

Financing flood protection measures in developing countries: Are private investments feasible?

Experience from Pevensey Bay Coastal Defence Project in UK

Octavian-Mihael Popovici

Master Thesis

MSc. Construction Management and Engineering

December 2013



Colophon

Title: **Financing flood protection measures in developing countries: Are private investment feasible?**
Experience from Pevensey Bay Coastal Defence Project in UK

Location: Delft

Date: 3rd of December, 2013

Status: Final version

Author

Name: Octavian-Mihael Popovici

Number: 4183436

Email: o.m.popovici@student.tudelft.nl

Program: Master Construction Management and Engineering (CME)

Faculty: Faculty of Civil Engineering, Delft University of Technology

Graduation Committee

Chairman: Prof. Dr. J.A. (Hans) de Bruijn (TPM)

First Supervisor: Dr. W.M. (Martin) de Jong (TPM)

Second Supervisor: Ir. L.P.I.M. (Leon) Hombergen (CEG)

Deltares Supervisor: Dr. M. (Monica) Altamirano

Disclaimer

This is a final thesis' report for the Master Construction Management and Engineering at Delft University of Technology. The research was performed by O.M.Popovici as a Graduation Internship report at Deltares. The author is responsible for the statements here included. The investigation seeks to provide a theoretical answer on how flood protection measures can potentially be implemented through private financing, under PPP. It is intended for general use. The image on the cover is copyrighted by Mackley Construction.



Preface

The Master Construction Management and Engineering is a very vast area of expertise. One of the biggest challenges a graduate student faces when nearing the end of his studies is choosing among a large number of disciplines and interesting thesis' topics. Deciding on the thesis topic is not a trivial task, requiring countless hours researching in order to find a topic that is worthwhile. With a background in road infrastructure civil engineering, addressing a topic such as flood protection, in which I had no previous experience, provided a challenge worth pursuing. With developing this thesis at Deltares, I gained insight on the effects of climate change and what measures are taken in order to counter them in a manner that is beneficial to the societal needs. Having seen how many issues developing countries face, especially flooding, it lead to the decision to focus on investigating if alternative financial mechanisms can be used for the development of such critical infrastructure. Formulating an adequate framework through which the case study selected was to be analyzed turned out be very time consuming, ongoing for several months. Even with this being theory oriented research, it can provide practical information to Deltares, as important insight on how flood protection can potentially be contracted under Public-Private Partnership with the private sector financing it. I believe that this topic contributed to the overall knowledge pool on alternative ways of financing flood protection, a topic that has not seen much attention in the past years.

This thesis represents the end of a two year journey, away from family and friends. It proved to be an unforgettable experience to which only a handful of my fellow countrymen would have had access to. Deltares' support, under the direct supervision of Monica Altamirano throughout the development of this research was invaluable and for that I show much gratitude. The same can be said about the moral support given by my parents and brother during this process. Finally I would also like to thank my graduation committee, for having the patience to guide me in times when I was lost. For this I am forever grateful.

Executive summary

In recent years the awareness of climate change has increased and it no longer represents a potential scenario anymore. Climate change is already here and the effects are felt by both ecosystems and the population. Developing countries are amongst those most affected, as they lack proper financial power to react to such changes.

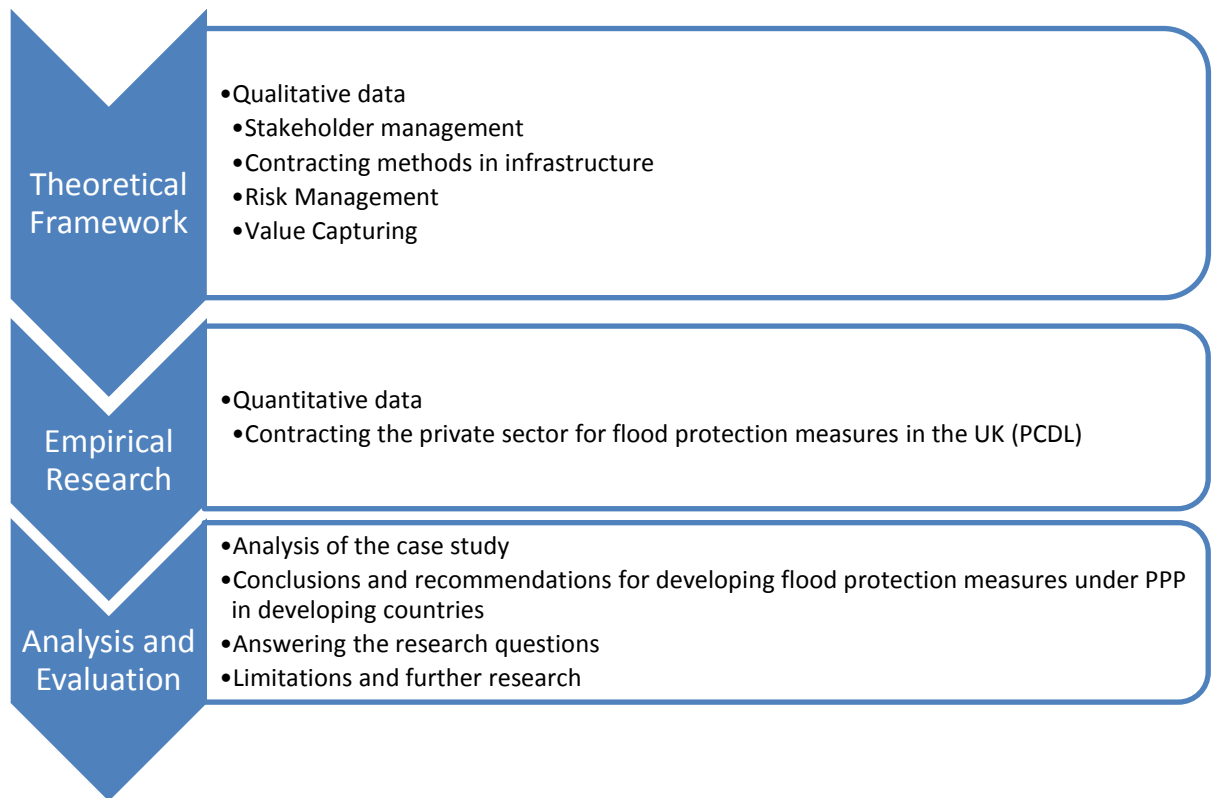
With the effects of climate change becoming more visible, one of the threats is the probability of increased flooding due to the combined effects of a rise in sea level, increased river discharges, more abundant and intense rainfalls, and stronger storm surges. This constitutes the rationale behind why governments of developed and developing countries alike should take action against these effects, addressing them early so that they don't propagate and leave an even bigger footprint on society. (Bouwer & Aerts, 2006)

However, the implementation of climate adaptation measures for infrastructure hit a variety of barriers. Infrastructure projects are, most of the time, on a large scale requiring considerable financing with governments not being able to implement them through traditional procurement methods. This leads to the need for using alternative project delivery and project financing methods, in close collaboration with a private party. With a public-private structure the technical expertise and financial power of the private sector are used. Also, with private financing, project implementation is no longer reflected on the national public debt, so they can redirect the public funds elsewhere. This collaboration comes with limitations. Generally, the private sector is not willing to invest in innovation, such as green measures for climate adaptation, thus limiting themselves to traditional engineering.

The purpose of this report is to explore potential ways of making private financing a viable option for the implementation of flood protection measures in developing countries. This constitutes the rationale behind the research, thus the main research question will be the following:

“Can private finance be made a viable option for implementing flood protection measures in developing countries?”

The proposed framework can be applied to flood protection projects worldwide, but out of considerations presented in the introduction, developing countries in general will be the focus of this research.



Research methodology

The rationale behind the proposed framework is to analyze the only identified case where flood protection measures were implemented under Public-Private Partnership (PPP), in an attempt to transfer the knowledge to developing countries reaching this paper's goal. For flood protection projects in developing countries private financing is scarce, building up the rationale in analyzing the selected case.

Stakeholder analysis will provide the background that enabled the government to involve the private sector in flood protection. Relevant actors will be identified and described, in order to give meaning as to why the government decided to involve them in the process. This will be achieved through the Stakeholder Identification Process and also, by placing them in the Power-versus-Interest grid their relevance will be underpinned.

There are numerous ways to involve the private sector in contracting infrastructure. The focus of this paper is to involve the private sector to a degree that most of the responsibilities are transferred from the government to them in a financially efficient manner. This leads to the selection of a contractual arrangement under PPP. To what extent responsibilities are transferred, depends on the project delivery method used in each specific case.

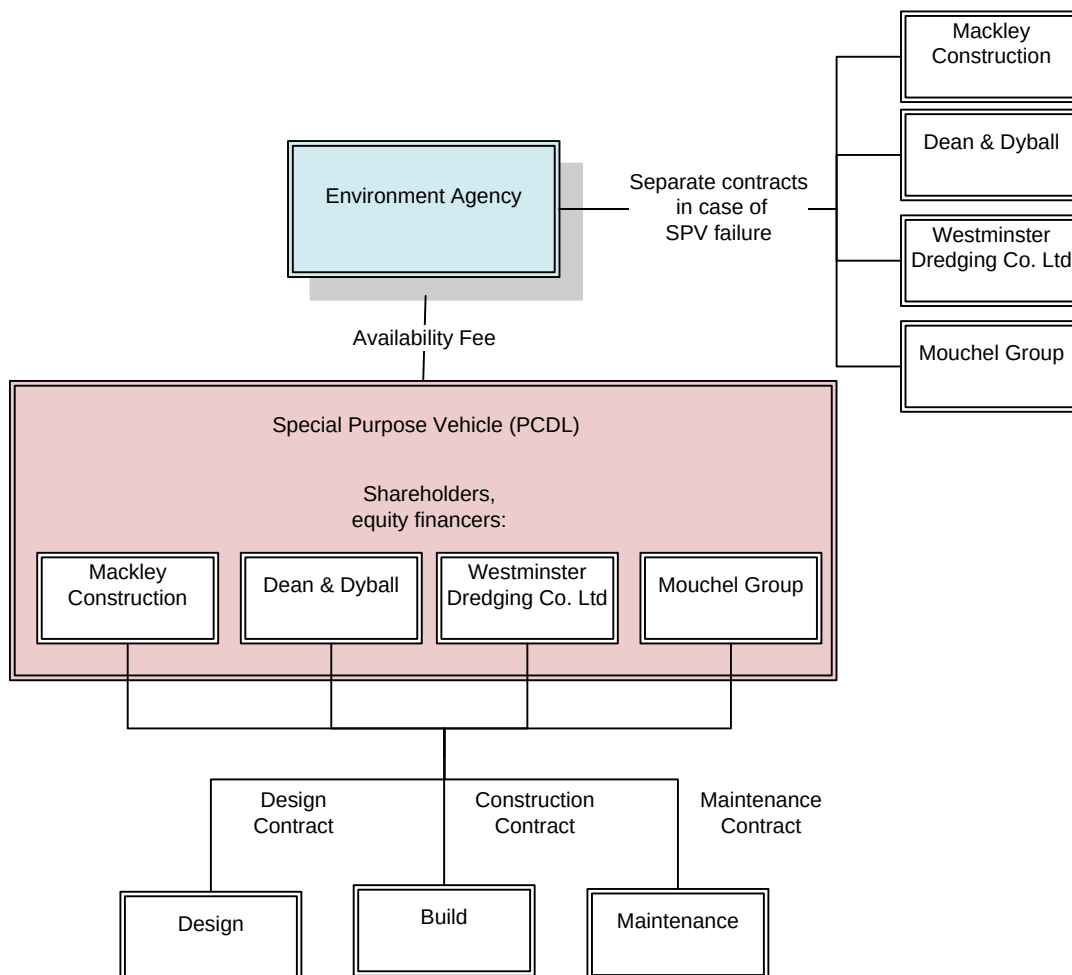
Selecting a specific project delivery method also underpins how risks were identified and allocated in the specific case. The more responsibilities are transferred to the private sector, the more risks they bear, while acknowledging to what extent they are able to handle these risks.

The financial arrangement of various project delivery methods differ. Through value capturing policies, new means of generating additional finance will be explored. By applying targeted taxation methods on relevant stakeholders that hold a direct benefit from the project, the government can monetize these stakeholder benefits, in an attempt of further supporting the project financially.

The Pevensey Coastal Defence Project (PCDL) is the only known flood protection project that was implemented through a PPP scheme with transferring financial responsibilities to the private sector. It was not only selected for this research on the basis that it is the only known one but also due to the overall success of the ongoing process that started in 2000.

The institutional framework for flood protection in the UK, even though complex, has a top-down hierarchical approach. It clearly defines the regulating agencies and enforcing authorities. Under the main regulating public body, the Department of Environment, Food and Rural Affairs, the Environment Agency (EA) serves as the main enforcing authority that oversees all flood protection works throughout the UK.

Contracted under a Design-Build-Finance-Maintain (DBFM) agreement, with a duration of 25 years of operation and maintenance, the project requires frequent surveys by the Environment Agency to assure correct implementation. The main service provided was for something not to happen: flooding. The initiation phase of the project represented an extensive learning process for all stakeholders, preparing the contract and tendering.



PCDL DBFM Contract Structure

The PCDL experience shows that an integrated flood protection project, including development, upgrading and maintenance is financially feasible for the private sector. By clearly defining the key physical features of the project early in the design phase, while still giving the contractor enough design freedom for developing innovative solutions, it can reduce the government's role to only supervision to ensure that the project is in line with the contract specifications. Over the specified contract duration, the government took the responsibility of performing annuity payments towards

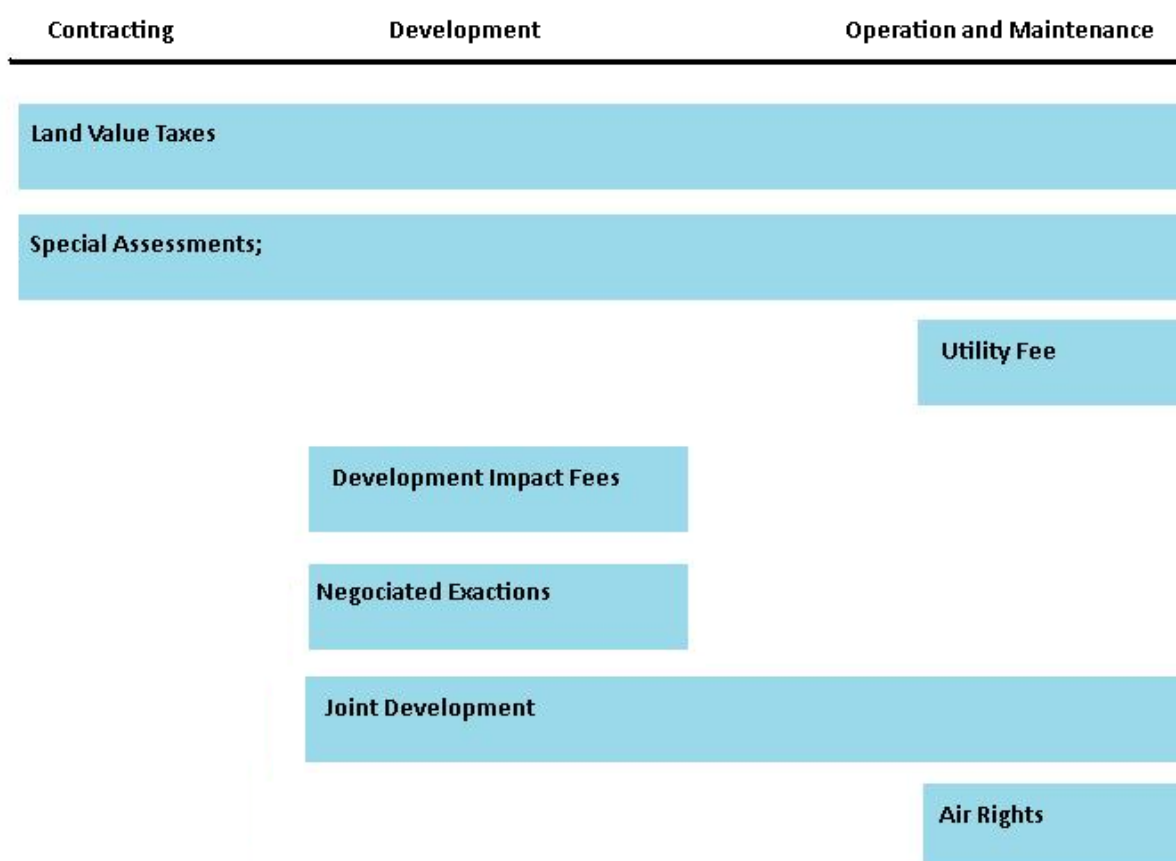
the established SPV(Special Purpose Vehicle) that developed the project. Using this contract structure, the project was financially attractive to the private sector, clearly showing that a return-of-investment is possible for flood protection services in this specific case, with the government being able and agreeing to perform annuity payments for service provision.

Among a variety of taxation methods applied in the UK, two of them were identified to be value capturing policies through which it allowed the EA to generate additional financing for the annuity payments to be executed towards the SPV. This shows that even with flood protection measures not generating any revenues, the government can employ specific strategies for co-financing flood defences developed under PPP. The value capturing policies were used to generate additional financing for the government to perform the annuity payments towards the private sector.

The application of value capturing policies is heavily dependent on context, the economic and social environment of specific countries, with some policies being more suitable than others. Through this analysis, the intention was to point out that there is potential use for such policies in generating additional financing for flood protection.

As a result of this research it can be concluded that value capturing can be a viable way of attracting private investments for flood protection. The application of one or several of these policies is heavily regulated by factors such as the economic environment, institutional framework and national policies for flood control, contract structure, financial mechanism and risk management. Only by taking all of them into consideration can governments formulate these taxation methods based on the situation.

By applying targeted taxation policies, even governments of developing countries can show private investors that they have the potential of financing the incurring annuity payments of a privately financed flood protection project. Having identified these value capturing policies, they can be applied in various stages of project development for flood protection as seen below.



