic meters produced] [In financial terms, construction and major repairs are the responsibility of FIPAG, so the need to capture investment to carry out the works is their responsibility, and this is equally shared with the transfer.
Financial	2-Risk of lack of internal revenue (from the public partner) that allows the execution of the necessary investments. In the Maputo region the lack of revenue of the water contract may be caused by: i) own funds, II) investment funding through the use of multilateral agencies (African Bank of the Development, World Bank, etc.), iii) loans contracted to commercial banking, IV) funds from international donors.

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
Financial	3-Risk of the FIPAG being unable to capture the necessary funds or investments in a timely and opportune manner to allow the necessary investment levels to comply with the agreed contractual terms with the waters of Maputo.
Financial	4-Risk of lack of commitment of the Mozambican Government and the FIPAG to timely fulfil the debt payment. This issue can generate a "snowball" effect that can harm the investments already made and the reputation of the water sector in Mozambique.
Financial	5-Risk of not being able to obtain new loans and lending due to the lack of commitment of the Mozambican Government and the FIPAG.
Financial	6-Risk of lack of financial sustainability of the water companies due to an unfavorable tax law in the country. FIPAG is compelled to invoice the fixed and variable income as compensation by the waters of the Maputo region for the use of their infrastructure. As these invoices are subject to VAT, FIPAG is required to register them and pay the Government. However, as there are delays in payment by the Management entity, FIPAG has to assume the payments which forces it to have negative costs (tax effects) on its accounts. This seriously compromises its ability to remain 'financially healthy'.
Financial	7-Risk of compromising the economic and financial equilibrium of the concessions due to the water sector being highly dependent on the political cycles. This has a direct impact on top and medium Government agencies, generating instability and unpredictability in the tariff structure.
Financial	1-Risk of the public partner being unable to define the appropriate economic and financial criteria to capture the best potential private partner.
Financial	2-Risk of lack of internal procedures that ensure the independence of the jury in the phase of analysis of proposals.
Financial	1-Risk of lack of definition of criteria and mechanisms.
Financial	2-Risk of lack of a suitable accounting policy that ensures the definition of the concepts of materiality and transparency in procedural terms.
Financial	3-Risk of poor internal and external procedures regarding the economic and financial record of the public and private partner.
Financial	4-Risk of poor management and leadership to ensure correct and accreted internal procedures (public partner).
Financial	1-Risk of lack of economic and financial mechanisms to ensure funding for: (i) Investment plans II) preventive maintenance plans.
Financial	1-Risk of not being able to provide sufficient guarantees to ensure the necessary investment levels to make the new ports (specifically the new Greenfield contracts under study).
Financial	2-Risk of lack of adequate supervision to ensure compliance with the investment plans envisaged in terms of the Brownfield contracts type.
Financial	1-Risk of setting ambiguous criteria for tariff plans.

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
Financial	2-Risk of lack of criteria to distinguish the political risk of operational problems.
Financial	3-Risk of low-skilled human resources, especially on top and medium management (from the public partner).
Financial	4-Risk of lack of sufficient financial resources from the public partner (FIPAG). In fact, a substantial revenue of the FIPAG is coming from a variable component to be payed by the private partner.
Financial	5-Risk of lack of accurate economic and financial reports made by the private partners.
Financial	6-Risk of lack of economic and financial negotiation skills of both partners (private and public).
Financial	1-Risk of lack of objective economic and financial criteria when setting the tariffs due to external interferences.
Financial	2-Risk of lack of tariff planning during the life of the concessions.
Financial	3-Risk of lack of an appropriate valuation of the Value for Money.
Financial	4-Risk of foreign exchange exposure.
Financial	5-Risk of dependence of external (international) investment (by the public partner).
Financial	6-Risk of a financial-economic imbalance of the concession, through the increase of the cost structure, even if it's not contemplated on the tariff to be charged to end-users (private and/or public).
Financial	7-Risk of lack of financial incentives to make investments in infrastructures, which will never be active in the private operator.
Financial	1-Risk of lack of guarantees (to be provided by the Mozambican Government) to obtain the necessary investments.
Financial	1-Risk of lack of contractual clauses that will allow the financial sustainability of the PPP.
Financial	2-Risk of lack of accurate economic and financial reports provided by the private operator to the public entity, which can compromise the quality of the future decisions made by the public entity.
Financial	1- Risk of lack of guarantees from companies.
Financial	2- Risk of lack of the ability to capture the necessary money to perform the investments in infrastructures.
Commercial	1-Risk of the public partner not having reporting mechanisms that allow the evaluation of the performance of the private partner's commercial rules, in accordance with the contractual terms signed by both parties.
Commercial	1-Risk of the private sector's low capacity to charge its end-customers, significantly reducing the possibility of generating a stable income level, especially in the railways area.
Commercial	1-Risk of lack of sufficient conditions to ensure the adequate charging level.

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
Commercial	2-Risk of political intervention that can affect the conditions to ensure the adequate charging level.
Commercial	3-Risk of lack of public policies that ensure '... A fair deal for those with lower income'.
Commercial	1-Risk of lack of sufficient conditions that ensure an adequate charging level. According to the interviewee, the component 'ensure the adequate charging level' is the basis of the business.
Commercial	2-Risk of lack of accurate customer information regarding the water delivery services.
Commercial	3-Risk of lack of accurate potential customer information regarding the water delivery services.
Commercial	4-Risk of solid statistical bases that determine the typology of real and potential customers - according to the interviewee '... Looking at the water counters is useless. It does not produce useful and reliable information to plan the management of the service'.
Commercial	1-Risk of the private partner not having adequate commercial records, which compromises the variable income of the public partner (he is payed based on the private partner) having a fixed and variable component as contractually specified which is connected to the water cubic meters produced. If FIPAG delays the necessary investments, the ability to generate business by the managing body is compromised.
Commercial	2-Risk of lack of internal mechanisms that ensure the ability to operate in the intended terms (including the problem of loss reduction + continuity of service provision).
Commercial	3-Risk of lack of a reliable client database, which compromises optimal invoice levels and a balanced contract.
Commercial	4-Risk of lack of definition of mechanisms that ensure adequate levels of recovery of the investments performed.
Commercial	5-Risk of lack of an effective complaint management mechanism between the private operator and the final customer.
Commercial	6-Risk of contractual dependence for the construction and maintenance of new infrastructures, which may limit FIPAG's ability to generate business flows.
Commercial	7-Risk of lack of legal mechanisms that ensure the proper handling of disputes between operators and final customers.
Commercial	1-Risk of lack of the appropriate criteria of commercial rules to evaluate the private partner's performance, according to the contractual terms signed by both parties.
Commercial	1-Risk of low charging rate to final costumers.
Commercial	2-Risk of lack of commercial evaluation to ensure Value for Money.
Commercial	1-Risk of the private partner not having internal mechanisms that ensure the adequate billing levels to the direct customers.
Commercial	2-Risk of lack of a previous definition on the PPP contracts regarding the minimum requirements of the software that should be used by the private partner to ensure consistent and adequate billing levels, including information reports.