Based on the key lessons resulted from the PCDL project analysis, recommendations were given for developing countries to enable private financing of flood protection measures, recommendations on developing the PPP process, formulating the contract for service provision, the selection criteria for project delivery methods, risk distribution and setting up of value capturing policies.

Recommendation 1. Make the PPP process transparent to avoid corruption and increase public acceptance

Transparency in different phases of a PPP project should be assured through proper legislative action. Information about procedures should be made openly available to the public. This would decrease the chances of corruption and avoid strategic behaviour, which can be easily identified in developing countries. Also, by ensuring a high level of transparency, the public has access to information about the project, further contributing to their acceptance it. This recommendation is general as it addresses contracting under PPP in both developing and developed countries, however, developing countries have this issue more accute, requiring more caution regarding the PPP process.

Recommendation 2. The contract needs to be formulated based on the provision of a service rather than the creation of a physical asset

Instead of focusing on developing hard flood protection infrastructure, governments should focus on contracting the private sector to provide flood protection as a service. By applying more performance based contracts, it allows governments to shift their role towards mainly monitoring functions to ensure the level of service agreed upon is maintained throughout the contract duration.

Through establishing a clear set of objectives and measurements for the service, the contractor's performance can be monitored upon the agreed key physical features based on the service provision.

Key physical features of the infrastructure need to be specified early in the design phase, giving clear guidelines on the type of materials and quantity to be used in the development, while still allowing sufficient freedom to the contractor to apply innovative solutions. By applying bonuses and sanctions based on performance the contractor can be motivated to improving its practices and solutions, which can lead to overall cost reductions of the project.

Recommendation 3. Governments should choose the most suitable project delivery method when contracting under PPP

Flood protection measures can in fact be implemented under PPP by selecting a suitable project delivery method. If governments lack the capability of financing the project it can choose to develop the project under different PPP models, based on the responsibilities and risks it is willing to share with the private sector. However, the private sector will only undertake financial responsibilities if it is feasible for them to achieve return-of-investment.

The DBFM model, and other variations such as Design-Build-Finance or Design-Build-Finance-Maintain-Operate should be implemented if governments can provide the means of repaying the private investment through periodical payments, in this way the private sector achieves return-of-investment. Transferring the maintenance and/or operational responsibilities to the private sector should only be done if government agencies lack the knowledge to perform these functions themselves. These responsibilities also imply the private sector expecting higher returns.

If possible, the Build-Operate-Transfer (BOT) contract should be used over the DBFM, as it further decreases the financial burden of the government. Under BOT, the private sector enters an agreement where he develops, operate and also recovers their investment through direct user tariffs of the specific infrastructure. One of the ways the private sector can achieve return-of-investment with using this project delivery method, by charging levees to users of the service provided.

Recommendation 4. Large unforeseeable risks should not be allocated to third parties as they generally drive project costs higher

It was mentioned that the private sector is only willing to take higher risks in exchange for higher profits. Even with current practices of predicting severe weather events, they are still surrounded by high uncertainty of their occurrence, representing a large risk, a risk that the private sector should not bear, in order to keep project costs under control. By defining storm conditions in the contract, it should be established up to which point it falls in the responsibility of the private sector. Any storm higher than the specified one should be a risk for the public sector. The chances of a severe storm occurring are low, and the public sector should keep that risk and financial responsibilities, so that, the project remains financially attractive to the private sector.

Recommendation 5. Value capturing policies can be used to make use of the dispersed benefits of flood protection

One of the implementation barriers of flood protection measures was that the benefits of such asset being rather dispersed throughout a large targeted area. By using specific value capturing policies, governments can create functional taxation systems, based on the income of the population, creating additional funds for financing the maintenance and operational costs of flood protection infrastructure.

Following the example of the PCDL project, governments should support establishing national and regional level Trust Funds for financing critical infrastructure such as flood protection. These funds can potentially be financed through the government applying certain value capturing methods discussed earlier, capturing the newly created value by having stakeholders that benefit contribute to these funds. However, governments should keep in mind areas with high poverty, and should be wary when applying more than one policy, to make sure their purpose does not overlap, creating high dissatisfaction amongst the public, resulting in a decreased willingness-to-pay.

Through these funds, if successful, it can increase the attractiveness of flood protection measures towards the private sector, by showing clear means of achieving return-of investment. Value capturing policies can be a potential mean to increase the financial feasibility of flood protection measures, by showing the private sector that a steady revenue stream can be established if they would make the financial investment.

Table of Contents

1. Introduction.....	1
1.1 Background.....	1
1.1.1. Climate change	1
1.1.2. Climate adaptation measures as a response to climate change	4
1.1.3. Climate change in developing countries	6
1.2. Problem Statement	7
1.3. Research Objective.....	8
1.4. Research Boundary.....	8
1.5. Research Questions	8
1.6. Report Outline	9
1.7. Research Methodology	10
2. Research Design	11
2.1. Stakeholder analysis.....	11
2.1.1. Introduction.....	11
2.1.2. Definition	11
2.1.3. Types of stakeholder analysis.....	12
2.1.4. Limitations	13
2.2. Project delivery methods	13
2.2.1. Introduction.....	13
2.2.2. Defining Public-Private Partnerships and traditional procurement.....	15
2.2.3. Classification of project delivery methods for infrastructure	17
2.1.4. Comparison project delivery methods.....	20
2.3. Risk Management.....	22
2.3.1. Introduction.....	22
2.3.2. Definition	23
2.3.3. Risk identification	24
2.3.4. Risk associated with project delivery methods.....	24
2.3.5. Risk allocation.....	25
2.4. Value Capturing	27
2.4.1. Introduction.....	27
2.4.2. Defining value.....	28
2.4.3. Identifying who benefits.....	29
2.4.4. Types of value capturing mechanisms	29
2.5. Concluding remarks.....	33
3. Analysis method	35
3.1. Introduction.....	35
3.2. Method Description	36
4. Private financed flood protection in the UK.....	38
4.1. Introduction.....	38
4.2. Project background	38
4.3. Project description	40
4.4. Stakeholder Analysis.....	40
4.4.1 Institutional framework.....	40
4.4.2. Stakeholder identification	43

4.5. Project delivery method	48
4.5.1. Contractual arrangement	48
4.5.2. Financial Structure.....	51
4.5. Risk Management.....	52
4.5.1. Risk identification	52
4.6. Value Capturing	53
4.6.1. Used value capturing policies.....	53
4.7. Concluding remarks	55
5. Analysis of PCDL project	56
5.1. Power-versus-Interest Grid	56
5.2. Project delivery methods alternatives	57
5.3. Risk Allocation Matrix.....	60
5.4. Alternative value capturing policies	62
5.5. Applicability of value capturing for flood protection	63
6. Project evaluation	66
6.1. Conclusions of PCDL analysis.....	66
6.2. Recommendations for developing countries	67
6.3. Answering the research questions	69
6.3.1. Secondary research questions:	69
6.3.2. Main research question.....	74
6.4. Limitations and further research.....	75
References.....	76
Appendices	79
Appendix A: Project delivery methods.....	79
Appendix B: List of interviewees.....	83
Appendix C: List of questions, interview with Bart Budding of Rebel Group	84

Index of figures

1: Climate change effects	2
2: Climate mitigation vs. Climate adaptation	4
3: Research methodology.....	10
4: Power versus interest grid; source:(Eden & Ackermann, 1998)	13
5: Public and private sector service delivery spectrum; source: (Australia, 2008)	14
6: Project delivery methods classification based on private involvement and risk; source:(Canada, 2011).....	21
7: Project delivery methods classification based on integration of contract and financing ; source:(Miller, 2000)	22
8: Project delivery methods allocated risks	25
9: Classification of value capturing policies by timing when tax imposition occurs. Source: Zhao et al. (2012)	33
10: Analysis method	35
11: Location plan of Pevensey Bay frontage. source: Gilham (2000)	38
12: Typical erosion prior to improvement works; source: Thomas and Amies (2009)	39
13: Shingle replacement in Pevensey Bay. Source: http://www.pevensey-bay.co.uk/recharge.html . 40	
14: Institutional framework for UK flood management; source: Brown and Damery (2002)	42
15: PCDL Hierarchical structure.....	47
16: PCDL DBFM contract structure.....	50
17: PCDL DBFM cash flow; source: Gilham (2000)	51
18: PCDL Power-versus-Interest.....	56
19: Applicability of value capturing policies for flood protection based on development stage. Adaptation from: Zhao et al. (2012).....	65
A.1: DBB.....	79
A.2: DB.....	79
A.3: DBM.....	80
A.4: DBF	80
A.5: DBFM.....	81
A.6: DBFMO	81
A.7: BOT.....	82

Index of tables

1: Climate change effects by sector	3
2: Traditional procurement vs. PPPs; source: (Australia, 2008)	17
3: DBB Pros & Cons.....	17
3: DB Pros & Cons.....	18
5: BOT Pros & Cons.....	19
6: : Risk matrix for public/private sector of infrastructure investments; source: Grimsey and Lewis (2002)	27
7: Pros-vs-cons for DBFM PCDL project.....	60
8: Risk Allocation Matrix for PCDL.....	61
9: Values of flood protection projects. Source: CTOD (2008)	64

List of abbreviations

BOO	Build-Own-Operate
BOT	Build-Operate-Transfer
BTO	Build-Transfer-Operate
CO ₂	carbon dioxide
DB	Design-Build
DBB	Design-Bid-Build
DBF	Design-Build-Finance
DBFM	Design-Build-Finance-Maintain
DBFMO	Design-Build-finance-Maintain-Operate
DBM	Design-Build-Maintain
DBO	Design-Build-Operate
DBOM	Design-Build-Operate-Maintain
DEFRA	Department of Environment, Food and Rural Affairs
DETR	Department of Environment, Transport and the Regions
EA	Environment Agency
GPS	Global Positioning System
IDB	Internal Drainage Board
IDD	Internal Drainage District
LFDC	Local Flood Defence Committee
OECD	Organization for Economic Cooperation and Development
OM	Operation and Maintenance
PCDL	Pevensey Coastal Defence Limited
PFI	Private Finance Initiative
PPP	Public-Private Partnership
PSC	Public Sector comparator
RFDC	Regional Flood Defence Committee
ROT	Rehabilitate-Operate-Transfer
SPV	Special Purpose Vehicle
UK	United Kingdom
WB	World Bank

1.Introduction

1.1 Background

1.1.1. Climate change

Climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (R.E.UNFCCC, 1992). This definition makes a clear distinction between climate change in direct result of human activities that alter the atmospheric composition and the climate change vulnerability which occurs out of natural causes. Adaptation can be considered a policy response to climate change.

The report of the Intergovernmental Panel on Climate Change (Smit & Pilifosova, 2001) attributed climate change as a direct result of human activities such as emissions of greenhouse gases mostly CO₂. From pre-industrial levels the concentration of CO₂ increased by 30% (UNFCCC, 1992) which led to an average global temperature increase of 0.74°C (UNFCCC, 1992). In the past 25 years the rate of warming seems to have accelerated, with estimates by Smit and Pilifosova (2001) indicating that the best case scenario is an average annual temperature increase by 3°C by 2100. This temperature increase has the potential to pose a catastrophic impact on society.

In a WB (2010) report it is mentioned that even with climate mitigation or adaptation programs in more developed countries becoming more common, an expected 2°C above pre-industrial levels will be reached by 2050. This will be translated into more intense rainfall, floods and other extreme weather events. Governments and policy-makers need to take measures to reduce the vulnerability of human and natural systems in to decrease the impact of climate change effects (Smit & Pilifosova, 2001). If current problems are not addressed, it can be expected that by the end of the century, the average annual temperatures will increase between 2-7°C. These changes have the potential of causing catastrophic impacts such as inundation of 30% of the coastal wetlands (WB, 2010).

The figure below underpins only a handful of potential threats.

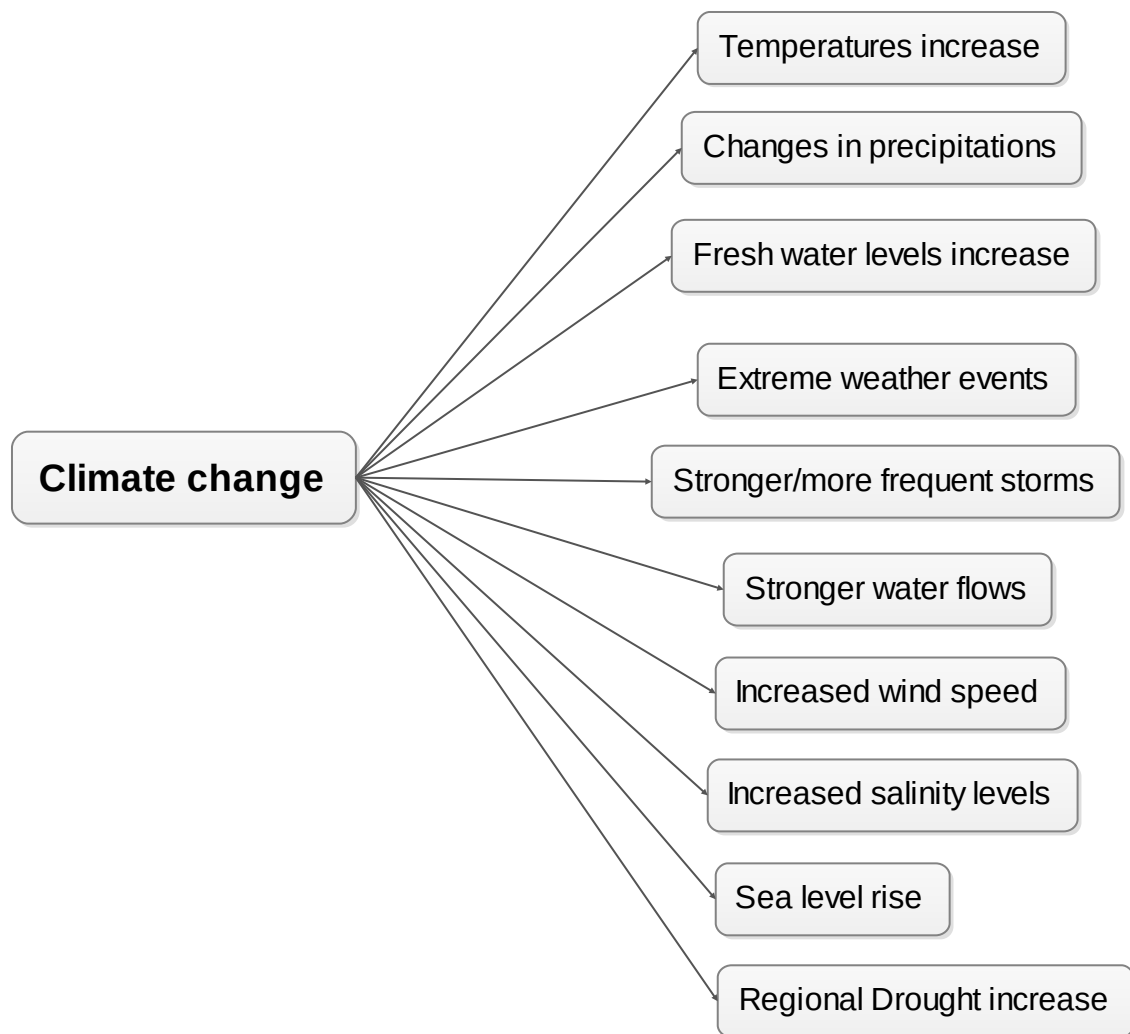


Figure 1: Climate change effects

Climate change will affect both the environment but also socio-economic and related sectors, including water resources, ecosystems, biodiversity, coastal zones and food security (UNFCCC, 1992), with an intensification of starvation, more prone in less developed regions. In combination with a potential increase of infectious diseases, less developed countries would feel the full effects of climate change.

In recent years the awareness of climate change has increased, with it not only being a potential scenario. Climate change is already here and the effects are felt by both ecosystems and the population. Developing countries are most affected, as they lack proper financial power to react to these changes, but also have strong economic dependency on climate-sensitive sectors such as water supply or agriculture (KfW, 2011).

In the table below effects on 3 infrastructure sectors are bundled in order to provide a general idea what the systems' failure would be with the coming of such climate change causes.

Climate change cause	Effect by sector		
	Road Infrastructure	Water management & flood defense	Water sanitation
Sea level rise	Flooding of structures	Breach of coastal defense systems	Increased pollution incidents,

	Erosion of foundation	- Increased risk of floods	- Mixture salt water- fresh drinking water - Mixture waste water- fresh drinking water
Temperature increase	cracks in foundation, pavement and structures	cracks in water defense systems	diminishing supplies
Increase in precipitations	- landslides - overflow of drainage systems	increased risk of floods	- reduced security of supply - increased pollution incidents
Decrease in precipitations	cracks in the foundation pavement and structures	cracks in structures	diminishing supplies
Fresh/salty water level increase	- erosion of concrete and foundation - flooding	- erosion of structures - increased risk of floods	- water treatment processes affected - reduced security of supply - increased pollution incidents
Stronger/frequent storm events	- increased risk of accidents - overflow of drainage systems	damage flood defense systems	reduced security of supply
Stronger/faster water flows	- erosion of concrete and foundation - soil foundation erosion	erosion of flood defense systems	Increased risk of fluvial flooding to wastewater
Increased wind speed	- increased risk of accidents - collapse of structures	damage flood defense systems	reduced security of supply
Increased salinity levels	erosion of concrete and foundation	erosion of flood defense systems	- diminishing supplies - water treatment processes affected - reduced security of supply - increased pollution incidents

Table 1: Climate change effects by sector

With climate change effects becoming more visible the probabilities of flooding may increase in result of combined effects of sea level rise, increased river discharges, more abundant and intense

rainfalls and stronger storm surges(Bouwer & Aerts, 2006). Climate change does not represent a potential scenario anymore, as its consequences are already visible affecting people and ecosystems around the world.

Climate change effects, besides the negative impacts they also offer some opportunities. A rise in precipitation levels can be a benefit for regions which were characterized in the past as having water shortages, boosting agricultural levels which translated in a positive impact on economy and population (KfW, 2011). However this will require close attention and control over these impacts in order to achieve a positive impact.