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
Commercial	3-Risk of lack of definition of internal mechanisms that ensure an internal recovery procedure for the designated "Big 5", which are public entities to which it is not possible to cut access to water.
Commercial	4-Risk of the public partner not having internal mechanisms to ensure an adequate report of information (commercial information) with respect to their private partners.
Commercial	5-Risk of lack of procedures that ensure a reduction of clandestine water links from the private partner.
Commercial	6-Risk of lack of definition of a solid and realistic plan for the management of water losses.
Commercial	1-Risk of inability to maintain a balanced partnership, which can cause the private partner to damage the ability to generate business.
Commercial	1-Risk of commercial losses.
Commercial	2-Risk of network Bypass (water theft).
Commercial	3-Risk of debt of the public entities (the 'Big5'). FIPAG has to take over 75% of the "Big5" debt and these have the option no to fulfil their contractual obligation, namely the payment of their invoices The risk of duplicate payments can lead to a deterioration of FIPAG's cash-flow.
Commercial	1-Risk of poor capacity to bill and charge the final customers (private and public).
Commercial	1-Risk of lack of thorough 'project finance studies' that ensure cost coverage.
Commercial	2-Risk of low business level.
Commercial	1- Risk of billing and charging the final customers.
Commercial	2-Risk of inefficient information systems that allow adequate levels of collection by the private partner.
Commercial	3-Risk of poor information levels regarding the final customers.
Infrastructure	1-Risk of lack of internal and external mechanisms that allow the public partner to receive the infrastructures in acceptable conditions at the end of the concession.
Infrastructure	2-Risk of the infrastructures being seriously damaged and/or technologically inappropriate after being delivered to the public partner.
Infrastructure	1-Risk of external pressure in underestimating the adequate level of infrastructure preservation on the PPP contracts. (e.g. political pressure or international bodies, such as the IMF).
Infrastructure	2-Risk of a poor definition of the internal methodology regarding the infrastructures construction and their maintenance rules.
Infrastructure	1-Risk of lack of adequate internal mechanisms to ensure asset management focused on the short, medium and long-term infrastructure, regardless of the type of contract between the partners.
Infrastructure	2- Risk of lack of adequate financial incentives that ensure the incentive for an adequate level of infrastructure maintenance, due

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
	to the fact that property of assets is always public property in the Mozambican case regarding PPP contracts.
Infrastructure	1-Risk of the infrastructures not being capable of fulfilling their purpose. That is, they are undersized due to the lack of 'structured' investment.
Infrastructure	1- Risk of lack of adequate infrastructures monitored by the Government.
Infrastructure	1-Risk of lack of a comprehensive cadastral survey of the infrastructures, which may compromise the entire tender phase and subsequent choice of the best private partner.
Infrastructure	2-Risk of lack of internal procedures that ensure the independence of the jury in the process of examining proposals.
Infrastructure	1-Risk of an inadequate infrastructure construction (Applicable only in BOT type PPP models).
Infrastructure	2-Risk of an inadequate development of infrastructures by not complying with the minimum specifications' standards.
Infrastructure	3-Risk of lack of mechanisms that will ensure the existence of clauses for innovation factors in infrastructures (in the case of the telecommunications sector this factor has a particular relevance).
Infrastructure	1-Risk of ambiguity in contractual terms in the allocation of responsibility in terms of major maintenance interventions, with particular emphasis on those that may have a relevant impact on larger infrastructures.
Infrastructure	2-Risk of lack of a Business Security and Continuity Plan that ensures the maintenance and conservation of the infrastructures.
Infrastructure	1-Risk of lack of sufficient guarantees to ensure the uptake of the levels of investment necessary to make the new ports (in respect of new Greenfield contracts under study).
Infrastructure	2-Risk of lack of adequate supervision to ensure compliance with the investment plans envisaged in terms of the Brownfield contracts.
Infrastructure	1-Risk of non-compliance (delays) of investment plans by FIPAG, which translates into a delay in the construction and rehabilitation of the infrastructures. This is fundamental to ensure the contractual commitments agreed by both partners as it can affect the business expectation of the management entity, which is responsible for the management of the systems.
Infrastructure	1-Risk of inefficient infrastructure registration.
Infrastructure	2-Risk of lack of a consistent water loss plan and the necessary investment plans to be carried out during the concession.
Infrastructure	1-Risk of lack of a detailed plan regarding the maintenance of the infrastructures when doing the procurement process for the PPP contract.
Infrastructure	2-Risk that the chosen technology solution has not been previously tested for construction and maintenance of the infrastructures.
Infrastructure	1-Risk of an inefficient record of information regarding the infrastructures in PPP contracts.

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
Infrastructure	1-Risk of an inefficient record of information regarding the infrastructures in PPP contracts.
Infrastructure	2- Risk of an incorrect assessment of real needs for the construction and maintenance of the infrastructure in the PPP contract.
Technical and Operational	1- There are large gaps in monitoring technical/operational indicators.
Technical and Operational	1-Risk of lack of an adequate framework from both partners to ensure proper technical and/or operational management.
Technical and Operational	1-Risks associated with inefficient technical/operational management.
Technical and Operational	2-Risks of political interference in the operational management of the concessions.
Technical and Operational	3-Risk of governance.
Technical and Operational	4-Risk of lack of separation between the Government in office and the public entity responsible for regulating the sector.
Technical and Operational	5-Risk of lack of internal mechanisms to ensure adequate levels of service.
Technical and Operational	1-Risk of the 'cut/paste technique for the construction of key performance indicators (key performance indicators) so that they are not the most suitable to objectively evaluate good and bad operators.
Technical and Operational	1-Risk of lack of internal mechanisms that ensure the ability to operate in the intended terms (including the problem of loss reduction + continuity of service provision).
Technical and Operational	2-Risk of lack of the mandatory maintenance plans agreed between the transferor (FIPAG) and the private partner.
Technical and Operational	3-Risk of lack of qualified human resources to assess the technical/operational area (public and private).
Technical and Operational	1-Risk of lack of definition of adequate technical and operational criteria.
Technical and Operational	2-Risk of lack of internal procedures that ensure the independence of the jury in the process of examining proposals.
Technical and Operational	1-Risk of lack of rigorous criteria for recruiting the best managers for the private partner (e.g. the interviewee said that '... An expat without any experience working in Africa was recruited as an administrator of one of the MCEL partner companies. Not long after, his personal life started interfering with his decision-making process in the company as he was being influenced by his girlfriend to make decision focused on personal interests').
Technical and Operational	1-Risk of ambiguity in contractual terms in the allocation of responsibility in terms of major maintenance interventions, with particular emphasis on those that may have a relevant impact on the preservation of infrastructures over the medium to long-term.
Technical and Operational	2-Risk of lack of business continuity plans that ensure the maintenance of the technical/operational area.