1.1.2. Climate adaptation measures as a response to climate change

As defined by Ryan-Collins, Ellis, and Lemma (2011) climate change effects can be addressed in two ways. Mitigation refers to early implementation of policies that lead to, for example, the reduction of greenhouse gasses. Adaptation addresses the climate change effects after their occurrence. It can come in two forms, “hard” engineering solutions, which refer to building infrastructure that is resilient to the upcoming changes in climate or adapting existing infrastructure assets to future demands. The second type of adaptation can be a “soft” non-engineering response, such as early-warning planning of flash floods and draughts or upgrading the design standards of infrastructure.

Climate adaptation is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. Adaptation to climate change has the potential to substantially reduce many of the adverse impacts of climate change and enhance beneficial impacts—though neither without cost nor without leaving residual damage(Smit & Pilifosova, 2001).

A proper response to climate change effects should be a combination between both mitigation activities such as the development of effective policies at a national level, in order to reduce greenhouse gas emissions for example, but also adaptation measures in order to cope with the physical impacts brought on by climate change.

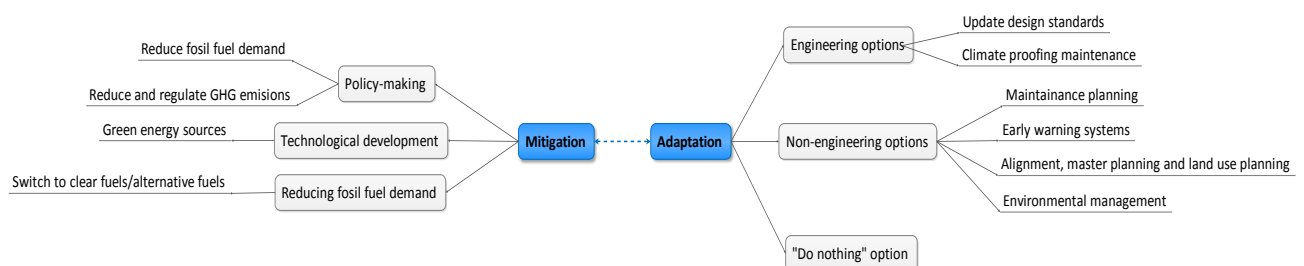


Figure 2: Climate mitigation vs. Climate adaptation

Climate adaptation can be done in two main ways: either “hard” engineering options or “soft” non-engineering ones.

“Hard” engineering options refer to updating design standards for the development of new infrastructure assets so they are prepared for climate change scenarios in a longer time span. Another way would be implementing climate proofing maintenance on existing infrastructure so that in the long-term it will be able to cope with the changing conditions of the environment.

“Soft” non-engineering solutions refer the implementation or revision of new or existing policies taking into account the effects of climate change. “Soft” adaptation can come in the form of suitable maintenance planning long-term oriented, implementing early warning systems for floods or

draughts, the alignment of the land use plan with a climate proof master plan or even environment management policies.

To get a general idea what adaptation costs are, a study entitled Economics of Adaptation to Climate Change (WB, 2010) states that the cost between 2010-2050 of adaptation to a 2°C increase in average temperatures in developing countries is in the range of 75\$ billion and 100\$ billion per year across sectors. According to the UNFCCC (1992) between 5% and 7% of this cost is represented by addressing coastal zones and river flood protection and even more pessimistic studies state that up to 25% would be required, an amount reaching 29.6\$ billion per year, only for coastal zones, according to the Commonwealth Scientific and Industrial Research Organization.

However, the implementation of **climate adaptation** measures for infrastructure hit a variety of barriers in its implementation. Infrastructure projects are, most of the time, on a large scale, requiring large financing, with governments not being able to implement them through traditional procurement methods. Another reason for the governments' inability to finance these climate adaptations, with them lending money directly from banks and procuring infrastructure in a traditional Design-Bid-Build setup, is that they are often regulated by international agencies. This leads to the need of using alternative project delivery and project financing methods, in close collaboration with a private party. With a public-private structure the technical expertise and financial power of the private sector are used. Also, with private financing, project implementation is no longer reflected on the national public debt as it is privately financed, so they can redirect the public funds elsewhere. This collaboration comes with limitations, generally the private sector not being willing to invest in innovation, such as green measures for climate adaptation, and limiting themselves traditional engineering.

1.1.3. Climate change in developing countries

Although developing countries are contributing the least to the main triggers of climate change, such as green house gas emissions, they are one of the most affected, as they lack economic and financial capacity to handle the effects attributed to climate change (Mitchell, Tanner, & Wilkinson, 2006). These developing countries are in need of financial investments in infrastructure and climate adaptation measures to cope with these changes, however, the implementation pace of such measures is not nearly what it should be. Climate adaptation requires hard measures to be implemented which involves more investments that are difficult to finance, especially in developing countries because of the lack of interest that private parties show, not being financially feasible for them.

Smit and Pilifosova (2001) in their report “Adaptation to Climate Change in the context of sustainable development and equity” summarize the key findings with regards to coastal zone climate adaptation:

- Without adaptations, the consequences of global warming and sea-level rise would be disastrous.
- Coastal adaptation entails more than just selecting one of the technical options to respond to sea-level rise, strategies can aim to protect, accommodate, or retreat. It is a complex and iterative process rather than a simple choice.
- Adaptation options are more acceptable and effective when they are incorporated into coastal zone management, disaster mitigation programs, land-use planning, and sustainable development strategies.
- Adaptation choices will be conditioned by existing policies and development objectives, requiring researchers and policymakers to work toward a commonly acceptable framework for adaptation.
- The adaptive capacity of coastal systems to perturbations is related to coastal resilience, which has morphological, ecological, and socioeconomic components. Enhancing resilience—including the technical, institutional, economic, and cultural capability to cope with impacts—is a particularly appropriate adaptive strategy given future uncertainties and the desire to maintain development opportunities.
- Coastal communities and marine-based economic sectors with either low exposure or high adaptive capacity will be least affected. Communities with less economic resources, poorer infrastructure, less developed communications and transportation systems, and weak social support systems have less access to adaptation options and are more vulnerable.

Source: (Smit & Pilifosova, 2001)

Climate effects are more ample in developing countries, which have no direct means of addressing them. They see themselves as victims to a process to which they contributed the least, considering the industrial nations responsible for acting against the resulting effects of climate change (KfW, 2011). Despite contributing the least to factors leading to a variety of climate change factors such as greenhouse gas emissions, they are likely to be the most affected by the effects for three main reasons. Firstly, the most acute climatic impacts occur at lower latitudes where developing countries happen to be located (Ryan-Collins et al., 2011). Secondly, they are most dependent on sectors such as water supply, fishing and agriculture which are the most climate sensitive, prone to

flood and changes in regional water supply (Mitchell et al., 2006). Finally, they lack proper institutional, economic and financial capacity to address the impacts and adapt (Mitchell et al., 2006).

1.2. Problem Statement

Developing countries, countries lack the financial and institutional capacity to properly deal with the effects of climate change, and most often they have economic dependencies on sectors that are climate-sensitive such as water supply, fishery or agriculture (KfW, 2011).

Flood protection is one of the sectors that developing countries fall short off due to the following considerations:

- Flood management systems, such as drainages, water storage units, river embankments and coastal dikes that offer protection against abundant rainfalls and increased debit of the water flow, are limited or missing in developing countries(Katsuhama, 2010);
- Such floods and abundant rainfall often interrupt national economic activities in developing countries (Katsuhama, 2010).;
- Hydrological and meteorological data for predictions but also early warning systems are limited or missing in developing countries (Katsuhama, 2010).;
- Implementation of flood protection measures but also institutional measures often require more time, because of financial constraints or lack of administrative capacity

Flood protection, as a climate adaptation measure, faces a number of barriers in its implementation. Gleijm and Gerdes (2012)define these barriers as cost versus benefits.

Cost wise, flood protection projects are **capital-intensive** (Gleijm & Gerdes, 2012). With basic flood defense infrastructure being underdeveloped or missing altogether, in developing countries, they are the most exposed to climate change and the effects associated with it. To bring flood defenses at an acceptable level of safety would require a significant amount of capital expenditures.

The distribution of climate change effects is not uniform. Some developing countries would experience climate changes more intense than others. This translates into project being generally **unique /non-repetitive** (Gleijm & Gerdes, 2012). Flood defense projects such as dikes or dams if implemented in country A it would mean that the same project cannot be copied and is not suitable for country B. Generally, a unique design has to be implemented for each situation, based on the potential impact that climate change will have on the specific country or region.

Benefits wise Gleijm and Gerdes (2012)defined them as being **delayed**, with the pay-back period for the investment being 25-30years, however a flood protection project may not even begin its pay-back in that timeframe, because of the inability of governments to finance such large scale projects but also the inability of the poor to pay large amounts for such a service.

The benefits are also **dispersed** (Gleijm & Gerdes, 2012), as flood protection projects cannot target specific groups or entities. The benefits will be more wide-spread, and there will always be free-riders of the benefits. Economically, this would translate into the inability to collect all payments for the service, in order to pay back for such a project. Such benefits can also be **non-financial benefits** (Gleijm & Gerdes, 2012). Generally flood protection is a service that prevents an event from happening, avoiding damage costs and possible insurance claims. These damage costs are uncertain or rather low in developing countries, so if an event does occur, the damage costs may be lower than the costs of implementing a flood protection measure. Private investors tend to focus on revenues

rather than human welfare, such factors generally not being taken into account, especially in developing countries. The implementation of a flood protection measure may not generate large revenues, but will protect societies and their population from harm. This added value to welfare is hard to monetarize in developing countries.

1.3. Research Objective

The objective of this paper is to explore additional ways of private financing projects in developing countries with regards to flood protection measures as a response to climate change, in order to increase the implementation pace of such measures.

The first step to analyzing the existing situation and generating recommendations based on other cases, is developing a suitable framework.

The analysis method will be described step-by-step on how the framework will be applied to the selected case study in order to generate key lessons

The proposed framework will be based on exploring the project delivery methods used in the Pevensey Coastal Defence project in the UK, the only known flood protection project developed under PPP worldwide. The institutional setting for the specific country will be analyzed. Contract and financial structure, risk distribution between parties will be assessed, actors and their roles will be identified.

The concept of value capturing generally used in transport infrastructure and services, will be transferred to flood protection, potentially creating new means of financing such measures, reducing the bottleneck created for the implementability of projects in developing countries.

For reaching the purpose of this research, the project delivery mechanisms and institutional settings that enabled private involvement in the implementation of the ongoing flood protection project in the UK will be analyzed, generating a set of conclusions that are key lessons on how flood protection measures can be implemented under PPP. This will give a better understanding about how was the environment created to support private financing for this type of project, understanding the dynamics behind stakeholder interaction, public agencies, laws and regulations.

Based on the conclusions, recommendations will be given on how flood protection measures could potentially be privately financed under PPP in developing countries.

1.4. Research Boundary

The result of this analysis can be applied in a number of developing and developed countries alike, but the focus of this paper is to find means of increasing the implementation pace of flood protection projects in developing countries in general, for reasons mentioned earlier.

The selection of the Pevensey Coastal Defence project is done based on it being the only available one to be analyzed where the project was successfully implemented under a PPP structure, with the private sector financing the works. Also it is the only known flood protection project developed under PPP worldwide. All data used for the analysis of this case has a public character, thus being limited to the information available.

Value capturing policies are generally used in financing transport infrastructure and services, so their application to flood protection will be based on assumptions, in an attempt to fit certain policies to match flood protection projects.

1.5. Research Questions

The research question, also present in the title of this paper will constitute the subject of research for the graduation thesis. The main goal of this paper is to assess if private financing can be possible for flood protection projects in developing countries.

Main research question:

Can private finance be made a viable option for implementing flood protection measures in developing countries?

Secondary research questions:

- *What are the main barriers that inhibit the implementation of flood protection measures in developing countries ?*
-Answered in Chapter 1

This question is answered in the Introduction part of this research paper, building up the rationale for further investigation in this matter. This question will identify the current state of implementation of climate adaptation measures in developing countries with an emphasis on flood protection.

- *What aspects should be taken into account and analyzed for generating key lessons with regards to their potential transfer to developing countries?*
-Answered in Chapter 2

Through answering this question the elements of the proposed framework will be described, through which the selected case study will be analyzed.

- *What were the factors that lead the implementation of the PCDL project under private financing?*
-Answered in Chapter 4

For answering this question, through extensive literature study, the only existing case identified where flood protection was privately financed is the Pevensey Coastal Defence. This case will be analyzed based on the described framework in order to generate valuable lessons on how flood protection projects can in fact be implemented with private finance.

- *What lessons can be drawn from the PCDL project? Can value capturing play a role in financing flood protection measures?*
-Answered in Chapter 5

This question will be answered by analyzing the findings on the PCDL project. It can be a potential mean of increasing attractiveness of the private sector towards such projects, if a steady revenue stream can be assured for them.

- *What recommendations can be given to make private financed flood protection measures in developing countries viable based on the UK example and taking different institutional settings into account ?*
-Answered in Chapter 6

This is the final stage, where an analysis of all empirical data is undertaken. The information resulted from previous questions will be used in order to formulate final recommendations for making private investments a viable way of financing flood protection projects in developing countries in general.

1.6. Report Outline

Chapter 1 presents the background, rationale behind this research and the research methodology to be used.

Chapter 2 presents the conceptual framework described in the research methodology. It describes the theories through which cases will be analyzed in order to extract key lessons.

Chapter 3 describes the analysis method to be used for the selected case study, following a step-by-step approach based on the conceptual framework described in Chapter 2.

Chapter 4 presents the first set of empirical results from studying the selected private involvement flood protection project undertaken in the UK, along with an analysis of these results based on the proposed method. This includes the description of the case, the selected project delivery method and the rationale behind it, including risk distribution. The institutional setting of the UK in general and for the specific case study are presented and value capturing policies will be tailored to fit with the existing case, assessing their potential applicability in this context.

Chapter 5 contains an analysis of the findings on the PCDL project.

Chapter 6 contains a set of conclusions that represent key lessons from the PCDL project, along with recommendations for developing countries regarding flood protection, answering the research questions to clearly show the research's results and further research that needs to be done regarding this topic.

1.7. Research Methodology

In the figure below the research methodology is presented. The research is divided into three main parts.

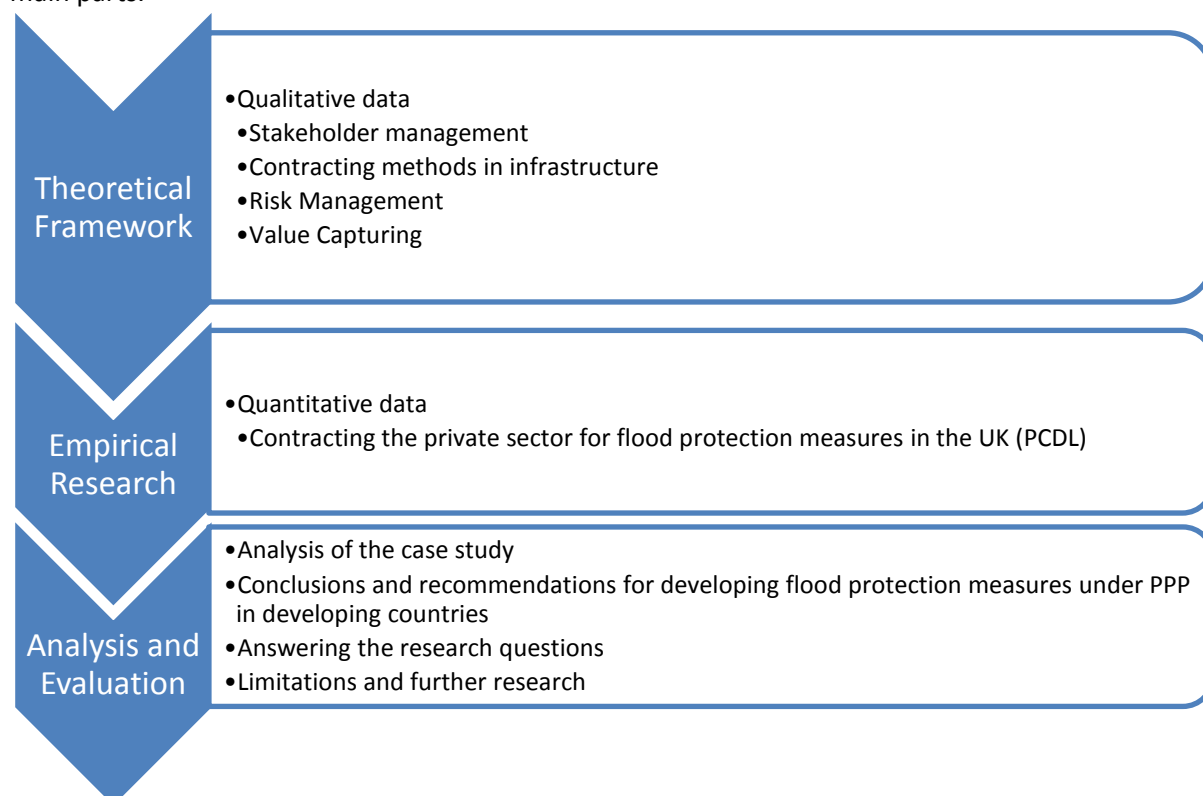


Figure 3:Research methodology

The results from the research phase of the report will be assessed in order to transfer important elements, that made the project delivery method work, to flood protection projects. Conclusions will be drawn and recommendations will be given. In the process the research questions will be answered individually to make the output of this report more clear.

2. Research Design

2.1. Stakeholder analysis

2.1.1. Introduction

In the process of any infrastructure development, numerous actors, groups and organizations come into play, all of them having different knowledge, expertise, power, interests and goals set. An emphasis on markets, participation, flexibility and deregulation all imply the need for more focused attention on a greater variety of stakeholders (Peters, 1996). The core utility of a stakeholder analysis is to manage relationships and interdependencies that form in a network of actors in order to assure that goals are achieved.

In the context of developing countries, in order to implement a project successfully, an array of stakeholders and their interests need to be taken into account. Understanding which stakeholders are directly involved in a process, their power and interest and the fact that those will vary over time is the key to assure that the implementation of a project will work. It can be used as a tool to empower and give voice to the poor, listening to their needs and linking it with the personal interests of the private sector R.E.Freeman (2010).

2.1.2. Definition

R.E. Freeman (2010) in his book *Strategic Management: A Stakeholder Approach* originally published in 1984, defined a stakeholder as any group or individual who can affect or is affected by the achievement of the organization's objectives. There are variations of the definition of stakeholder including the following:

- 'All parties who will be affected by or will affect [the organization's] strategy' (Nutt & Backoff, 1992);
- 'Any person group or organization that can place a claim on the organization's attention, resources, or output, or is affected by that output' (John M Bryson, 2011);
- 'People or small groups with the power to respond to, negotiate with, and change the strategic future of the organization' (Eden & Ackermann, 1998);
- 'Those individuals or groups who depend on the organization to fulfill their own goals and on whom, in turn, the organization depends' (Johnson, Scholes, & Whittington, 2008);

With stakeholder definitions varying, the existing literature describes the need for stakeholder support in order to create winning coalitions (Frank & Bryan, 1993), to ensure long-term viability of organizations (Eden & Ackermann, 1998) and the successful implementation of policies plans and programs (John Moore Bryson & Crosby, 1992). An emphasis on markets, participation, flexibility and deregulation all imply the need for more focused attention on a wider array of stakeholders (Peters, 1996). The need to manage relationships has become such a part of the need to govern that Feldman and Khademian (2002) assert that 'to manage is to govern'.

As a point of reference the definition of Freeman (2010) will be considered for this research as it mentions all groups or individuals, creating a more broader sense of stakeholder involvement.

Considering stakeholder involvement being so important, implementing a stakeholder analysis toolset becomes crucial for public organizations to achieve their goals. Stakeholder analyses should be undertaken because it can add valuable contributions to creating value through their function. The goal of the analyses is to help identify relevant stakeholders involved in the process, meeting the needs of key stakeholders in order to create public value and advance the common good (John M Bryson, 2004).

The stakeholder analysis will be implemented in this research through the identification of all involved actors resulting from extensive literature study, or, if information is not fully available, assumptions will be made based on available data, in an attempt to define the institutional setting for the selected case study.

2.1.3. Types of stakeholder analysis

John M Bryson (2004) has identified and collected, from existing literature, five main stakeholder identification and analysis techniques:

- The stakeholder identification process;
- The basic stakeholder analysis technique;
- Power versus interest grids;
- Stakeholder influence diagrams; and
- Participation planning matrix.

Out of the above mentioned techniques, relevant to the proposed framework and its application are the stakeholder identification process and the power versus interest grid. These two techniques will be applied to evidentiate the institutional context in which the selected project was implemented. The purpose is to indicate how a structured institutional setting supports the implementation of such project, but also it sets the background for the decision to use a specific contractual arrangement. These two techniques will be described below.

Stakeholder identification process

For implementing any stakeholder analysis tool, the identification of stakeholders in various steps based on their potential power and influence on the project is the first step.

Initiating a preliminary stakeholder analysis using either the power-interest grid, stakeholder influence diagram, participation planning matrix or any combination of them requires identifying all relevant stakeholders that have the potential of influencing the process. This step is typically 'back room' work (Eden & Ackermann, 1998) and identifies the main actors that have a stake in the process. Necessary input will be gathered through interviews, literature review, questionnaires, focus groups or other information-gathering techniques.

After the reviewing the results of the preliminary analysis, a broader array of stakeholders can be involved. All relevant stakeholders who might need to be involved, and are directly or indirectly affected to any extent, will be taken into account using the same stakeholder analysis techniques mentioned above. This step should be repeated to properly identify all actors that might be affected at some point in the process. Stakeholders are included when there are good and prudent reasons to do so, but not when their involvement is impractical, unnecessary or imprudent. Choosing who to involve, when and why is hard to determine for achieving effectiveness (John M Bryson, 2004). There is no way of escaping the need for wise and ethical judgments if public value is to be created and the common good advanced (Vickers & Vickers, 1998).

Power-versus-interest grid

The power versus interest grid is an analysis technique and is described by Eden and Ackermann (1998) as a two by two matrix where the dimensions are the stakeholder's interest with the organization or the project and the stakeholder's power to affect the future of the organization or projects. This divides stakeholders into four quadrants:

- The bottom left quadrant is defined as *'the crowd'* which consists of stakeholders that have very little interest in the project but also reduced power to influence the outcome;
- The bottom right quadrant is defined as *'the context setters'*, those who hold power but very little direct interest in the specific project;
- The top left quadrant, defined as the *'subjects'*, those who have an interest but hold little power; and
- The top right quadrant, defined as *'the players'* who generally have high interest and also high power in the process.

- The main goal of the power-versus-interest grid is to determine which stakeholders, based on their power and interest should be taken into account in order to create a functional process. It can also provide information on how to align stakeholders interests of more powerful stakeholders but also it is a mean to integrate those who lack power in the decision making process.

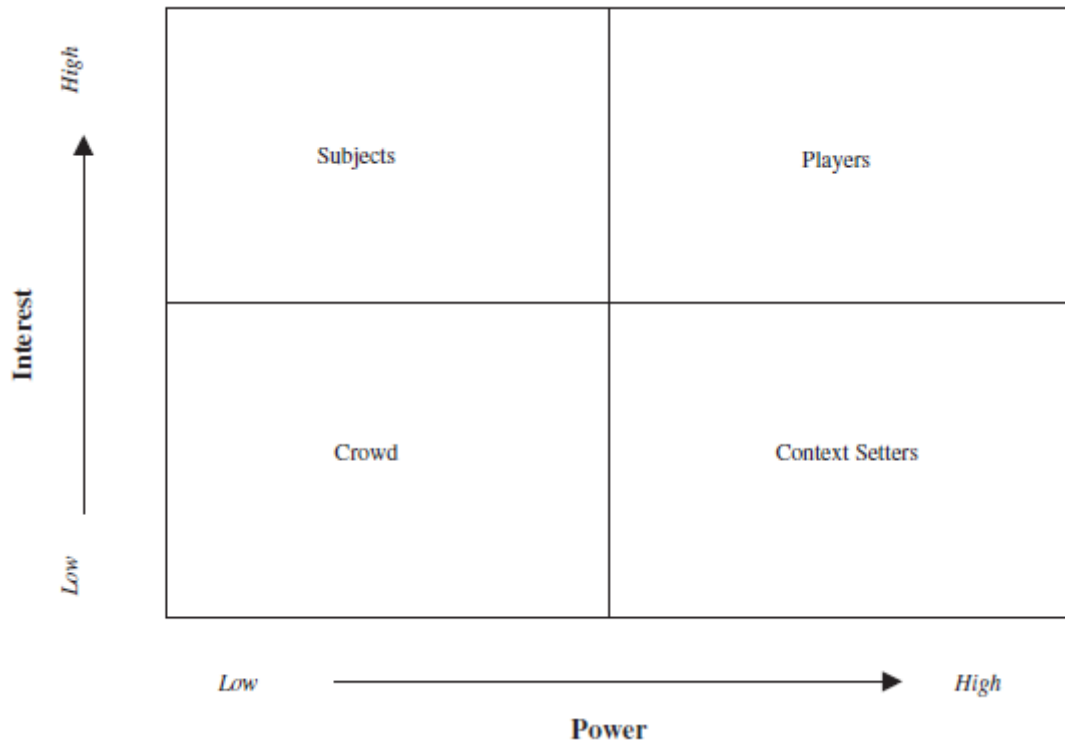


Figure 4: Power versus interest grid; source: (Eden & Ackermann, 1998)

The main goal of the power-versus-interest grid is to determine which stakeholders, based on their power and interest should be taken into account in order to create a functional process. It can also provide information on how to align stakeholders interests of more powerful stakeholders but also it is a mean to integrate those who lack power in the decision making process.

2.1.4. Limitations

One of the main limitations of stakeholder analysis tools is that real-world stakeholder networks are messy and dynamic systems. Though the implementation of such tools, structure can be given to this mess, extracting valuable lessons for formulating the problem and the interaction strategies in order to assure the implementability of a process. The information that needs to be gathered needs to come from trustworthy sources which are difficult to come by.

Generally information to perform stakeholder analysis as a process management tool comes from text analysis of available documents. It is done through careful documentation from websites, interviews, and written reports as the main data collection technique. This will undoubtedly imply a substantial amount of time and resources to be spent in order to give stakeholder analysis legitimacy. No matter how much background research is done on actors, assuring the collaboration among them creates additional challenges, with their interests continuously shifting and goals always placing personal success higher the process success..

2.2. Project delivery methods

2.2.1. Introduction

In recent years, governments worldwide face the need to provide sufficient financing for the development and maintenance of infrastructure to support economic growth. The main challenges

are meeting up the demands of increasing urbanization and the expansion of services to non-developed or under-developed regions. Also, generally infrastructure services are often provided at an operating deficit, only through subsidies can this be covered, further increasing public expenditures (Felsing, 2008).

The main challenge for governments when it comes to infrastructure development is the efficient use of scarce public resources. The public sector has few or no incentives for efficiency embedded in their organization and processes and often lacks determination or financing to efficiently build and operate infrastructure. Injecting incentives in the public sector is difficult. This is where the private sector operators intervene, entering into an investment or contracting opportunity, with their main goal being to maximize profits. Optimizing efficiency of services leads to increasing the chances of those services to be economically sustainable (Felsing, 2008).

The promotion of private involvement in the public sector is not merely motivated by the need for private investment, but rather due to the expectation that private parties will deliver projects more efficiently by having, most of the times, a larger knowledge pool for effectively managing projects. Often, infrastructure projects managed by the government resulted in long delivery times and significant budget overruns. A broad number of possibilities exist for involving the private sector in financing, development, operation and maintenance, which traditionally is the domain of the public sector.

To meet society needs, the involvement of the private sector in infrastructure development is an option that governments, in developed and developing countries alike, cannot afford to ignore. Besides additional capital, the private sector's involvement can bring a number of other benefits, from end-user benefits through creating a more competitive environment to the mobilization of private sector's knowledge and technical expertise (OECD, 2007).

As a direct result of countless experiences of private participation in developing infrastructure, a general consensus has been reached that Public-Private Partnerships can be used for as a tool to create additional or complementary value, in order to meet the infrastructure needs in a wide range of sectors from education, healthcare to water and transport (Commission & Policy, 2003).

The figure below shows where PPPs fall in the spectrum of private provision of services and infrastructure.



Figure 5: Public and private sector service delivery spectrum; source: (Australia, 2008)

The choice between using public or private provision of various infrastructure should be based in a detailed cost-benefit analysis, while taking into account all suitable alternative project delivery methods.

In the context of developing countries, the availability of public resources is even more scarce, with investments not merely reaching the need for infrastructure development. In this case, most public authorities face fiscal constraints, unable to finance vital infrastructure to a point where private financing would appear the only feasible option (OECD, 2007).

When selecting a project delivery method, sectoral differences need to be carefully taken into account. Models that involve the private sector serving the public interest might be optimal in

some infrastructure sectors but not for others (OECD, 2007). Also models can be more applicable in some countries or regions than others.

The aim of this section is providing an overview of the project delivery methods available through which the benefits of contracting the private sector can be harnessed.

2.2.2. Defining Public-Private Partnerships and traditional procurement

When trying to define a Public-Private Partnership, one has to keep in mind that there is no one general definition of what a public-private partnership is. Among a number of definitions, three are provided below.

Felsing (2008) in the Asian Development Bank PPP Handbook refers to “**public-private partnerships**” as a range of possible relationships among public and private entities in the context of infrastructure and other services. A strong PPP allocates the tasks, obligations and risks among the public and private partners in an optimal way. The public partners in a PPP setup are government entities, including ministries, departments, municipalities or state-owned enterprises. The private partners can be local or international and may include businesses or investors with technical or financial expertise relevant to the project. Increasingly, PPPs may also include nongovernmental organizations and/or community-based organizations who represent stakeholders directly affected by the project (Felsing, 2008). The shared resources of the public and private entities are blended in order to achieve a goal or a set of goals that prove mutually beneficial (WITTERS, MAROM, & STEINERT, 2012).

The OECD (2008) defines a public-private partnership as: “... *an agreement between the government and one or more private partners, which may include the operators and the financiers, according to which the private partners deliver the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partners*”.

The Australian Government (Australia, 2008) defines a PPP as “...*a long-term contract between the public and private sectors where government pays the private sector to deliver infrastructure and related services on behalf, or in support, of government’s broader service responsibilities. PPPs typically make the private sector parties who build infrastructure responsible for its condition and performance on a whole-of-life basis.*”

Traditional procurement refers to the provision of services or assets by the government. In this setting, generally, the government specifies the quality and quantity level of service, while the physical development is attributed to private companies, to whom the contract is awarded through tendering. The ownership with the asset remains with the government, with them being responsible for the operation and maintenance of the specific asset.

Both PPPs and public procurement involve the private sector to some extent. The key distinction is the distribution of risk and using risk as a tool for achieving efficiency. Types of risks and their distribution using a variety of project delivery methods will be further elaborated later in this chapter.

If properly implemented, the key features of using PPPs over traditional procurement can be:

- Faster implementation: Even with public financial constraints, assets and services can be provided through private financing;
- Reduce whole life costs: Integrating works, the design, construction, in the situation of some contracting methods, financing and operation and maintenance are all provided by one private party or consortia, controlling costs, reducing the whole life costs of an asset or project;

- Better risk division: One of the core principles of any PPP, the distribution of risk to the party most suitable to manage it. Optimizing risk transfer assures best value;
- Better incentives for performance: A proper risk distribution should offer enough incentives for the private sector to improve the overall performance;
- Better value-for-money: Through the integration of works under one party, project delivery innovation can be implemented, offering performance incentives and penalties for the service provided by the private sector;

However, implementing a project under PPP does not guarantee any of the features listed above, due diligence being required for each of them, in order to assure these features are achieved.

The table below summarizes the key differences between using traditional procurement and PPPs.

Traditional Procurement	Public-Private Partnerships
Procurement of infrastructure asset	Procurement of infrastructure service
Short-term contracts for design and construction	Integrated long term contract for design, construction, finance, operation and maintenance
Input-based specifications	Output-based specifications
Government retains asset risks	Distribution of risks
Financing done by government	Financing can be done by government, private sector or a combination of the two
Government operates asset	Operation of the asset done by either government or private sector
Multiple contracts to be managed over the whole life of the asset	One contract to be managed by the government over the whole life of the asset
Generally no performance standards	Performance standards. Incentives and penalties can be offered based on performance
Lower quality end product and service	Higher quality end product and service

Tabel 2: Traditional procurement vs. PPPs; source: (Australia, 2008)

2.2.3. Classification of project delivery methods for infrastructure

Based on the requirements of the public sector and the characteristics of the asset or service to be developed, a variety of project delivery methods can be employed¹. The main two variables that influence the selection of a certain delivery method are risk allocation and degree of private sector participation.

Design-Bid-Build

The traditional project delivery method used by the public sector in a variety of infrastructure sectors is Design-Bid-Build. Under this approach the public sector the project is divided into separate contracts. The design can be done in-house or contracted to private firms. With the design specifications set, the physical development is then contracted to the most suitable contractor through a competitive tendering process. During the construction phase, the appointed contractor and any subsequent sub-contractors will be monitored and managed by the public sector. With the completion of works, operation and maintenance is undertaken by the public sector. For this type of project delivery method financing is done fully by the public sector. This translates to most of the risks residing with the public sector.

DBB can be defined as the traditional approach prescribed by statute for delivering public owned new projects. The contracting authority either performs the design work in-house or solicits for an architectural/engineering design firm to prepare drawings and specifications under a design services contract, and then separately contracts for construction by engaging a contractor through competitive bidding also referred to as the “low-bid” method (MCBOC, 2011). This is also specified in other literature as well, such as the Canada (2011) or Commission and Policy (2003).

Pros	Cons
• Most frequently used form of contract • Longest legal history • Competitive setup	• Focus on lowest price translated into lowest quality • Difficult for scope changes

¹ For the representation of different project delivery methods please refer to Appendix A.

• Most easy to understand	• All risks stay with the owner
---------------------------	---------------------------------

Tabel 3: DBB Pros & Cons

Shifting to a more integrated approach of delivering works, towards a higher degree of private sector participation as presented in figure 5, a more evolved form of the DBB is the Design-Build.

Design-Build

For DB the public sector finances the project but integrates the design phase and construction works under one contract with a specific contractor. Through DB, the tendering duration for a project can be shortened, and the development time can be reduced with the design and construction becoming concurrent. Due to lack of technical expertise the public sector has the option of hiring a consultant to supervise the contractor in the delivery of works. Financing is fully done by the public party.

Pros	Cons
• Integration of both Design and Construction phases • Lower tendering duration • Concurrent design and construction • Both design and technical risks during construction phase transferred to the contractor	• Less control over the project • Limits competition in the tendering phase as the contract becomes more complex • More supervision required over the contractor to maintain scope

Tabel 4: DB Pros & Cons

Proceeding on the public-private delivery spectrum, the following project delivery methods fall into the definition of a PPP, having increased involvement of the private sector, up to the point of full privatization of an asset or service.

Design-Build-Operate

Design-Build-Operate is a derivative of DB, while integrating operations under the contract with the private party. Financing and maintenance are responsibilities of the public sector.

Design-Build-Maintain

An improvement of the DB, it integrates the maintenance function in the contract, as a responsibility of the private party. Financing and operation of the asset or service are functions undertaken by the public sector.

Design-Build-Operate-Maintain

Design-Build-Operate-Maintain integrate maintenance under the contract with the private sector. Financing and risks associated with it is done by the public sector.