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
Technical and Operational	3-Risk of lack of procedures ensuring a reduction of clandestine connections to the water supply that have a big impact on the technical/operational area.
Technical and Operational	4-Risk of lack of a plan for the management of water losses that has a big impact on the technical/operational area.
Technical and Operational	1-Risk of lack of adequate maintenance levels (in the case of Brownfield ports contracts that are still in operation).
Technical and Operational	1-Risk of the operator focusing too much on curative maintenance, neglecting the needs of preventive maintenance.
Technical and Operational	2-Risk of poor technical/operational management.
Technical and Operational	3-Risk of information asymmetry between the master plans of the municipalities and the reality, leading to a misunderstanding of the infrastructures by the private partner as well as to technical/operational issues.
Technical and Operational	1-Risk of poor human resources regarding the technical/operational skills field of private operators - that arise from the phenomenon captured by the ruling elites.
Technical and Operational	1-Risk of adequately monitor the operational performance of each operator by the board of directors of the public partner.
Context	1-Macroeconomic risk is understood as external factors to the activity sector in which PPP operates. Special emphasis was given to the political pressure risk.
Context	2-Risk of corruption. In 2015 the Centre of Public Integrity of Mozambique disclosed a document, which highlighted the problem of excess and power as a strong constraint for the effective transparency and economic rationality of economic resources.
Context	3-Risk of influence peddling and conflict of interests between the private and public part.
Context	4-Risk of the public partner not fulfilling its duties due the political dependence.
Context	5-Risk of poor institutional capacity to attract the required amount of investment in a timely manner.
Context	1- Risk of political instability.
Context	2-Risk of internal instability as a result of internal conflicts (e.g. In the case of Nacala, there were several extremist attacks that led to the need to revise the terms of the North Concession contracts).
Context	3-Risk of external political pressure, which end up creating internal pressure for a differentiated tax treatment (negative) for national companies.
Context	1-Risk of political interference between the partners (public and private component).
Context	2-Risk of the Mozambican market to sustain (capture) strong investments from the private sector.
Context	3-Risk of political interference in the sector ('We are in a country where rights are only respected when it suits certain interests').

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
Context	4-Risk of lack of adequate financial incentives to ensure an adequate level of infrastructure maintenance, due to the fact that ownership of assets is always public property, in particular in the case of developing countries.
Context	5-Risk of social pressure to deliver the goods and/or service at any price, disregarding the implications of those action on the contracts… (e.g. water providers in this case).
Context	1-Risk of inefficiently delegating a management framework, which regulates the allocation of contractual positions. Initially, FIPAG was responsible for making all necessary investments to infrastructures (including preventive maintenance). However, nowadays FIPAG (often) directly provides the service to the end customer. This "strabismus" generates an absence of alignment between the original strategy for the sector and the reality - an absence of a strategic definition for the sector.
Context	2-Risk of political influence in decisions that should have an economic and financial rationale.
Context	3-Risk of lobbying by the large stakeholders who operate directly or indirectly in the main and related activities connected to the water and sanitation sector, such as large suppliers, municipalities, large customers, etc.
Context	4-Risk of lack of cohesive external policies to attract investments.
Context	5-Risk of lack of written documentation on the internal guidelines for the sector.
Context	1- Political Risk.
Context	2-Risk of lack of a coherent and consistent strategic definition in terms of sectoral and integrated management of water resources.
Context	3-Risk of asymmetric information between the public and private partner.
Context	4-Risk of climate changes.
Context	1-Risk of lack of coherence between the various laws in PPP contracts in Mozambique (for example, the Public Procurement Code provides that for a public tender to be valid. 6 competitors must show interest, a value that is totally unrealistic in the case of PPP).
Context	2-Risk of Governance.
Context	1-Legal risk.
Context	2-Political risk.
Context	3-Risk of governance.
Context	4-Risk of lack of frameworks able to internalise and contextualise the moment in which the partnership was performed. For example, the case of the transfer, the exploitation and rehabilitation of the Nampula building, from MCEL company to VISABEIRA group for the period of 25 years. It was an old building, and in the interviewee's opinion, it improved the city, it is currently a mixture of luxury apartments and a shopping centre. However, the current administration does not understand the

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
	context in which it was celebrated and it questions the previous decisions.
Context	1-Political risk.
Context	2-Risk of climate changes.
Context	1-Political risk.
Context	2-Risk of governance - in the specific case of ports. In the opinion of the interviewee the company holding the heritage of ports and railways does not contribute to a fair and balanced partnership. In practice, the public partner does not fulfil its supervision obligations due to political pressure.
Context	1-Risk of governance-interference by the various actors in the sector, generating diffuse strategies.
Context	2-Political risk.
Context	1-Political risk.
Context	2-Risk of climate changes.
Context	3-Risk of tariff changes arising from the political context.
Context	4-Risk of governance.
Context	5-Risk of exposure to economic cycles.
Context	1-Political risk (adverse events to the project, such as an arbitrarily privatization decision of infrastructures).
Context	1-Risk of legal ambiguity in the establishment of criteria for the definition of a PPP in the Mozambican case.
Context	2-Political Risk. The interviewee mentioned that PPP emerged as an ideology of neoliberalism, where the important thing is to liberalize. Therefore, the use of PPP should firstly be understood as more than a strategic option. However, in the Mozambican case, the country's wealth is in the hands of an elite. Considering that the entire private initiative is controlled by the Government, soon all private and public initiative will be in the hands of that same elite.
Context	3-Risk of external interference on the designation of top management in the public partner, which can lead to the poor allocation of human resources.
Context	4-Strategic risk.
Context	5-Risk of governance.
Context	6-Risk of climate changes.
Context	7-Risk of cultural and social issues. The Government has an obligation to provide all services at a price that tends to be free of charge.
Context	8-Risk of lack of objective and transparent criteria when choosing the private partner.
Context	9-Risk of lack of objective criteria when choosing the PPP model.
Context	1-Risk of defining a coherent and stable Government policy over the years.
Context	2-Governance risk. Strong political influence when choosing a partner (public and private).
Context	3-Risk of instability. Strong political and social instability can decisively affect the management capacity of PPP contracts.