Design-Build-Finance

Design-Build-Finance is a project delivery method through which contracts are awarded through a competitive tender process. Similar to the DB contract, DBF integrates the function of financing to the private sector. The risk associated with the design, construction and financing is thus transferred to the private sector. Upon completion, the public sector performs a one-time payment to its private partner. This payment is linked to satisfactory completion, the private sector is incentivized to complete the development under agreed quality and time-frame. After completion, operation and maintenance is undertaken by the public party, this limits the private party's incentive to take into account operational efficiency in the design and construction phases.

The main difference from the DB model is that the private partner assumes the financing risk of the asset until completion and handover. There are variations of the DBF project delivery method. One of them is Design-Build-Finance-Maintain.

Design-Build-Finance-Maintain

The Design-Build-Finance-Maintain delivery method is similar to the DBF but it integrates maintenance in the contract. The private partner is thus responsible for the design, physical development, financing the project and maintaining the asset over the contracted period of time, which can extend up to 25-30 years. With financing done by the private sector, the public sector is responsible of making periodical availability payments, based on performance. The private sector recovers the initial investment and their projected revenues over the contract duration. At the end of the prescribed long-term period, ownership is transferred back to the public sector. During the contract, operation of the asset/facility is undertaken by the public party. **Design-Build-Finance-Operate-Maintain**

The Design-Build-Finance-Operate-Maintain delivery method further advances in the private delivery spectrum in figure 4, integrating more operational responsibilities to the private sector, transferring the risks from public to private even more. The main difference between DBFOM and DBFM is the transfer of operational responsibilities and the associated risks to the private sector.

Build-Operate-Transfer

Through the Build-Operate-Transfer delivery method, the private sector also called the concessionaire is responsible for financing, design, construction operation and maintenance of an asset of the conceded period of time, after which ownership is transferred to the public sector at no costs. During ownership, the private sector is responsible to recover their initial investment and estimated profit through tariffs paid by the end-users of the service or asset.

Pros	Cons
• Integrated contract • Innovation • Reduction of public debt through private financing; • Facilitates technology transfer through international contracts; • Risk transferring to private sector	• High transaction costs; • Limits competition in the tendering phase as the contract is rather complex • Not suitable for small-scale projects • Success is dependent on the availability of finance; • Successful only if sufficient revenues are generated during operations

Tabel 5: BOT Pros & Cons

There are a number of variations of this project delivery method such as:

- **Build-Own-Operate:** ownership stays with the private sector indefinitely or for a very long period of time
- **Build-Transfer-Operate:** ownership is transferred to the public sector directly during construction; and then the private party operate under a lease contract;
- **Rehabilitate-Operate-Transfer:** method used for maintenance especially in the road sector; private party finances the rehabilitation and obtains revenues from the operation of the asset during the concession period; at the end of the period full ownership is transferred to the public sector at no additional costs;

Operation and management Contract

Gidman, Blore, Lorentzen, and Schuttenbelt (1995) stated that operation and management contracts are the simplest form of partnership between public and private parties. Under this type of

contract the private sector undertakes the operation and maintenance of an already existing asset. This enables governments to benefit from the technical expertise of the private sector. The private sector is paid through a fixed availability fee or incentive based, through which it receives premiums for achieving better quality than prescribed.

Lease / Affermage

The contractual arrangements between leasing and affermage are rather similar, the only difference between them is being technical. Under a lease agreement the private sector operating an asset will receive all revenues, making an periodic payment to the public sector. While under an affermage contract, the private and public partners share the revenues.

Leasing can be combined with concessive contract such as BOT resulting in a Build-Lease-Operate-Transfer contract or with DB resulting in a Design-Build-Lease type of project delivery method. In BLOT, the private sector receives a franchise to finance, design, build and operate an asset and, during the leasing period pays a periodical fee. The DBL is a project delivery method through which the private partner designs and develops the specific asset. After finishing works, it will operate the specific asset while paying a periodical fee to the public sector.

Partial Divestiture / Privatization

Privatization involves the sale of public-owned asset, the private party assumes full responsibilities for the it. Ownership is thus transferred indefinitely to the private sector. Through partial divestiture the public sector retains partial property of the public asset, but all of the responsibilities and associated risks of financing, design, construction, operation and maintenance belong to the private sector (Akintoye, Beck, & Hardcastle, 2003).

2.1.4. Comparison project delivery methods

With PPPs coming in many times and forms, in the previous subsection the most used methods of contracting the private sector for the delivery of infrastructure are described. The Canadian Council for Public-Private Partnerships (Canada, 2011) frames the most used project delivery methods in infrastructure based on the degree of private sector involvement and the degree of private sector risk.

The figure below is an adaptation for the project delivery methods mentioned earlier.

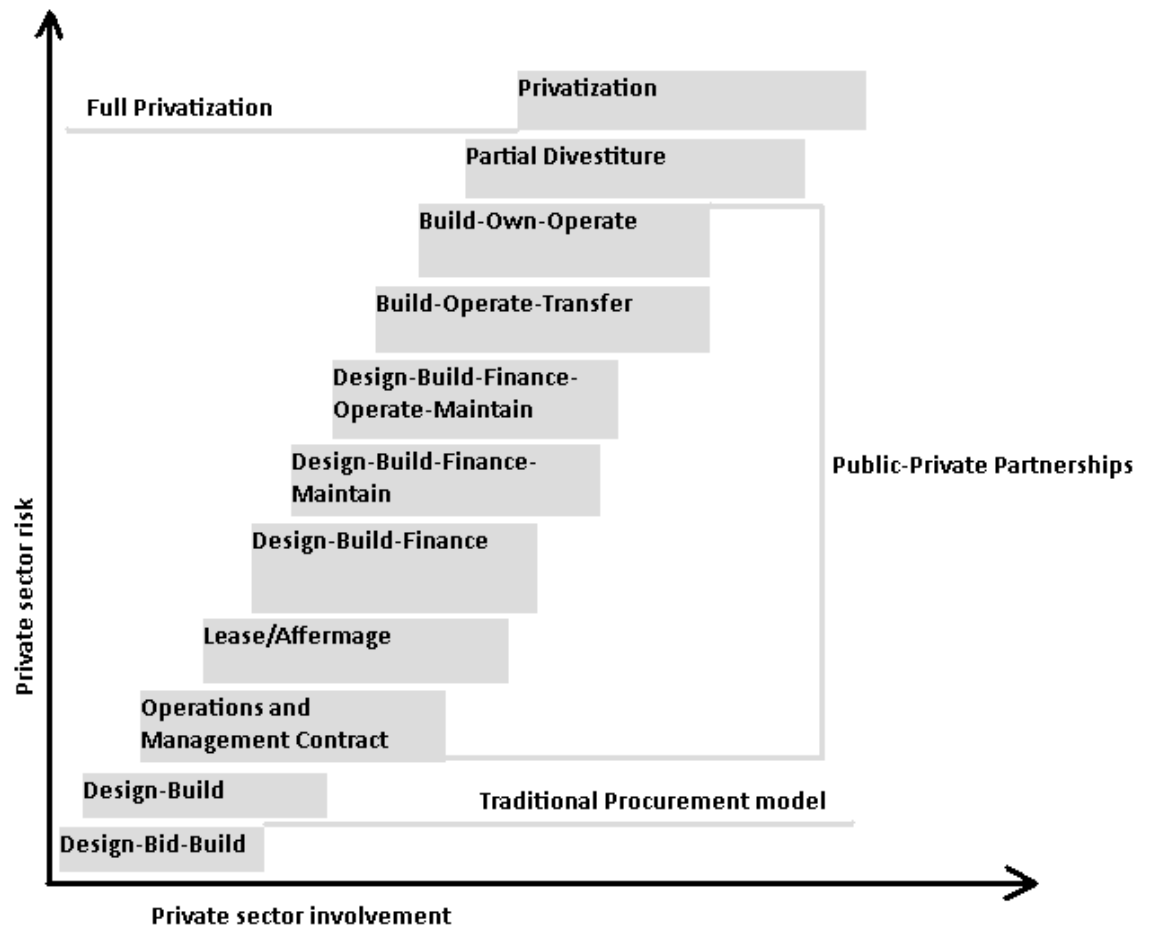


Figure 6: Project delivery methods classification based on private involvement and risk; source:(Canada, 2011)

Another way of classifying the procurement methods can be based on the degree of integration of works and source of financing. This model has been developed by Miller (2000) and has been adapted to the models described in this research.

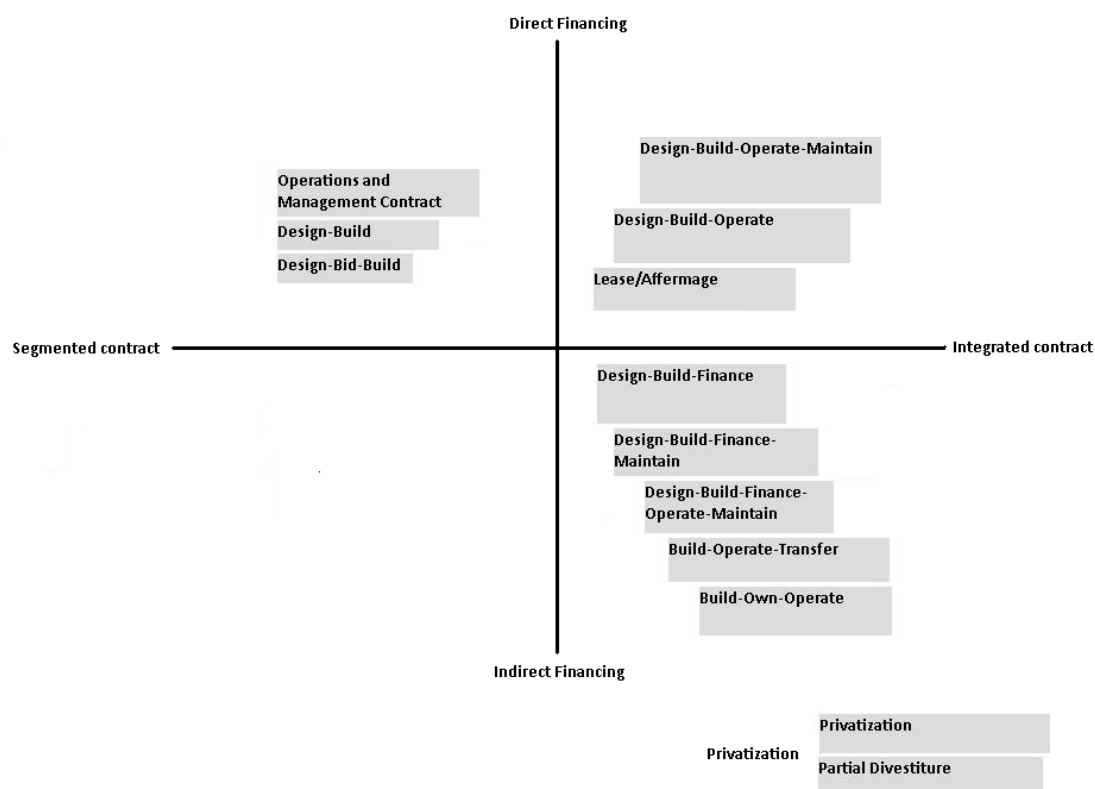


Figure 7: Project delivery methods classification based on integration of contract and financing ; source: (Miller, 2000)

The upper left quadrant contains project delivery methods that segment the contract into different works, such as design, construction, operations and maintenance. Financing is fully don't by the public sector.

The upper right quadrant shows project delivery methods that integrate all or most of the works under one contract with the public sector undertaking financing and risks associated with it.

For the bottom left quadrant there are no suitable forms of project delivery methods that can be applied to infrastructure development.

The bottom right quadrant ranks the project delivery methods that integrate works under one contract and where financing is don't partially or fully by the private sector.

Partial divestiture and full privatization do not belong to any quadrants, as the asset, Greenfield or Brownfield, full or partial ownership will fall with the private sector, all of the risks being transferred to them.

2.3. Risk Management

2.3.1. Introduction

An Important factor for the framework described above is Risk Management, being directly linked to the selected project delivery method for the implementation of a specific project. Despite having many complex risks that impact infrastructure in a negative way the private sector shows increasing interest in taking over the role traditionally belonging to the public sector in financing, developing and managing infrastructure assets.

With a varying degree of private sector involvement using different project delivery methods and also due to the size and timeframe of infrastructure projects a large range of potential risks can influence the outcome. The concept of risk involves a range of elements that are hard to control: from political risks that involve unstable governments and changes in policies and legislations,

macroeconomic risks, to technological risks, referring to the potential use of new technologies and the uncertainty associated with them (Pereira, Orenstein, & Chan, 2013).

Most common the risks associated with infrastructure projects come from the complexity of the contracting method used, in terms of design, financing, technical details, construction, etc., with the occurrence, intensity and impact of the risk altering over the duration of the project. For example, the construction phase of the project will give rise to difference risks from those during the operating phase (Grimsey & Lewis, 2002).

In the context of developing countries, proper identification of risks and distributing them to the parties most capable of managing them is the key to successfully implementing and delivering infrastructure projects. This represents a general concern for developed and developing countries alike, in the case of developing countries, risk identification and distribution representing an important way of capturing the interest of private financiers for them to invest in, showing that a project can be successfully implemented in an unstable environment such as developing countries. Private financiers and corporations are generally driven by increasing profit, balancing against risks related to the project. These two concepts are often directly correlated: investors will be willing to take higher risks in exchange for higher returns (Pereira et al., 2013).

Infrastructure projects in developing countries tend to have a high risk profile due to various factors such as unstable political environment, reduced willingness to pay for specific services but also the inability of the poor to pay for essential services such as water supply or irrigation. PPP projects are viable only if a reliable, long-term revenue stream can be established, the risk that projected revenues do not materialize is the greatest risk to the commercial viability of a project (Grimsey & Lewis, 2002).

2.3.2. Definition

A risk, as defined by the PMI (2000) is „...an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective. A risk has a cause and, if it occurs, a consequence. [...] Risk conditions could include aspects of the project environment that may contribute to project risk such as poor project management practices, or dependency on external participants that cannot be controlled.” Based on this definition, risk management can be defined as a systematic approach through which risks are identified, assessed and addressed.

For any project delivery method risks are going to exist, creating the need to manage them to an acceptable level. For example, the selection of a project delivery method can seem suitable for a high degree of involvement of the private sector, however, due to the complexity of the contractual arrangement, it may lead to an increased risk exposure by all parties involved. For example, if the financial risks are transferred to the private sector, only for the government to decrease their total financial burden, offering no proper means of helping them handle these risks, it can lead to the failure of project. Thus, it is crucial to properly identify key risks present in a project, in order to mitigate them, and efficiently distribute them among the partners most capable of handling them.

In the previous subchapter project delivery methods for the provision of infrastructure were described. They were systematically arranged based on the private sector involvement, through which private parties undertake more risks they are better able to manage than governments.

In order to allocate risks between parties, the first step is identifying them. The next section will catalogue risks in order to properly identify them.

2.3.3. Risk identification

Risk identification can support the provision of infrastructure in developing countries through facilitating the flow of local or international private capital and through the creation of favorable conditions for implementing a project.

There are various means of risk identification but Grimsey and Lewis (2002) have identified ten general risk categories that are present in any infrastructure project. These are:

- **Technical risks:** due to design and engineering failures;
- **Construction risks:** due to faulty construction techniques and cost escalation and delays in construction;
- **Operating risks:** due to higher operating and maintenance costs;
- **Revenue risks:** due to inaccurate demand projections, volatility of prices, decreased willingness-to-pay by costumers leading to revenue deficiency;
- **Financial risks:** arising from improper hedging of revenue streams and financial costs;
- **Force majeure risks:** involving wars, riots and other natural calamities;
- **Political risks:** caused by legal changes and unsupportive government policies;
- **Environmental risks:** because of adverse environmental impacts and hazards;
- **Project default:** as a result of any combination of the risks mentioned above;
- **Asset risks:** involving the termination of the contract by the government or, the residual transfer value at the end of the contract.

As mentioned earlier these risks are generally present in any infrastructure projects with their intensity varying based on the context and situation. Through proper project delivery methods revenue and market risks can be lowered.

2.3.4. Risk associated with project delivery methods

Gradually, for the project delivery methods described earlier, the private sector involvement increases, with it the associated risks. For the delivery methods mentioned the associated risks will be described based on the general risk categories described by Grimsey and Lewis (2002).

For the traditional procurement method, DBB, contracting is done segmented. The design and physical development is done with two or more contractors, which have their liabilities limited to technical and construction risks. With design and construction being integrated under one contractor in DB, he take on both technical and construction risks, increasing his liability, with the public sector undertaking the remaining risks mentioned above. In DBF financial risks are transferred to the private sector, decreasing the amount of risks undertaken by the public entity. Under DBFO and DBFMO, the operating risks are transferred to the private entity, further decreasing the risk burden of the public sector. BOT integrates the revenue related risks to the private entity.

Technical Risks	DBB DB	DBF	DBFM DBFOM	BOT
Construction Risks				
Financial Risks				
Operating Risks				
Revenue Risks				
Force majeure risks				
Political Risks				
Environmental risks				

Figure 8: Project delivery methods allocated risks

In the figure above, DBB and DB contracts transfer both the technical risks and construction risks to the contractor but under different circumstances. For DBB these two risks are transferred separately to different parties undertaking works, with DB integrating risks under one contract.

Some of the risks will inherently reside with the private sector, risk such as force majeure risks or political risks. Such risks and their occurrence will be more severe in developing countries where proper legislation and policies are poor or missing altogether. These risks should be mentioned in the contract between the public and private bodies and partially or fully be transferred to governments so that a sustainable business environment is created and the private sector finds enough reasons to invest even in riskier environments such as developing countries. Environmental risks should also be clearly specified, avoiding uncertainty in case of an event, empowering the most suitable party to handle them. Environmental risks will generally reside with both the private sector and the public sector. Events of environmental nature, besides affecting the private sector financially, would also affect the wellbeing of the population, land, or animals which are the concern of the public sector.