RISK CATEGORIES	PARTICIPANTS ANSWERS - RISK FACTORS
Context	4-Risk of lack of transparency. The absence of public channels to disclose to potential stakeholders how PPP procurement procedures are conducted may condition the entry of new partners.

APPENDIX I – ANSWERS: RISK TREATMENT OR MITIGATION MEASURES

RISK CATEGORIES	PARTICIPANTS ANSWERS
Financial	1-The development of the public partner's ability to build mechanisms.
Financial	2- The development of adequate management mechanisms.
Financial	3- The development of adequate monitoring mechanisms.
Financial	1- The creation of mechanisms to improve the ability to attract investment per contract.
Financial	2-The introduction of evaluation mechanisms to assess the amount (value for money) of the new contracts.
Financial	3-The creation of internal mechanisms to stop the contamination effect that can arise from the public component.
Financial	1-The rationalisation and planning investments that can be undertaken by the private sector.
Financial	2-The segregation of the planned investment plans, in phases, to be liable for a prior and timely evaluation.
Financial	3-The possibility of improving the investment plans, with the aim of having the Government as the major endorser.
Financial	1-The need to adapt the delegated management framework so that private operators are able to capture the necessary investment levels for the construction and rehabilitation of infrastructures.
Financial	2-The creation of financial incentives in contractual terms.
Financial	3-The introduction of the “Business plan” concept in the contracts, where it is clear the identification of potential sources of financing for the infrastructures (if this is one of the objectives of the agreement).
Financial	4-The public partner must have the ability to learn from the good practices carried out by the private sector.
Financial	5-The future contracts should be of longer duration, creating a higher level of accountability between both partners.
Financial	6-The creation of an evaluation grid to monitor the criteria for investment VS benefits.
Financial	1-The private partner and FIPAG should create mechanisms to optimize the component related to donations made by international agencies, reducing the present weight of 'traditional loans'.
Financial	2-The Government should create mechanisms to prevent the deterioration of FIPAG's treasury, such as taking tax commitments (e.g. the VAT payment), especially when the public partner (FIPAG) is not paid.
Financial	3- The introduction of mechanisms in the contractual terms that ensure the rationale of the tariff structure, and in case of deviations they must be compensated directly via Government budget, installing the principle that '... The irrational Government interference must be compensated as a way to compensate for the loss of business by the operator'.

RISK CATEGORIES	PARTICIPANTS ANSWERS
Financial	1-Human resources training (internal and external).
Financial	2-The development of adequate methodologies to ensure the management of competitors' complaints in the tender phase.
Financial	3- The creation of the procurement manager, especially in the tender phase.
Financial	4-The creation of a manual of internal procedures to ensure that the following principles are properly monitored: i) financial ii) infrastructure iii) timely fulfilment of all the steps during the contract life cycle.
Financial	1-The introduction of accounting classification manuals as mandatory clauses in the contracts.
Financial	2-For the duration of the contract, the private partner should provide a manual with information on the accounting criteria regarding the methodology applied to asset management and the depreciation method on a regular basis to the public partner.
Financial	3-The introduction of a requirement list before the tender phase of the minimum requirements regarding the accounting management methods and registration, namely the type of software which will store the documentation.
Financial	4-The obligation of the private partner to provide a detailed plan that ensures that the public partner and the regulator have access to reports containing relevant information during the contract life cycle.
Financial	1-The introduction of mechanisms to ensure funding for the (i) investment plans and ii) the preventive infrastructure maintenance plans.
Financial	1-The establishment of mechanisms to ensure adequate levels of transparency to capture the necessary investment levels for Greenfield ports projects.
Financial	2-The creation of supervisory mechanisms for Brownfield projects that will allow the public partner to ensure a correct and adequate level of monitorization of contracts.
Financial	1-The inclusion, in contractual terms, of a methodology that ensures the review of the tariffs in force, where appropriate.
Financial	2 -The integration, in contractual terms, of methods for further financial compensations due to contractual deviations during the contract life cycle.
Financial	1-The introduction of previous studies that ensure a production of adequate levels of cash flow.
Financial	2-The 'savings account' concept (performed by the private partner) during the contract life cycle should be mandatory in future contracts, a possible way to address the need of critical investment in the infrastructures.
Commercial	1-The development of the ability to build mechanisms between the partners.
Commercial	2-The development of internal and external mechanisms in the contracts, that will allow the public partner and the regulator to implement adequate monitoring mechanisms during the contract life cycle.

RISK CATEGORIES	PARTICIPANTS ANSWERS
Commercial	1-The creation of minimum traffic clauses (in terms of the number of passengers) that will allow the private partner to overcome the difficulties in receiving the money from tickets (in the case of the public railways' company).
Commercial	2-The design and implementation of a consistent and sustainable commercial strategy in the ports and railway companies, that will encourage the right private partners and punish the bad ones.
Commercial	1-The creation of the necessary conditions to ensure the correct and expected billing collection from the final customers during the contract life cycle.
Commercial	2-The creation of a sound policy from the Government to allow and ensure a '... Fair business for the Poor'.
Commercial	1-Review of studies prior to the construction of the new contracts to identify potential outbreaks of demographic and habitational growth.
Commercial	2-The introduction or reinforcement of the principle of the paying user. introduction or reinforcement
Commercial	3-The introduction of the adequate levels of service (quality, quantity and accessibility) the private partner has to comply with during the contract life cycle.
Commercial	4-The introduction of mandatory clauses regarding the information systems that ensure current and coherent information on demographic and housing pressures. This enables the potential asymmetries in terms of service provision to be rigorously foreseen (water and sanitation).
Commercial	5-The introduction of mandatory clauses in the new contracts where the public partner can revise the terms of service levels through financial compensation.
Commercial	6-The introduction of contractual clauses that allow the private partner to demand from the public partner the construction of additional infrastructures to face an increase in demand.
Commercial	7-The introduction of mandatory reports for an appraisal of potential customers, including (i) the demographic structure of the areas: ii) clients' ability to pay and iii) building registration, etc...
Commercial	8-The creation, by the Government, of an information system based on the geographic and ethnographic data arising from the information produced (e.g. building information and registration) that should indicate potential new customer groups.
Commercial	1-The introduction of procedures to ensure that the service provider has made every effort to issue the invoice and bill to all its customers. In the case of the waters of Mozambique contract, we must divide the customers into three main types: domestic, commercial and the Government (in the latter case, there are legal and institutional constraints that generate significant incentives to achieve an optimum billing level).
Commercial	2-The introduction of Key Performance Indicators to allow real incentives regarding the optimum small customers billed. That

RISK CATEGORIES	PARTICIPANTS ANSWERS
	is, there is an incentive for the waters of the Maputo region to carry out immediate billing. The private partner does not have the motivation to report the real billing levels from its customers to FIPAG. This reality comes from the fact that after, the private partner has to pay more to FIPAG (variable contract terms).
Commercial	3-The introduction of mandatory internal mechanisms and internal procedures that force the contract manager to make every effort to obtain adequate levels of recovery, such as penalties, due to a low performance, measured in terms of Key Performance Indicators.
Commercial	4-The introduction of mechanisms to ensure that FIPAG fulfils its function as a provider of the necessary investment levels for an appropriate level of business generation and its levels of treasury flows which will ensure the economic and financial balance during the contract life cycle.
Commercial	1-Human resources training (internal and external).
Commercial	2-The construction of adequate communication channels to deal with the competitors in the tender phase.
Commercial	3-The creation of the contract manager role throughout the duration of the contracts (by the public partner).
Commercial	4-The creation of a manual of internal procedures to ensure that all the principles associated with the contract are being fulfilled, namely: i) financial and infrastructure maintenance are timely fulfilled.
Commercial	1-Ensure that when building a new contract, the direct and indirect mechanisms for billing costumers are included.
Commercial	2-In future studies, include a more realistic perspective specially with regards to the capacity of the contract to generate the necessary cash flows.
Commercial	3-To perform independent audits to access the value for money when the contracts are close to termination.
Commercial	4-Human resources training (especially from the public entity).
Commercial	5-The introduction of contracts clauses to allow adequate contract terms (with no compensation for public contracting party) in the case of disruptive changes (e.g. the unexpected rise of customers and users as a result of the unexpected access to mobile phones).
Commercial	1-The development and approval (by the public partner) of billed mechanisms for "Big 5" debtors.
Commercial	2-The development and approval (by the public partner) of collection mechanisms for private debtors.
Commercial	3-The development of back-up mechanisms that ensure a continuity of operations and its generation of business.
Commercial	4-The introduction of a mandatory and exhaustive cadastral survey, identifying: i) how many houses there are and their typologies in the concession area, ii) the profile of the population and their potential growth, iii) recognition of the number of contracts vs quantity of counters.

RISK CATEGORIES	PARTICIPANTS ANSWERS
Commercial	5-The introduction of a budget (by the private partner) to create awareness campaigns directed to their direct customers with the message 'it is necessary to pay to get access to basic goods as a way to get better levels of service'.
Commercial	1-The clear identification of public entities to which it is not possible to cut access to water, their monitoring and reporting to the Government to avoid 'opportunistic' behavior.
Commercial	2-The development of mechanisms that reduce the distance between the private partner and the final customers. In the case of Maputo region waters, one of the measures taken was the creation of more points of service to the public.
Commercial	3-The development of mechanisms that allow a swift 'injunction' process to private clients whose access to water was blocked due to failure in paying their invoices.
Commercial	4-The development of awareness campaigns to the population focused on the principle of '... Paying user ' to discourage water theft.
Commercial	1-The inclusion of a pilot program to introduce the concept of prepaid water, similar to the system already in force for electricity in Mozambique. The interviewees argues that there are studies that support this option, saying that there is data that supports that water consumption may increase.
Commercial	2-The inclusion of effective systems for monitoring the water sector, for example.
Commercial	3-The creation of a procedure for reducing network water losses.
Commercial	4-Mandatory studies before contracts are made to ensure that the tariff systems cover at least the operating costs plus the investment cost. All deviations from this standard will have counterparts that financially compensated in order to ensure the maintenance of the financial-economic balance of the concession.
Commercial	5-The inclusion of mandatory campaigns (with shared costs for the public and private partners) to create the feeling of '... Payer user' on the final customers.
Commercial	1- The demand for mandatory due diligence projects in future contracts between partners.
Commercial	2- The need of mandatory studies in terms of real and potential customers (e.g. highway).
Infrastructure	1-The development of capacity-building framework mechanisms for public-side.
Infrastructure	2- The creation of adequate management and monitoring mechanisms for both partners, improving the contract management results.
Infrastructure	1-The creation of mechanisms that allow an adequate registration of assets during the contract preparation phase.
Infrastructure	2-The creation of mechanisms that allow an external evaluation of the accuracy of the infrastructure records.

RISK CATEGORIES	PARTICIPANTS ANSWERS
Infrastructure	3-The creation of internal mechanisms and clauses on the new contracts that can work on an objective way to access the qualifications of the private and public partners.
Infrastructure	4- The creation of internal mechanisms (by the public partner) to correctly and timely evaluate the private partner during the contract life cycle.
Infrastructure	1-The introduction of a private operator performance assessment to ensure proper asset management.
Infrastructure	1-A review of studies during the construction of new contracts, intending to identify potential outbreaks of demographic and habitational growth.
Infrastructure	2-The obligation to design and install information systems, ensuring coherent information regarding demographic and housing pressures to prevent potential asymmetries in terms of service provision. This measure should allow building a rigorous framework (water and sanitation) that will have a substantial impact on current and future infrastructure projects.
Infrastructure	3-Design reports on the diagnosis of potential customers, including (i) demographic structure of the concession areas; ii) the customers' ability to pay; iii) building registration, etc...
Infrastructure	4-The construction of a set of rules and procedures for the construction of infrastructures and its maintenance.
Infrastructure	1-Human resources training (internal and external).
Infrastructure	2-The creation of an infrastructure procedures manual.
Infrastructure	1-Human resources training (internal and external).
Infrastructure	2-The creation of an infrastructure procedure manual.
Infrastructure	1-The public partner should contract an external audit to access how the infrastructure was before starting the design of a new contract.
Infrastructure	2-The identification of the 'grey zones in the contract', before a renegotiation contract phase.
Infrastructure	3-The creation of backup plans (business continuity plans) for the maintenance of infrastructure-business, ensuring service provision.
Infrastructure	1-The establishment of mechanisms to ensure adequate levels of transparency to capture investments for Greenfield Ports
Infrastructure	2-The creation of supervisory tools for Brownfield projects.
Infrastructure	1-The introduction of standards, rules and regulations to create an updated infrastructure track.
Technical and Operational	1-The development of capacity-building framework mechanisms for public-side.
Technical and Operational	2- The creation of adequate management and monitoring mechanisms for both partners, improving the contract management results.
Technical and Operational	1-The introduction of a mandatory human resources training by the private partner, ensuring the knowledge gap regarding the technical and operational skills.