2.3.5. Risk allocation

At a conceptual level, under a PPP, the public sector is purchasing a service which he is paying only for a satisfactory level of service. The risks are transferred to an entity that is suitable for managing them, provided with an incentive to achieve efficiency. However, in order to achieve value-for-money, governments must decide which risks they can handle and which risks should be transferred. In order to achieve an optimal distribution there are several important rules to follow. Ng and Loosemore (2007) have mentioned that risks should be transferred to parties that:

- Are made fully aware of the risks undertaken;
- Is most suitable to manage the risk effectively and efficiently;
- Has the ability and resources to handle the risk;
- Has the motivation to undertake the risk;

- Has been given the proper incentives for taking it.

There is considerable evidence to suggest that risk transfer is often handled poorly between parties to many PPP projects and that these types of problems are rather common. For a variety of reasons parties to concession projects take on risks that they are not clear of or are not able to cope with. It would seem that all too often the distribution of risk is influenced more by economics, commercial requirements, debt financier's requirements, bargaining power and company culture and policies rather than by the principles mentioned above (Ng & Loosemore, 2007)

To achieve this, a number of standardized risk allocation matrices have been elaborated in order to provide guidance for proper risk allocation in a variety of project delivery methods. Grimsey and Lewis (2002) have developed a matrix through which a general risk identification and allocation can be done. However the main limitation of this matrix is that it is rather general with risks needed to be analyzed and managed on a project-by-project basis.

Type of risk	Source	Risk owner
Site risks		
Site conditions	Ground conditions, supporting structures	Construction contractor
Site preparation	Site redemption, tenure, pollution/discharge, obtaining permits, community liaison Pre-existing liability	Project company
Land use	Native title, cultural heritage	Government
Technical risks	Fault in tender specifications Contractor design fault	Government Design contractor
Construction risks		
Cost overrun	Inefficient work practices Changes in law, delays in approval	Construction contractor Project company
Delay in completion	Lack of coordination of contractors, failure to obtain standard planning approvals Insured force majeure events	Construction contractor Insurer
Failure to meet performance criteria	Quality shortfall Defects in construction	Construction contractor/project company
Operating risks		
Operating cost overrun	Project company request or change in practice Government change to output specifications	Project company Government
Delays or interruption in operation	Operator fault Government delays in granting approvals providing contracted inputs	Operation contractor Government

Shortfall in service quality	Operator fault Project company fault	Operation contractor Project company
Revenue risks		
Increase in input process	Breach of contract by government Breach of contract by project company	Government Project company
Changes in taxes, tariffs	Fall in revenue	Project company
Demand for output	Decreased demand	Project company
Financial risks		
Interest rates	Fluctuations with insufficient hedging	Project company or government
Inflation	Payments eroded by inflation	Project company or government
Force majeure risk	Floods, earthquakes, riots, strikes, war	Shared
Political risks		
Changes in law	Construction period Operation period	Construction contractor Project company or shared
Political interference	Breach of license Expropriation Failure to renew approvals, import restrictions, discriminatory taxes	Government Insurer or project company Government
Project default risks	Combination of risks	
Asset risks	Technical obsolescence Termination Residual transfer value	Project company Project company Government

Tabel 6: : Risk matrix for public/private sector of infrastructure investments; source: Grimsey and Lewis (2002)

2.4. Value Capturing

2.4.1. Introduction

Infrastructure development generally requires large financing and involves various forms of project delivery systems, as described earlier. An important part of infrastructure development is adopting the proper financial mechanism to assure its implementability and feasibility through the whole life-cycle, development costs but also operating costs.

There are a number of financial mechanisms through which infrastructure can be financed, however, one particular mean of generating additional financing for infrastructure that will be explored as part of the framework is value capturing.

Having identified the actors involved in a project development through actor identification, value capturing will attempt to answer three main questions, that can be indirectly found residing in the research questions:

What values are created through the implementation of an infrastructure asset ?

Who is benefits from the created value ? and

How can governments use these values in their benefit ?

LACMTA (2012) defined value capturing as the process of identifying and capturing value as a direct result from the implementation of one or more public infrastructure services. The fundamental theory behind value capturing is that any actor who benefits, directly or indirectly from a particular infrastructure or service should also contribute in paying for it. It is seen as a way to pay for capital projects as well as a potential source of income for paying ongoing operating costs (CTOD, 2008).

Value capturing is a particular method used for financing capital infrastructure, a concept mostly associated with financing transport infrastructure and services (Zhao, Iacono, Lari, & Levinson, 2012). With the development of road infrastructure or transit systems, systems such as tram lines, subways or trains, better accessibility to certain areas is provided, driving up the land values of the surroundings, creating extra value that certain actors benefit from financially.

Land value is generally determined to the availability of public goods and services associated with them. Public infrastructure, besides generating value for users, it also creates unearned revenues for land and business owners. Through value capturing, governments can identify who benefits from specific infrastructure services, allowing them to adopt targeted, specific taxes, often referred to as value-capture taxes (Rybeck, 2004). Through these specific taxes, additional financing can be created, assuring the financial feasibility of infrastructure over its whole life-cycle.

2.4.2. Defining value

The first step in applying value capture theory as part of the proposed framework is identifying the key values that reside from the implementation of an infrastructure asset. By properly identifying created values, it enables government to employ a number of strategies in order to create additional financing for the specific capital projects but also to assure that a steady revenue stream is created for the asset so that it is kept operational through the intended life-cycle. All benefits will be considered: financial, social, and environmental benefits.

For example, transportation infrastructure and services, besides the increase in land value it brings, it also has the potential to offer a number of other benefits. General benefits for transport infrastructure and services have been summarized in a report by CTOD (2008):

Environmental benefits:

- Decreased traffic congestion;
- Decreased fuel consumption;
- Improved air quality;
- Reduced risk of urban sprawl;

Financial benefits:

- Decrease in road and parking facility costs;
- Increased productivity and efficiency for companies;
- Increased property values;
- Higher revenues from property taxes;

Social Benefits:

- Increased social cohesion between communities;
- Decreased chance of traffic accidents;
- Improved transportation options;
- Decreased overall transportation costs;
- Increase of job opportunities;
- Area revitalization;

Some of these benefits summarized above accrue to the general public where some solely to private interests. Nevertheless, governments should not neglect these benefits when providing capital infrastructure. All benefits should be monetarized so that all stakeholders who share benefits, direct or indirect, should also contribute in paying for the specific asset or service.

2.4.3. Identifying who benefits

After properly identifying the values created by the implementation of infrastructure assets, it is important to understand who benefits most from the values identified previously. Knowing which actor benefits from what values will allow governments to employ certain taxation strategies so that everyone who gains from a specific project also contributes to financing it, so that a win-win-win situation is created, for society as a whole, for direct users but also local businesses or property owners, that have gains from a project.

There are three main categories of stakeholders that generally benefit from the implementation of transport infrastructure and services, as identified by Zhao et al. (2012):

- The general public, which benefits from broad economic and social returns;
- Direct users: those who benefit directly from an infrastructure asset or service;
- Property owners /local businesses: the implementation of infrastructure raises the value of the surrounding area from which they benefit;

At the broadest level, through the provision of infrastructure and services, benefits are created for the general public, as the creation or enhancement of infrastructure can lead to economic and social returns. This is the basis of the application of taxation to the general public. Taxation methods to the general public include gas taxes, vehicle sale taxes, vehicle property taxes, or general road taxes.

The direct users of the asset are the main beneficiaries when it comes to infrastructure development. Applying taxation methods to certain groups that benefit directly from a specific service is considered the main source of revenue when it comes to infrastructure development. The main taxation method to direct users is through direct user fees.

When it comes to the implementation of transport infrastructure, a restricted group of beneficiaries can be identified, stakeholders that are not direct users of the assets, but enjoy some benefits. Generally these are property owners who indirectly receive a value increase of their property and, business owners, for example a delivery company will benefit directly, if better means of transportation are made available, they will benefit from a decrease in transportation costs such as gas or man-hours required for their activities.

2.4.4. Types of value capturing mechanisms

After identifying the values that are created from the implementation of capital infrastructure, but also who are the main beneficiaries of the newly added values, a set of strategies will be explored, strategies that governments can employ so that these values are monetarized and used as an additional source of financing.

With having identified the created values and who benefits from them, Zhao et al. (2012), in his report, has identified eight value capturing strategies that are associated with transport infrastructure, but most of the identified policies also have a more general application to different types of infrastructure:

- Land value taxes;
- Tax increment financing;
- Special assessments;
- Utility fees;
- Development impact fees;
- Negotiated exactions;

- Joint development; and
- Air rights.

Land value taxes

Land value taxes are the most commonly used type of value capturing policies, used to capture the overall value created by the provision of public infrastructure. With the implementation of any capital project, property values adjacent to the asset increase. This allows governments to implement higher taxes for property so that development financing and also operational costs are covered. This can be used for a variety of infrastructure sectors, from transport, health, water utilities, education, etc.

Tax increment financing

Tax increment financing is a public finance method that makes use of taxes levied on the incremental increase in property value so that development costs but also operational costs are financed. It is most frequently used by local governments in promoting housing and economic developments (Zhao et al., 2012).

The main purpose of TIF is to encourage new developments. It captures the value of total growth in property taxes from within an established area. As it is based on the total increase in taxes generated, new developments have a much higher impact on TIF than the growth in value for existing properties. It redirects existing property taxes for new developments instead of creating additional obligations for owners. This can also be used as a way to directly subsidize private developments (CTOD, 2008).

In 2005 the state of Pennsylvania authorized the use of TIF, allowing transit agencies to cooperate with local authorities to create TIF districts around transit stops. The revenues generated this way are used for projects within the district.

Source: CTOD (2008)

The main drawback of TIF is that it redirects taxes that would be used for other purposes by local or national governments.

Special assessments

Special Assessments, also referred to in other literature as Special Assessment Districts, Benefit Assessment Districts or Local Improvement Districts (CTOD, 2008), refer to a specific area to which a special tax is applied to all who benefit from an infrastructure or service, basically land owners agreeing to tax themselves for the purpose of increasing the land value.

Generally used to finance the development of sewage, water and utility services (CTOD, 2008) but also used to finance social services such as the police, fire brigade or transport services. Any beneficiary of newly created values will then pay higher taxes for the period of the special assessment. This strategy may be used for both financing development of an asset but also the ongoing operating costs of it, assuring a steady revenue stream.

A good example of this taxation method is the New York Avenue Metrorail Station in Washington, DC where a type of special assesment district was established, a transit benefit district, used to fund 28 per cent of the total cost of a new station along the existing line. The targeted area included a significant ammount of vacant or underutilized property. Several major property owners in the area agreed to pay a Metro Benefit Fee, which involved property owners within 600 meters of the station to retire \$25 million in generaql obligation bonds, matched with funding from the Federal Transit Administration. This shows that property owners are willing to contribute to the development of transit systems, as they unlock the value of their property, by opening up an area for development where it wouldn't otherwise be possible.

Source: CTOD (2008)

This value capturing strategy works best only if targeted population acknowledges the common values created, such as safety, reduction of travel times, etc. One of the drawbacks of special assessments is that it is difficult to implement across a larger area, across district borders or even across national borders. Another drawback is that the majority of the targeted population needs to be willing to pay this type of tax, and unavoidably people who refuse, will still benefit from specific services, becoming free riders.

Utility fees

Utility fees, part of the user-pays principle, mainly address the users of a specific infrastructure, where anyone that wants to use a specific service must pay for it.

One particular application is for financing transport services, with transport being regarded as an utility like other services such as waste water treatment that are primarily financed from user charges. These fees are also referred to as transportation utility fees (CTOD, 2008).

Development impact fees

Development impact fees represent a one-time tax collected at a local level by governments for the purpose of financing new infrastructure and services in a specific region. This type of tax is calculated based on the impact the development of new infrastructure will have on the surroundings.

The city of San Francisco introduced Transit Development Impact Fees in 1981 to offset the increased operating costs of the transport services downtown. At that time the fee was \$5 per square foot of new office development. The fee was expanded to include commercial uses with fees increasing from \$8 to \$10 per square foot depending on the land use. This type of taxation generates in average \$10 million annually which have been used mainly for operating costs.

Source:CTOD (2008)

Negotiated exactions

Similar to development impact fees, the only distinction being that the level of tax to be paid is pre-set through a process of negotiation between property owners and local governments. The main use it to ensure the provision of infrastructure in high-growth, already developed areas (CTOD, 2008).

Joint development

Joint development can be defined as a real estate development project in which multiple parties are coordinated to develop sites including utilities and transit, generally on publicly owned land (CTOD, 2008). It is generally associated with the development of new areas where the public and private sectors collaborate. It may include cost-sharing, revenue-sharing or a combination of the two.

In Portland Oregon the RedLine/Airport MAX light rail extension was developed by a private entity in exchange for development rights around Cascade Station. The development company took the responsibility for repaying \$28 million in bonds for the construction of a sector of lightrail in exchange for the development rights in the surrounding 120 acres for the development of major retail and office spaces.

Source: CTOD (2008)

Air rights

Air rights is a specific form of value capture commonly associated with road and transport infrastructure. Certain types of services that are physically place above or under an area such as subways or highways may increase the land value near access points causing land developers to build at much higher densities. This translates into higher buildings being built. Governments can implement a type of taxation for certain types of buildings that go above a specified height. This enables governments to capture the value created near access points for transportation services.

The figure below frames the policies described relative to the stage in the development cycle at which tax imposition takes place.

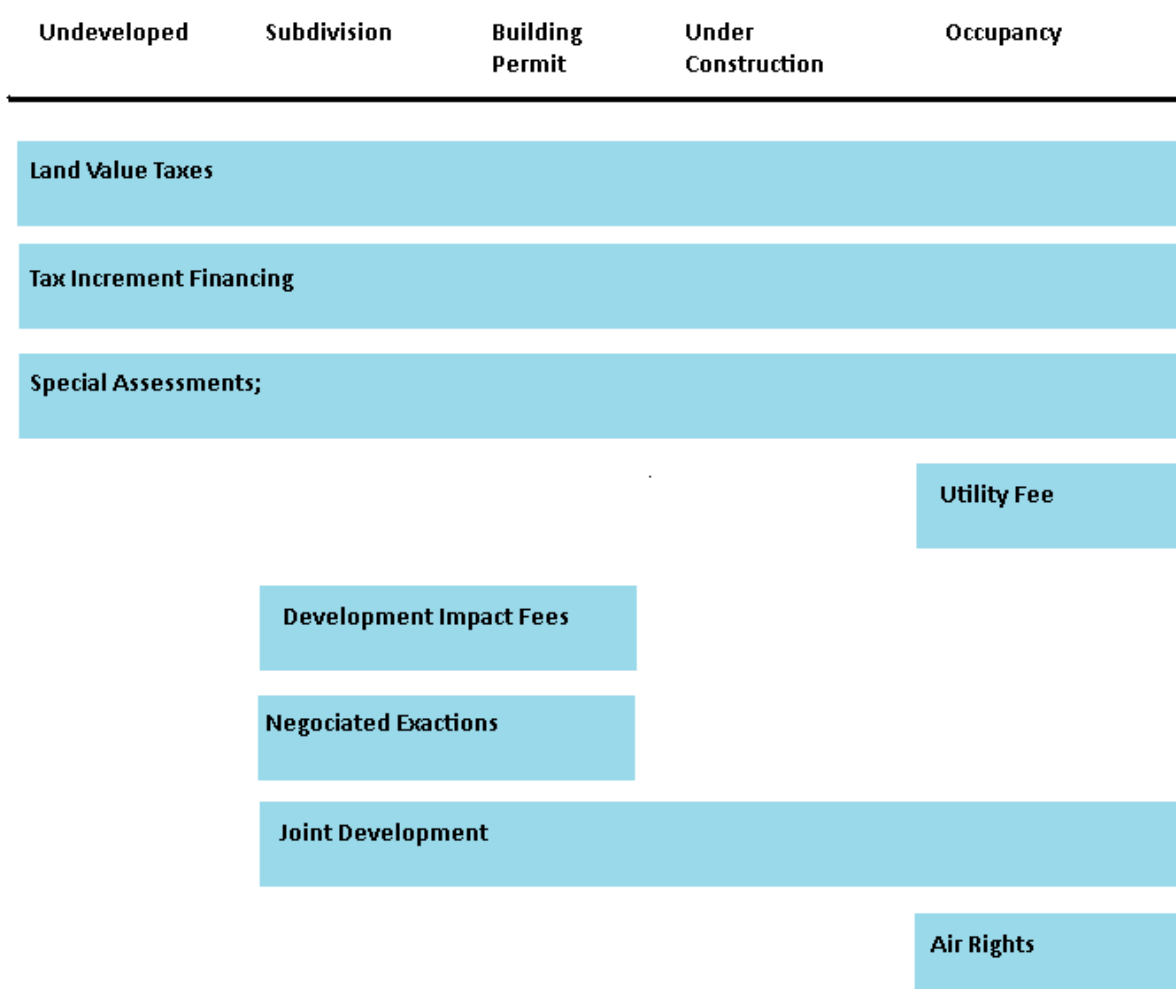


Figure 9: Classification of value capturing policies by timing when tax imposition occurs. Source: Zhao et al. (2012)

With the above-mentioned value capturing policies, they can be used in a variety of contexts and more than one can be implemented at a time. However these policies are heavily dependent on factors such as the availability of local enabling legislation, stakeholder support, willingness of districts or countries to implement value capture techniques for financing infrastructure, institutional capacity, general income of users and willingness to pay for a specific service or asset (LACMTA, 2012).

2.5. Concluding remarks

The rationale behind the proposed framework is to analyze the only identified case where flood protection measures were implemented under PPP, in an attempt to transfer the knowledge to developing countries reaching this papers goal. For flood protection projects in developing countries private financing is scarce, building up the rationale in analyzing the selected case.

Stakeholder analysis will provide the background that enabled the government to involve the private sector in flood protection. Relevant actors will be identified and described, in order to give meaning to why the government decided to involve them in the process. This will be achieved through the Stakeholder Identification Process and also, by placing them in the Power-versus-Interest grid their relevance will be underpinned.

There are numerous ways to involve the private sector in contracting infrastructure. The focus of this paper is to involve the private sector to a degree that most of the responsibilities are transferred from the government to them. This leads to the selection of a contractual arrangement under PPP. To what extent responsibilities are transferred, depends on the project delivery method used in a specific case.