RISK CATEGORIES	PARTICIPANTS ANSWERS
Technical and Operational	2-The implementation of measures by the public partner to monitor the effectiveness of the human resources training plan implemented by the private partner during the contract life cycle.
Technical and Operational	3-The introduction of performance evaluation clauses regarding human resources (public component).
Technical and Operational	4-The introduction of clauses in future PPP contracts that compel the private party to provide a systematic training plan to the employees, especially the ones that are connected to the technical and operational fields.
Technical and Operational	5- The introduction and/or review of current key performance indicators.
Technical and Operational	1-The introduction of contractual mechanisms to optimize the current operating conditions (e.g. incentives for the most efficient operators and of concession contracts).
Technical and Operational	2-The creation of tools that will ensure effective management skills (from both partners).
Technical and Operational	1- The review of the current key performance indicators to penalize operators that are not efficient, taking into account the binomial costs Vs. cubic meters produced.
Technical and Operational	1-The introduction of internal rules (mandatory in terms of future specifications and their proposals) to ensure the reduction of losses (resulting from theft-bypass to systems, management of ruptures, obsolete and deteriorated infrastructures).
Technical and Operational	2-The creation of a plan by the private partner that ensures the existence of preventive infrastructure maintenance.
Technical and Operational	3-The creation of mechanisms to control small clients and reducing water theft.
Technical and Operational	4-The creation of a program by the public partner to create awareness in the population that the local companies should be seen has their partners and not as their enemy, conveying the message that it is necessary to maintain the infrastructures and pay for the services.
Technical and Operational	5-Fundraising through multilateral agencies to manage water losses.
Technical and Operational	6-The introduction of contracts to externalise the management of leak control from pipe bursts.
Technical and Operational	7-The introduction of mandatory clauses in the contracts passing the responsibilities of the maintenance of the infrastructure to the private partner.
Technical and Operational	8-FIPAG should be compelled to perform an exhaustive infrastructure record.
Technical and Operational	9-The creation of mandatory maintenance plans of the infrastructures that are on the contract scope. These plans should be performed by the private partner and approved by FIPAG.
Technical and Operational	10-Fundraising through multilateral agencies for maintenance management.
Technical and Operational	11-The obligation of an annual human resources training plan (for both partners).

RISK CATEGORIES	PARTICIPANTS ANSWERS
Technical and Operational	12-Introduction of internal mechanisms (applicable to the public and private partner) to ensure an adequate contract control level.
Technical and Operational	13-Introduction of mechanisms (applicable to the public and private partner) to measure the performances of their internal and contracted boards.
Technical and Operational	1-The introduction of a mandatory human resources training by the private partner, ensuring the knowledge gap regarding the technical and operational skills.
Technical and Operational	2-The creation of the contract manager ensuring that he has technical and operational skills.
Technical and Operational	3-The creation (by the public partner) of an internal procedure manual to ensure that the technical and operational principles are in accordance with the contract.
Technical and Operational	1-The public partner should contract an external audit to access how the infrastructure was before starting the design of a new contract.
Technical and Operational	2 -The creation of backup plans (business continuity plans) for the maintenance of infrastructure-business, ensuring service provision.
Technical and Operational	1-The public partner should contract an external audit to access how the infrastructure was before starting the design of a new contract.
Technical and Operational	2 -The creation of backup plans (business continuity plans) for the maintenance of infrastructure-business, ensuring service provision.
Technical and Operational	1-The existence of appropriate maintenance plans (in the case of Brownfield ports contracts).
Technical and Operational	2-The inclusion of a procedure to monitor the maintenance plan.
Context	1-The Government should develop measures to promote transparency. The interviewee was recently involved as a consultant in the Government's training proposal to fight corruption.
Context	2-The implementation of concrete monitoring measures to compel the public companies to comply with Decree-Law No. 16/2012, regarding the private public partnerships (see article 27-monitoring).
Context	1-The creation of a network of requirements for the entry of new foreign companies in Mozambique.
Context	2-Fostering the sense of national "sovereignty."
Context	1-The rationalisation and planning of investments to be carried out by the private sector.
Context	2-The division of the investment plan in phases, providing adequate liability.
Context	3-The introduction of lifelong measures in contracts that reduce the "usual" information asymmetry.
Context	1-The obligation of formalising the changes made by the public partner regarding the sector.

RISK CATEGORIES	PARTICIPANTS ANSWERS
Context	2-Updating the economic models of the contracts.
Context	1-The Government review of the current legal framework to mitigate present real differences between PPP contracts and Procurement. The interviewee suggests the creation of a regime of exception for PPP contracts.
Context	1-The creation of workgroups that have the mission to review and access the legal inconsistencies of the current legal framework and provide solutions to integrate them into the PPP contracts.
Context	2- Create a robust legal framework to ensure the independence of the sector regulator, increasing their power to intervene in the water sector and PPP contracts.
Context	1- The introduction of compensatory clauses in new PPP contracts.
Context	2-The introduction of tools that will allow updates of the Business Continuity Plans.
Context	1- The introduction of compensatory clauses in new PPP contracts.
Context	2-The introduction of tools that will allow updates of the Business Continuity Plans.
Context	1-The segregation of duties regarding the current legal framework. The provider for the investments, who is also responsible for monitoring the PPP contracts, should not be allowed to be responsible for managing some operational activities at the same time.
Context	1-The creation of an insurance to mitigate the risk of the political interference (political risk) (e.g. Multilateral Investment Guarantee Agency - MIGA).
Context	2-The creation of an insurance to mitigate the possibility of interference in contracts resulting from technological, operational or financial changes.

APPENDIX J - VEI PRESENCE IN MOZAMBIQUE

START	END	CONTRACTS DETAILS
2005	**2012**	***Contract name*** Water Operators Partnership for Southern Cities in Mozambique ***Brief description of services provided*** Through a Public-Private Partnership (PPP) arrangement Vitens Evides International provides technical assistance and management support to (i) FIPAG, the national organisation responsible for **water supply** and **asset management** in Mozambique and (ii) to the water companies for all the major towns in Southern Mozambique: Chókwé, Inhambane, Maxixe and Xai-Xai; The services can be summarised as follows: • Financial Management and Customer Services: General Plans and Programs, Customer Service and Financial Management Services; • Asset and Repair and **Rehabilitation** Services: **Asset Management** Improvement Programs, Capital Investment, Small Works and Delegated Works Planning and Implementation, **Network Improvement**; • Reduce the level of **non-revenue water**; • Support and **capacity building** in general plans and programs: Base Year Data Report, Management Information Systems Plan, Procurement Guidelines, Strategic Business Plan, Annual Business Plans and Annual Operations and Maintenance Budgets, **Annual Capital Investment Program Plan**, Emergency Response Plan, **Staff Training** and Development Plan and Merit Payment Program, Environmental Management Plan; • **Daily Management, Operations and Maintenance**: Procurement, Service Area Expansion, Tariff Advice and Assistance, New Technologies and Corporate Communications, Financial, Administrative and Regulatory Management, Urban Development and Planning Control; • Water Operations: General Water Operations Improvement Programs, General Water Operations Services. ***Amount of contract:*** USD 11,300,000 Amount paid to VEI USD 11,300,000 ***Name of employer:*** 1. FIPAG (Water Supply Asset holder Mozambique); 2. Royal Netherlands Embassy in Maputo. ***Address:*** Avenida Filipe Samuel Magaia Nº 1291 Maputo, Mozambique Dr. P.M. Paulino Paulino@fipag.co.mz / +258 82 3100060
2006	**2012**	***Contract name*** Water Operators Partnership, for the cities of Tete, Moatize, Chimoio, Manica and Gondola