Selecting a specific project delivery method also underpins how risks were identified and allocated in the specific case. The more responsibilities are transferred to the private sector, the more risks they bear, while acknowledging to what extent they are able to handle these risks.

The financial arrangement of various project delivery methods differ, through value capturing policies, new means of generating additional finance will be explored. By applying targeted taxation methods on relevant stakeholders that hold a direct benefit from the project, the government can monetarize these stakeholder benefits, in an attempt of further supporting the project financially.

The next chapter describes the analysis method used, how the elements of the framework piece together in an attempt to generate key lessons. These lessons will then be transferred to flood protection projects in developing countries, potentially increasing their implementation pace and the private sector's interest in such a sensitive topic.

3. Analysis method

3.1. Introduction

The next part of the report will bring together elements of the described framework in order to link them together, creating the rationale through which the selected case will be analyzed. For any infrastructure development, the process is complex, with interdependent variables shifting constantly, requiring an in-depth analysis. The variables were previously described as part of the framework in Chapter 2.

In this chapter, the step-by-step approach will be presented on how the variables of the framework will be used in the analysis of the case study. In the figure below these variables form the layers of the framework and are indicated based on their impact in the analysis. The layers will give depth to the case study and also establish the relevance of framework criteria when analyzing the case study.

The purpose of the proposed analysis is to generate key lessons on how flood protection projects can be implemented under PPP. To achieve this paper's goal, a set of conclusions and recommendations will be drawn based on the elements that enabled the case study to be contracted under a PPP setting, and also how could it have been further improved.

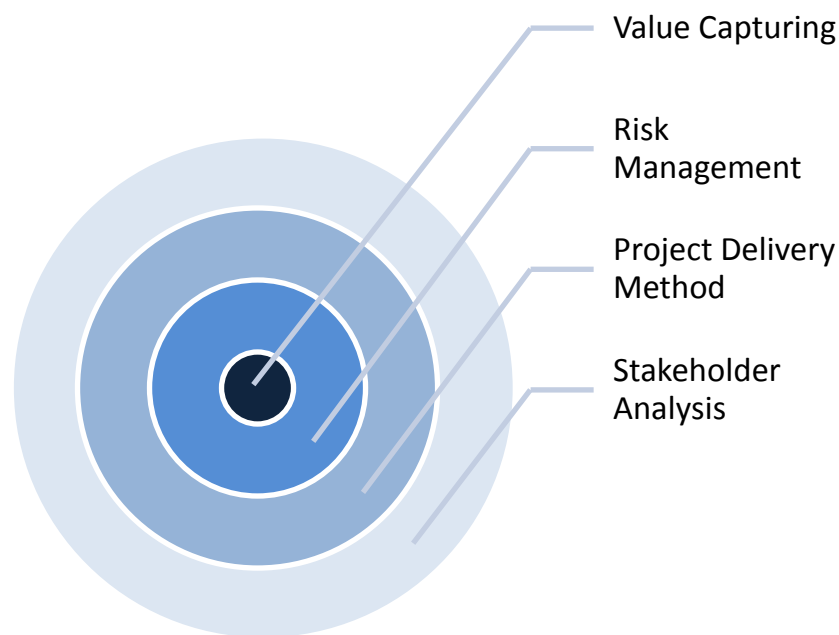


Figure 10: Analysis method

The outer layer of the method, Stakeholder Analysis, explores the setting in which the project was implemented and which stakeholders were involved at different stages of the project. Establishing their interest with the project will help understand the rationale of the government on why to involve them in the process and also to what extent. This will be shown in the Power-versus-Interest grid presented in Chapter 2. Having the main factors described, the institutional framework for the project will be outlined, to gain insight how the environment influences the implementation of complex projects, benefiting them or hindering their development.

Stakeholder Analysis will be done in two steps. Firstly, outlining the overall institutional framework of country, identifying the main governing agencies and policies regarding water management and flood protection. This will provide the background setting in which the project was developed. Going more in depth for the specific project, the second step is for relevant stakeholders

to be identified and described, in order to justify why government agencies decided to involve them and what strategies were applied.

The next layer of the analysis is Project Delivery Methods. Understanding the complex relationships between stakeholders at different stages of the project, with varying power and interest, the contractual arrangement between the government agency and the consortia is molded so that it fits specifically in the institutional setting in which it takes place. The selection of a specific project delivery method in the case study will be justified in accordance with the institutional framework for the specific country is, the contract duration, the overall structure and also the financial structure selected for the project. The reason why this will be assessed is to identify and understand how contracting flood protection PPP was made possible. Alternative project delivery methods will be compared, resulting in a list of pros and cons for the preferred method.

Going further with the analysis, Risk Management forms the second inner layer of the proposed analysis. Risk management is one of the main reasons behind selecting a contractual arrangement, identifying risks and deciding to what extent these will be transferred to the private sector. This alone, if properly implemented decides the success or failure of a project. How risks were identified and allocated for the case study will be assessed, and with the use of the Risk Allocation Matrix referenced in Chapter 2, a set of recommendations will be given on how successful Risk Management was implemented and how could it have been further improved in this specific case.

At the core of this research stand Value Capturing Policies, in an attempt to reach this papers goal of exploring additional means of financing flood protection projects in developing countries. These policies can enable the government to create additional financing for a project, by identifying actors who directly benefit for the implementation of certain projects and applying specific taxation methods based on those identified benefits. The financial structure used, outlined through analyzing the project delivery method, will be carefully looked at in order to identify if any of the mentioned policies were implemented without labeling them as Value Capturing Policies. Based on the findings, the analysis will go further by identifying if the policies used were most suitable for the specific case, or if not, what other policies could be implemented to generate additional financing successfully.

Based on the aforementioned method key lessons will be extracted out of each layer analyzed, in an attempt to understand and transfer these lessons to flood protection projects in developing countries. These key lessons will be in the form of conclusions resulted from each analyzed element, with recommendations on their potential transferability to developing countries.

3.2. Method Description

Step 1. Outlining the overall institutional framework of country, identifying the main governing agencies and policies regarding water management and flood protection. This will provide the background setting in which the project was developed.

Step 2. Identifying and describing relevant stakeholders. This is done in order to justify why government agencies involve stakeholders from different hierarchical levels in the process and what strategies were applied.

Step 3. Outlining the contractual arrangement used for the case study.

Step 4. Outlining financial structure of selected case study, further outlining the reasoning behind the selection of a specific contractual arrangement.

Step 5. Outline risk identification and allocation for the case study.

Step 6. Identifying Value Capturing policy used.

Step 7. Comparison of the selected project delivery method against alternatives. This will result in the formulation of a Pro-and-Con list on why the selected contractual arrangement is most suitable.

Step 8. Formulating the Risk Allocation Matrix for the case study, to evidentiate the role Risk Management played in the implementation of the selected case study under PPP.

Step 9. Identifying other applicable value capturing policies..

Step 10. Conclusions and recommendations for transferring findings into a different setting.

4. Private financed flood protection in the UK

4.1. Introduction

Through the framework presented in Chapter 2 the PCDL Project will be analyzed based on the method described in the previous chapter, in combination with theories on value capturing, it aims to generate lessons for implementing private financed flood protection projects in developing countries and reaching this paper's goal.

Having known only one case study where flood protection was developed through private finance, the purpose of this paper is limited to the information available. The selected case to be analyzed, is the only flood protection project developed under PPP, located in the UK: the Pevensey Bay Sea Defenses project. It is the first flood protection project under PPP worldwide using a DBFM contract for 25 years for the upgrading and maintaining coastal flood protection infrastructure, it considered a pathfinder for its kind.

In order to guarantee the accuracy of this research and produce high-quality, valuable outcomes, official documents and real data available on public agencies' websites will be used to analyze information about the selected PPP project in the UK. The next subchapters will describe the Pevensey Bay Sea Defenses Project and analyze its PPP settings.

4.2. Project background

The Pevensey Bay Sea Defence is assembled out of naturally formed shingle banks that cover a nine kilometer area between Eastbourne and Bexhill in East Sussex on the English Channel coast.

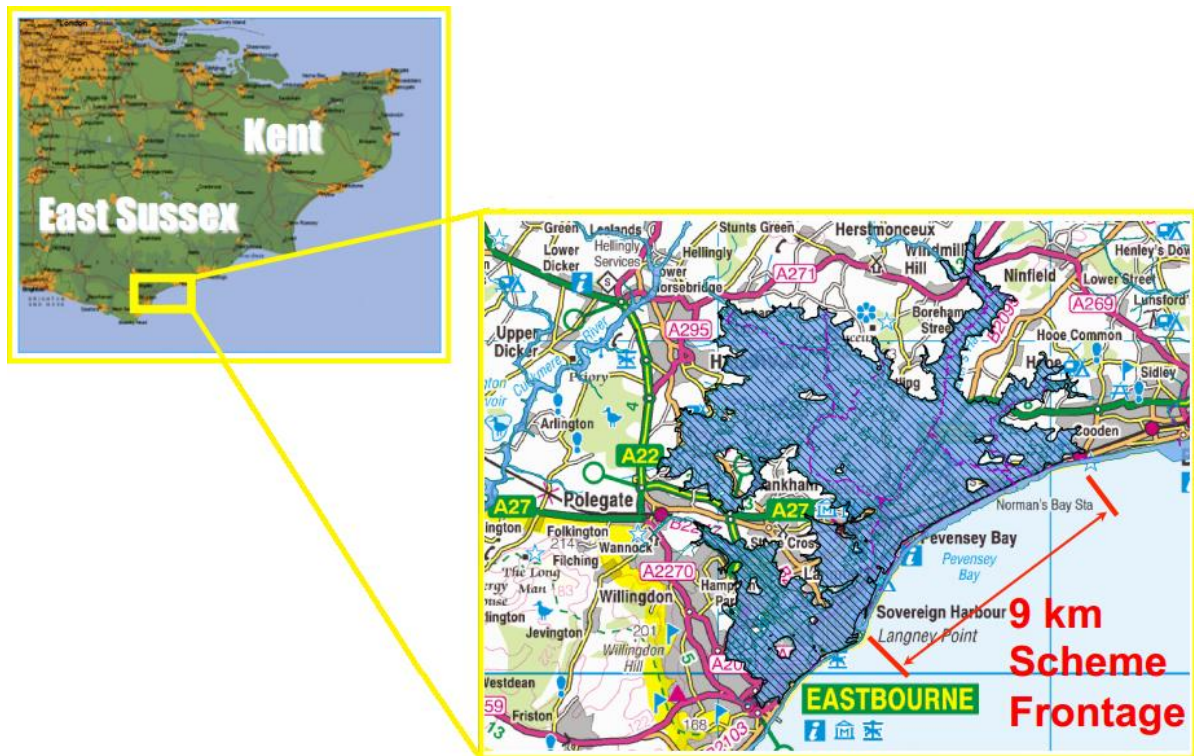


Figure 11: Location plan of Pevensey Bay frontage. source: Gilham (2000)

The shingles are supported by a timber groyne field, consisting of 150 timber groynes that reduce and dissipate the wave power, that, in the late 90s, was reaching the end its technical life. If the shingle banks would be breached, more than 50 square kilometers behind the defences would be flooded at high tide. In these 50 kilometers, over 8000 properties are situated, several caravan parks,

important road and rail infrastructure as well an important ecological site that has Ramsar Convention status, a wetland of international importance.(Thomas & Amies, 2009)



Figure 12:Typical erosion prior to improvement works; source: Thomas and Amies (2009)

Due to lack of maintenance investment the embankment narrowed because of erosion and by 1997 it was expected that a storm with a return period of 1:20 years would breach the defenses causing the earlier mentioned damage. In the figure above the typical erosion that occurred during winter is seen, this being prior to the improvement works that started as of early 2000 (Thomas & Amies, 2009).

In the UK, flood protection projects have been generally procured under DBB, with the design being done in-house using consulting engineers, and the construction works being contracted to the private sector. The maintenance is done in-house by a department of the Environmental Agency. However, Pevensey Bay was a more sensitive situation, with more than 3000 properties built right on top or behind the defences, the result of poor land-use planning (Thomas & Amies, 2009). This required a solution to a complex problem, that lead to devising a strategy on how to involve numerous affected stakeholders in the development of the project.

In the mid 90s there were various defence solutions for Pevensey Bay, from doing nothing to constructing rock islands, examined in a report by the Environmental Agency. Resulting from this report, the existing solution was reached, preventing the bay to revert back to permanent salt marshes. The selected option had to comply with strict economic limitations, that the costs of the defence should not exceed the potential flood damage to the area. The „open shingle beach” solution was the most economically feasible, other options involving large rock groyne structures, with their costs not being justified.

The initiative to contract the project under PPP/PFI was first taken in 1997 and approved in 1998, followed by a bidding process and the contract commencing as of June 2000. Due to lack of experience with flood defence projects contracted under PPP, contract preparation and tendering constituted a learning process for all parties and proved lengthy time-wise.

4.3. Project description

Under the PPP agreement the contractor is responsible for the upgrading of shingle embankments over the 9 kilometers of shoreline as well as their maintenance over a 25 year period starting the year 2000.

The project involves the distribution of 200,000 cubic meters of shingle distributed over the entire area of nine kilometers and their maintenance. The shingles are mobile under wave action, its shape altering in a matter of hours with new tidal conditions. The Environmental Agency performs aerial surveys annually to monitor the state of the beach since 1973, identifying long term trends. Since advancements of GPS technology, real-time beach surveys were performed on a monthly basis.



Figure 13: Shingle replacement in Pevensey Bay. Source: <http://www.pevensey-bay.co.uk/recharge.html>²

Resulting from the identified trends, a 1:400 year storm was defined. In order to withstand such a catastrophic event, a minimum width for shingle embankment was prescribed. In recent years the PCDL performs monitoring operations more than the Environmental Agency. Through a GPS receiver mounted on a quad bike, it allows quick mobility and surveying all along the nine kilometer shoreline every month for the last six years. Through this process, areas where work is required are identified, continuing to identify long term trends in tidal levels as well as help improve the maintenance techniques. At the moment Pevensey is the most monitored beach in the UK.

4.4. Stakeholder Analysis

4.4.1 Institutional framework

Through researching official documents and websites the institutional framework for flood management in the UK will be described in the lines below. The purpose of identifying the overall institutional framework for the UK is to outline the environment that enabled the project to be developed under a PPP agreement.

² Consulted 04-10-2013

Flood management In the UK is governed by a complex framework of institutions. Policy and operational responsibilities are fragmented among different organizations, which successfully separate the national policy for flood management from regional level to local levels. This results in clear role distribution between actors in the overall institutional framework of the country, facilitating the smooth implementation of projects. With so many hierarchical layers for flood management, it can be said that such complexity inhibits the functionality of flood management policies. However, identifying and acknowledging the role of various agencies involved in the process create a functional process in which a project can take place. The policy and operational responsibilities are highly fragmented and structured following a top down approach which efficiently separated the national policy strategy from its delivery at regional and local levels (SCA, 1998).

The framework gives clear guidelines and role distribution to create a functional system in which flood defence projects can be implemented, at a national, regional or local level, under the supervision of the most able governing body, with the overall supervision being done by the Environment Agency.

Department of Environment, Food and Rural Affairs (DEFRA)

The main institution that governs flood risk management in the UK is the Department of Environment, Food and Rural Affairs, previously known as the Ministry of Agriculture Fisheries and Food in combination with the Department of Environment, Transport and the Regions (DETR). In the context of this paper, DEFRA is responsible for the overall policies for flood and coastal defences with these policies being enacted by various operating authorizes across the country, on different hierarchical levels.

Financing flood protection projects by DEFRA comes in the form of capital grants, allocated sum for developing flood protection measures in Pevensey Bay was roughly 2 million pounds, just a small percentage of the total costs of the PCDL project. The government financing the project would involve using up the whole flood protection budget for the Sussex region. By contracting the project under PPP it allowed the government to extend the payment period for the project over the entire duration of the contract, 25 years.

The key overall objectives of DEFRA are:

- Providing efficient and cost effective national wide flood warning systems;
- Providing technically and economically sound flood protection measures;
- Discourage inappropriate development in flood prone areas.