START	END	CONTRACTS DETAILS
		Brief description of services provided Vitens Evides International provides management and operation support to FIPAG (National Asset Holding and Investment Fund) within the framework of a Water Operators Partnership. The aim is to improve the **management and operations** of the water supply operators in the towns Tete, Moatize, Chimoio, Manica and Gondola (together over 500,000 inhabitants). The overall objective is to create autonomous water companies that provide safe and reliable water services to their customers and that are able to sustain these services, based on efficient use of water and affordable tariffs, related to the level of services and that cover at least the cost of operation and maintenance. The services can be summarized as follows: • Daily Technical Management: **Staff training** in **operation and maintenance**, network expansions, New Technologies; • Daily non-technical management support: Financial, Administrative, Institutional and Regulatory Management • **Asset management**, Repairs, **Distribution renovation**: Asset Management Improvement Programs, Works Planning and Implementation, Network renovations; • **NRW-management**: Reduce the level of non-revenue water; • Support and capacity building in general plans and programs: Base Year Data Report, Management Information Systems Plan, Procurement Guidelines, Strategic Business Plan, Annual Business Plans and Annual Operations and Maintenance Budgets, Annual **Capital Investment Program Plan**, Emergency Response Plan, **Staff Training,** Environmental Management Plan; • Technical support: Urban Development and Planning; General Financial Management and Customer Services: General Plans and Programs, **Capital Investments**, Customer Service and Financial Management Services, Tariff Advice and Assistance, Corporate Communications. ***Amount of contract:*** USD 7.344.000 Amount paid to VEI: USD 7.344.000 ***Name of employer:*** FIPAG (Water Supply Asset holder Mozambique) Royal Netherlands Embassy in Maputo ***Address:*** Avenida Filipe Samuel Magaia Nº 1291 Maputo, Mozambique Dr. P.M. Paulino Paulino@fipag.co.mz / +258 82 3100060
2012 May 7	**2016 May 6**	***Contract name:*** Capacity Building in Sustainable Water Infrastructure Management in Mozambique Northern Region. ***Brief description of services provided:***

START	END	CONTRACTS DETAILS

Capacitate the management teams of FIPAG Northern Regional Office and water supply companies Angoche and Nampula through:

- Staff training in general and change management, finance, business planning and control
- Embedding roles and responsibilities of relevant stakeholders in the water sector.
- Formulating project proposals to attract investments
- Execute a baseline survey in the peri-urban areas of Angoche and Nampula, sensitize users of public stand pipes and train operators of stand pipes and include relevant stakeholders to increase access to drinking water
- Capacitate the technical oriented staff of FIPAG Northern Regional Office and water supply companies of Angoche and Nampula through class room training and training on the job:
  - ¬ To operate the laboratory and to test water quality
  - ¬ Project management
  - ¬ Maintenance of treatment works and distribution networks, boreholes, electrical installations and hydro mechanical equipment
  - ¬ GIS and hydraulic modelling
  - ¬ Develop and implement best practices and knowledge sharing between FIPAG regions
  - ¬ Realization of two demonstration projects on NRW reduction and implementation of pilot projects in other FIPAG cities in the Northern region

Amount of contract: USD 1.633.000
Amount paid to VEI: USD 1.045.000

Name of employer:
1. FIPAG (Water Supply Asset holder Mozambique);
2. European Union Water Facility

Address:
Avenida Filipe Samuel Magaia Nº 1291
Maputo, Mozambique
Dr. P.M. Paulino
Paulino@fipag.co.mz / +258 82 3100060

Ref no 4	Project title		FDW Sustainable Water Services Beira, Mozambique					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by VEI**	**No of VEI staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
VEI	Mozambique	6.5 M	5,0 M	2 FTE	National Asset Holding and Investment Fund [FIPAG]	Sustainable Water Fund (NEA, GoN)	2015 –2020	WSUP (UK)

Detailed description of project

The defined project activities which are currently under execution are:

- Water production: capacity of the water treatment plan extended with 10% (approximately 5.000 m3)
- Water distribution:
  - 36 air valves replaced in the main transport pipe
  - 85 km network extension
  - 112 kilometers of 'spaghetti networks' restructured
  - 23 kilometers of weak (leaking) spots in the network replaced
  - DMA's created
  - Updated GIS system, hydraulic calculations, pressure management approach and water balances available
- Commercial and financial:
  - House-to-house survey (over 120.000 houses) in which illegal customers are detected and broken water meters are identified
  - 26% of the water meter population (13.500 water meters) replaced
- Debt recovery strategy
- Sustainability:
  - Awareness campaigns regarding WASH (water use, hygiene)
  - Awareness campaigns regarding gender and women
  - Customer satisfaction surveys and improved customer processes
  - Implementation of a NRW unit to sustain low NRW after the project

Change management training

Type and scope of services provided

A consortium consisting of WSUP, FIPAG and VEI developed a strategy to reduce real and commercial losses to increase water availability to the people of Beira and to increase financial sustainability of the water utility. The project is reducing NRW with 10% or more, provide extra water for 110.000 people and increases revenues with 18% (minimum).

For every step from source to tap effective investments are mixed with capacity building, ensuring organisational embedding and change.

Production: water treatment plant optimization (chemical use and energy efficiency)

Distribution: reduction of physical losses through establishment of a GIS, DMAs for NRW/water balances (to localize high volumes losses), hydraulic modelling and pressure management, and improved speed/quality of repairs (physical losses)

Commercial losses are reduced through a water meter replacement program, removing leaking water meters and illegal connections, including a house-to-house survey to identify customers, detect water leakage and illegal connections

FIPAG Beira's financial sustainability will be improved through capacity building in the commercial area, debt management programs

An important part of the proposed project focuses on the required social changes through community involvement and awareness campaigns

Ref no 9	Project title		AIAS, Mozambique (Phase 1)					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by VEI**	**No of VEI staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
VEI	Mozambique	EUR 4.3 million	EUR 2.3 million	2.4 FTE	AIAS	Royal Netherlands' Embassy, Maputo	January 2014 August 2017	SNV, World Waternet, BopInc

Detailed description of project

In 2009, the Government of Mozambique created the *Administração de Infraestruturas de Abastecimento de Água e Saneamento* (AIAS) to provide leadership to these water and sanitation developments in the country's 130 peri-urban centres. In addition, AIAS' mandate also covers sanitation assets in Mozambique's 21 cities. In 2013, about 25% of the 3.6 million people living in these 130 peri-urban towns had access to water. Access to sanitation was about 13%.

VEI, in collaboration with SNV, World Waternet and BopInc, supported AIAS in improving access to water and sanitation services in 15 small towns in Mozambique.

Through the project the partners:

- Strengthened the capacity of AIAS organization at central and provincial levels;
- Strengthened water operators, enabling them to increase water coverage by 70,000 people;
- Raised awareness on sanitation and hygiene in 15 project towns;
- Involved the private sector in implementing innovative business ideas in the water and sanitation sector.

Type and scope of services provided

- Strategic technical assistance at AIAS' headquarters;
- Elaboration of strategic plans and a financial model for AIAS as a whole;
- Elaboration of water tariff models;
- Implementation of financial and commercial management software;
- Training of water operators in distribution, production, commercial management and electrical maintenance;
- Development of sanitation development plans at town level;
- Awareness campaigns on sanitation and hygiene;
- Conception and implementation of biogas installations;
- Conception and implementation of smartphone-based water meter reading and invoicing technology.

Ref no 10	Project title		AIAS, Mozambique (Phase 2)					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by VEI**	**No of VEI staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
VEI	Mozambique	EUR 4.1 million	EUR 2.1 million	2.5 FTE	AIAS	Royal Netherlands' Embassy, Maputo	September 2017 December 2020	SNV, BopInc

Detailed description of project

In 2009, the Government of Mozambique created the *Administração de Infraestruturas de Abastecimento de Água e Saneamento* (AIAS) to provide leadership to these water and sanitation developments in the country's 130 peri-urban centres. In addition, AIAS' mandate also covers sanitation assets in Mozambique's 21 cities. In 2013, about 25% of the 3.6 million people living in these 130 peri-urban towns had access to water. Access to sanitation was about 13%.

From 2014 till 2017 VEI supported AIAS in improving access to water and sanitation services in 15 small towns in Mozambique.

In 2017, EKN awarded VEI a contract for the implementation of the second phase of this project. In the second phase, 35 small towns in Mozambique will benefit.

Through the project the partners:

- Strengthened the capacity of AIAS organization at central and provincial levels;
- Strengthened water operators, enabling them to increase water coverage by 130,000 people;
- Raised awareness on sanitation and hygiene in 35 project towns;

Involved the private sector in implementing innovative business ideas in the water and sanitation sector.

Type and scope of services provided

- Strategic technical assistance at AIAS' headquarters;
- Elaboration of strategic plans and a financial model for AIAS as a whole;
- Elaboration of water tariff models;
- Implementation of financial and commercial management software;
- Training of water operators in distribution, production, commercial management and electrical maintenance;
- Development of sanitation development plans at town level;
- Awareness campaigns on sanitation and hygiene;
- Conception and implementation of biogas installations;
- Conception and implementation of smartphone-based water meter reading and invoicing technology.

Ref no 11	Project title		FIPAG institutional support (Phase 1)					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by VEI**	**No of VEI staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
VEI	Mozambique	M5.2 USD	M5.2 USD	2 FTE	National Asset Holding and Investment Fund [FIPAG]	Royal Netherlands' Embassy, Maputo	2012-2016	n/a

Detailed description of project

The contract is a continuation of the existing PPP between VEI and FIPAG and builds upon previous contracts for Western and Southern Cities (2005-2012). Main focus of the contract is to support FIPAG to grow into a financial sustainable utility and more specifically to support the establishment of the recently established regional offices in Xai Xai, Beira and Nampula. Whilst the majority of activities are focused on training and support of the regional offices support to the local water supply companies (total: 18 companies) and the water company of Maputo continues as well.

Type and scope of services provided

- Commercial area: data quality, analyses, debt management, organisational development, NRW reduction, field surveys (GPS)
- Finance & Control: support with the development and implementation of the control loop: development of annual plans and budgets and during the year monitoring progress. Activities also include business analyses.
- Institutional support for asset management, maintenance and other relevant areas, models (tariffs, investment projections)
- Technical support: optimising water treatment, management and maintenance of boreholes, energy and chemical reduction plans, training for electricians, pump courses, design of networks, improving GIS, EPANET training, network cleaning
- Meter management: calibration and water meter exchange programs
- Maintenance management: implementation of supporting software, on the job training, application of measuring equipment, organisational advice
- Auditing
- NRW management: pilots, making DMA's, training of plumbers

Water quality advice: monitoring, laboratories, sampling, analyses.

Ref no 12	Project title		FIPAG institutional support (Phase 2)					
Name of legal entity	**Country**	**Overall contract value (EUR)**	**Proportion carried out by VEI**	**No of VEI staff provided**	**Name of client**	**Origin of funding**	**Dates (start/end)**	**Name of consortium members, if any**
VEI	Mozambique	M 4.5 USD	M 4.5 USD	2 FTE	National Asset Holding and Investment Fund [FIPAG]	Royal Netherlands' Embassy, Maputo	2016-2021	n/a

Detailed description of project	**Type and scope of services provided**
The contract is a continuation of the existing PPP between VEI and FIPAG and builds upon previous contracts as from 2005. The contract extension focuses on capacity development for the longer term. The institutional capacity comprises technical, financial, and planning areas. Four young technicians are contracted (GIS, ICT, electrical engineering, ICT) to be trained and integrated into the FIPAG organization. Moreover, three regional coordinators (South, Central, North) are trained to coordinate implementation of the TA activities and will be integrated into the FIPAG organization.	• Development of an internal ICT platform to share, store, analyse and report internal (performance and operational) data to internal and external stakeholders • NRW management: pilots, making DMA's • Energy assessments and programs for the reduction of energy cost • Development of GIS department • Institutional support for asset management, maintenance management) • Technical support: optimising water treatment, management and maintenance of boreholes, design of networks, improving GIS, EPANET training • Water quality advice: monitoring, laboratories, sampling, analyses • Attracting investments

Source: Data provided by Vitens Evides International via e-mail on the 5th August 2020.