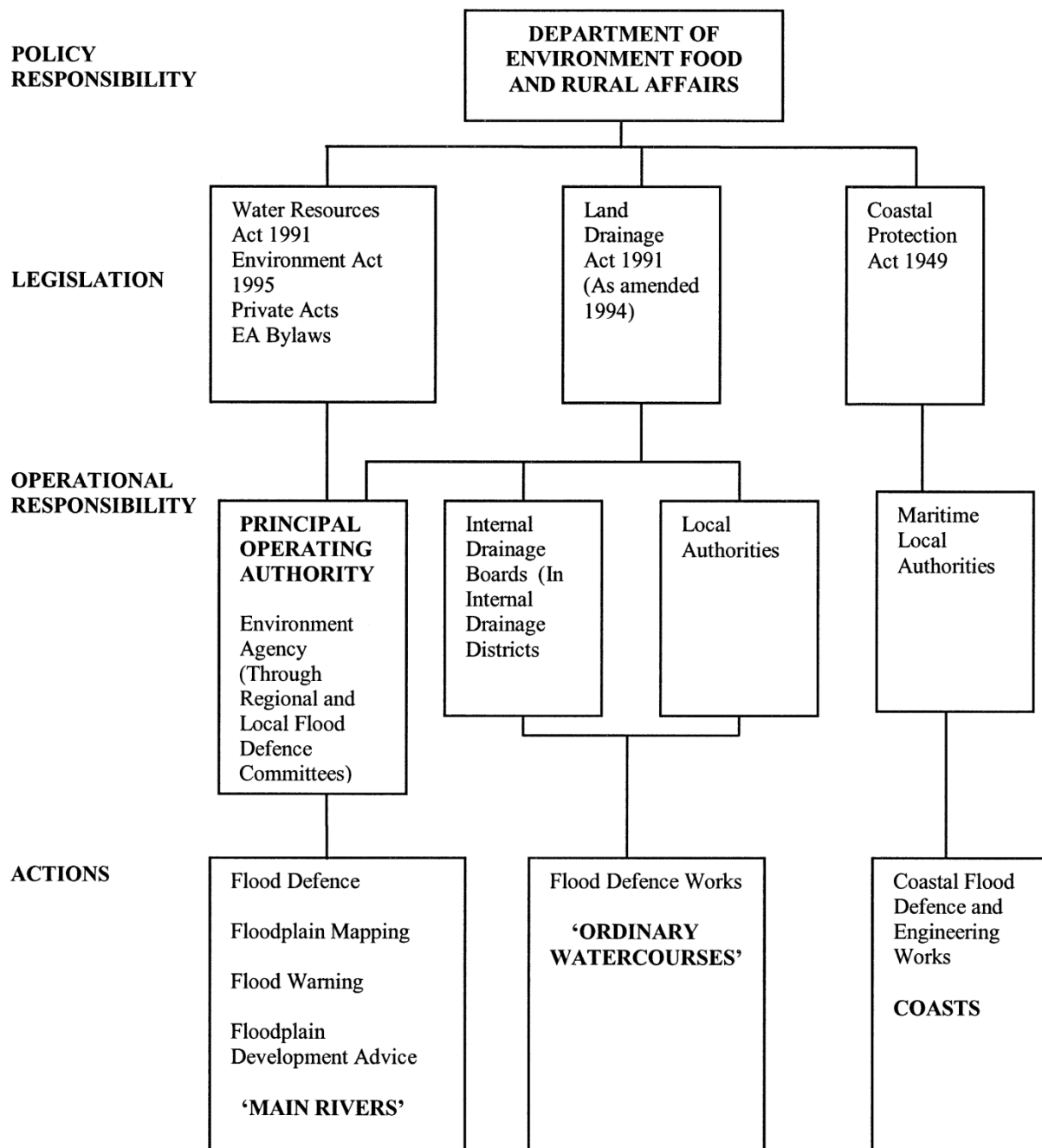


Figure 14: Institutional framework for UK flood management; source: Brown and Damery (2002)

Environment Agency

The main operating authority is the Environment Agency, a non-departmental public body of DEFRA who is directly responsible for flood management throughout the country. It supervises all works related to flood defence on the coasts and main rivers of the country. It acts as a national co-ordinator in accordance with policies and guidelines developed by DEFRA, with a strategic overview of all sources of flooding and coastal erosion, as mentioned in the Flood and Water Management Act 2010.

The EA's functions are then put in action through either **Regional Flood Defence Committees** (RFDCs) or **Local Flood Defence Committees** (LFDCs). Created under the *Environment Act 1995*, these two committees are responsible for flood defence works and raising sufficient funds for the implementation of projects at local and regional levels.

The **EA's** responsibilities are elaborated in various acts and policies and can be summarized:

- Construction works and maintenance of riverine and coastal defence assets;
- Flood and coastal erosion risk management activities;
- The identification of floodplain regions through Indicative Floodplain Maps;
- Flood warnings and administering communication channels; and
- Overseeing all upcoming planning that affects rivers and drainage countrywide.

Internal Drainage Boards

Internal Drainage Boards (IDBs) are responsible for policies overseeing the water resource management throughout the country on “ordinary watercourses”. There are a total of 235 IDBs in the UK. Each IDB operated within a predetermined jurisdiction also known as a drainage district. The boards are made up of elected members who represent the land owners, and other interest groups. They are independent public bodies that are responsible for managing land drainage, inland riverine flood defence works.

Local Authorities

Local Authorities are empowered to build flood defence works with the approval of the representing IDB. Local authorities are considered local coordinators in the Flood and Water Management act 2010 and have the following functions:

- Prepare and maintain strategies for local flood risk management in their designated areas;
- Create and maintain a register of physical assets in case of flood losses;
- Issue approvals for the replacement, altering or removal of certain flood defence structures;
- Emergency planning and recovery at a local level;

Maritime Local Authorities

Maritime Local Authorities act in coastal areas and have powers to carry out works for the protection against coastal erosion or breaching by the sea, regulated under the terms of the *Coastal Protection Act 1949*. There are a total of 88 Maritime Local Authorities at the moment in the UK. They work alongside the EA to develop and maintain coastal flood defences.

The Flood and Water Management Act 2010

In the guidelines for the Flood and Water Management Act 2010, the Environment Agency is empowered to “develop, maintain, apply and monitor a strategy for flood and coastal erosion risk management in the UK”. It places the EA in the leading role for implementing flood management projects countrywide. The Act also places regional and local authorities in a position of leadership for smaller projects, under the supervision of the EA.

4.4.2. Stakeholder identification

Following the step-by-step method described in the previous chapter, the next step in the analysis of the PCDL project is to identify and describe relevant stakeholders to the project in order to justify why the government decided to involve them in the process and also to what extent. With works being done for the entire contract period of 25 years, it was important even for low power stakeholders to be taken into account, increasing their acceptance towards the project.

One of the key features of the Pevensey Bay PPP contract was stakeholder identification and involvement. This feature allowed for a higher level of acceptance from the public, keeping various local, regional and national level stakeholders involved. This led to the public acknowledging the benefits of the project. By having an “open door” policy, it allowed the public to accept the ongoing works on the Pevensey frontage, even with works being executed during low tide which occurs in early mornings, the public acknowledged the need and success of the project. City and county

parishes where generally involved to represent the public at the lowest level of government, assuring this key feature is achieved.

From the project website all relevant stakeholders were identified, with the purpose to determine their goal, interest and power with regards to the project, and to place them in the overall institutional framework for this specific case. Mentioned earlier were three layers of stakeholders, at a local, regional and national level.

Below, all relevant stakeholders will be described as well as their goal with the project. Information from their official websites will be used for this matter.

PCDL Consortia

There are four contractors that form the SPV to develop the Pevensey Bay Coastal Defence project. They perform works under the direct supervision of the EA. The four contractors are:

Dean&Dyball Civil Engineering



A division of Balfour Beatty Regional Civil Engineering, Dean&Dyball Civil Engineering is a regional contractor that previously executed the Bulverhythe Coastal Defences in 2005, a project just east of Pevensey, in partnership with the companies that form the PCDL. It is part of the PCDL consortia, both a shareholder and a contractor, their main interest is the smooth operation of the project, in order to assure a steady revenue stream, as planned.

Mouchel Group



A national contractor with clients both in the UK and worldwide, with a history of marine engineering projects for over 100 years. Part of the PCDL consortia as a shareholder and contractor, they have particular expertise in planning and management of coastal protection projects. It shares interest with Dean&Dyball Civil Engineering.

Mackley Construction



Working on the coastline of southern England since 1928 they have been involved with coastal defences and marine civil engineering projects. Part of the PCDL consortia, they share the same interest with the other companies.

Boskalis Westminster Ltd



The largest dredging contractor in the world, it has projects in more than 50 countries around the world, their main activities are dredging and coastal protection. Established in 1933, it is the longest established dredging company in the UK today. Part of the PCDL consortia, they share the same interest with the other shareholders of the PCDL.

Local level Stakeholders

At the lowest level of the hierarchical structure governing flood protection measures in this specific project reside local level stakeholders that represent the interests of various groups. They are located at the lowest level of the hierarchy as they only serve the interest of small, isolated groups or communities. With the project being of national importance, their power is limited to the degree of influence they hold with the project.

Eastbourne Parish Council

Eastbourne is a town located west of Pevensey Bay, with the Eastbourne Parish Council overseeing the interest of the city's inhabitants, it is responsible for the governance at a local level.

Their key services include rubbish, recycling, planning applications and taxing. As the Pevensey Bay area includes part of the region under the Eastbourne Parish Council's jurisdiction, their goal with the Pevensey Bay Coastal Defence project is successful implementation of the project as well as their involvement in key decision making regarding the project.

Pevensey Parish Council

Responsible for the governance of the parish of Pevensey, the Pevensey Parish Council aims to maintain the wellbeing of the city's citizens, making sure the project is implemented in correlation with the public needs.

Rother District Council

The Rother District comprises of 29 separate parishes, with the Rother District Council representing them in local government. Among these parishes, Bexhill is included, a town located just north-east of Pevensey, with a direct opening to the Pevensey Bay. The Rother District Council, with higher power than the local Bexhill Parish Council, aims for the project to be beneficial for the citizens it looks after, making sure all decisions are in their best interest.

Wealden District Council

Pevensey Bay is located in Wealden District. Representing 35 parishes in local government, the Wealden District Council, with higher power in the government hierarchy, it represents the Pevensey Parish Council and their citizens, assuring the PCDL is in the interest of the citizens as well as them being kept involved in the development.

Eastbourne Fishermen&Boatmen Protection Society

The Eastbourne Fishermen and Boatmen Protection Society is a representative body for all afferent boat owners in the region. They oversee the best interest of their represented citizens regarding activities in the coastal region. They are directly involved in issuing dredging licenses and approvals in the Pevensey Bay areas as well as protecting the sea wildlife in the region. Their goal with the PCDL is to assure that project works do not disrupt fishing and leisure activities in the Pevensey Bay.

Sovereign Harbor Residents Association

The Sovereign Harbor Residents Association assures that residents of the Harbor in the Pevensey Bay are represented and given voice in all decisions regarding the management and development of the Sovereign Harbor. As the works for Pevensey Bay Coastal Defence directly involve the harbor, the main goal of the Sovereign Harbor Residents Association is to make sure that the implementation of the project is in correlation with the needs of the affected residents.

Regional Level Stakeholders

Regional level stakeholders oversee works executed are done according to the best interest of the region they represent. They also take into account the position of local authorities with regards to the project.

East Sussex County Council

The East Sussex County Council is a regional authority that represents five local government districts within the county: Lewes, Wealden and Rother, as well as the Eastbourne and Hastings urban areas. With higher power than local and district authorities their main goal with PCDL is to assure that the local authorities, at all government levels, are kept involved in the process.

South East Coastal Group

The South East Coastal Group brings together local and regional authorities as well as the Environment Agency and other non-governmental stakeholders to achieve strategic management of the shoreline of South East UK. Their main goal is to provide coordination, communication and offer guidance to member organizations in the management of coastal works. They have the power to undertake coastal protection and flood defence activities throughout the South East of the UK.

Sussex Flood Defence Committee

The Sussex Flood Defence Committee is responsible to oversee and authorize the Environment Agency's flood defence works in the county of Sussex. They also decide the value of the levy to be raised on the local authorities to finance flood defence works, the money being later refunded by the Central Government. The interest of the Sussex Flood Defence Committee is to reduce flood risk to local communities and infrastructure, assuring the proper implementation of the PCDL project under the guidance of the Environment Agency.

Pevensey Levels Internal Drainage Board

Initially the IDBs work was to manage water levels and reduce flood risks to communities at a local level, acting in an area called Internal Drainage District. Over the past decade the Environment Agency acted as an IDB for a number of IDD's throughout the South East UK, under the supervision of Regional Flood Defence Committees. With the Flood and Water Management Act 2010, it is mentioned that the responsibilities of the IDB should no longer be undertaken by the Environment Agency. This led to the IDB acting in the East Sussex County to be dissolved with the responsibilities being transferred to the East Sussex County Council. In doing so, it should collect a special levy on all district and local authorities within the former IDD. Part of the levy will be paid by land owners that will become responsible for carrying out and funding the maintenance of watercourses and structures inland. This will transfer the burden of maintenance to the District Council, with the East Sussex County Council responsible for enforcing and consenting.

National Level Stakeholders

At a national level the main governing body is DEFRA which aims for developing safe, sustainable solutions in the interest of the country. Under the guidance of DEFRA, the EA oversee projects are implemented in line with existing policies. The two national level stakeholders are:

DEFRA



The Department for Food, Environment and Rural Affairs is the main governmental body responsible for emergency planning in case of flooding. Their main responsibilities are to enforce a national framework and guidelines on how local, regional and national agencies should respond to flooding and also to coordinate all policies for supporting local authorities in flood defences and coastal works. Their main interest is the successful implementation of any project undertaken by the Environment Agency, assuring that it's within scope, budget and time.

Environment Agency



Part of DEFRA, it is the main enforcing public body that operates within the flood defence policies and guidelines issued by DEFRA. The Environment Agency main responsibilities were described earlier, with their overall interest being to implement flood defence project in concordance with the national framework for flood protection regulated by DEFRA. In the case of PCDL their main interest is for the consortia to deliver and maintain the works as agreed in the contractual arrangement.

With the most relevant stakeholders being described in the lines above as well as the interests with the Pevensey Coastal Defence project, Figure 27 will be further elaborated on, mapping the position of stakeholders relative to the actors in the hierarchical structure. To understand the power distribution among stakeholders in the PCDL project, the hierarchical structure of the project will be made clear in the figure below.

This will also make more clear the Power-versus-Interest grid that will be done later with the list of relevant identified stakeholders.

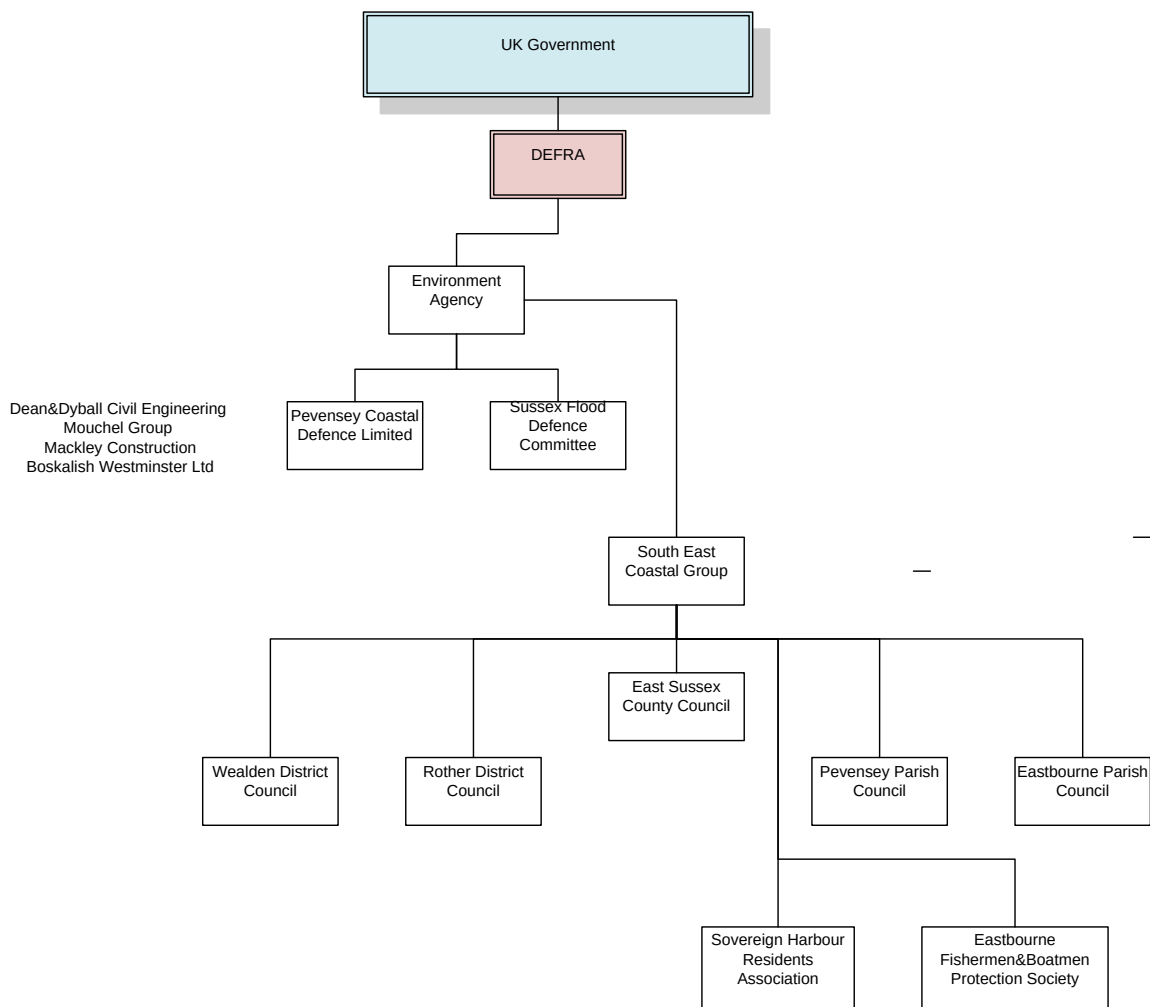


Figure 15: PCDL Hierarchical structure

The figure above is based on the overall hierarchical structure of the UK for flood protection, tailored to the PCDL project, giving a clear vision of the position of each identified stakeholder. At the bottom of the hierarchical structure reside local level stakeholders that hold limited power to how much they can influence the project.

One step higher regional level stakeholders take part in the decision making process based on the interest of the region they represent. The East Sussex County Council oversee the works executed are in accordance with the unified interest of the districts in which the project is being developed.

The South East Coastal Group represents an unification of local and regional stakeholders that interact directly with the EA, to give feedback and input on how the project is to be implemented according to the needs of the region.

The PCDL consortia develops the project under the direct supervision of the EA that performs actions based on the guidelines set by DEFRA. The role of the Sussex Flood Defence Committee is to monitor the EA actions are in line with DEFRA.

4.5. Project delivery method

After describing the background in which the project was implemented, the next step in the proposed analysis is to investigate the impact the contractual arrangement had in the implementation of the project.

4.5.1. Contractual arrangement

PPP contracts have mainly been used to deliver solid structural assets such as roads, transit systems, schools, hospitals, etc. In the case of a flood protection project there is high uncertainty surrounding it due to the site conditions changing every day of every year but also that the provided service is for something not to happen, namely, flooding. Procuring the project under traditional financing schemes would involve a combination of capital grants from DEFRA and a levy from the local authorities, with a budget of roughly 2 million pounds per year for all works in Sussex(Thomas & Amies, 2009). Upgrading and maintaining the coastal region of Pevensey under traditional procurement would have used up the entire budget. Using a PPP structure allowed the works to be done in one go, with paying for it over the period of the contract.

With the main reason for the government to contract the Pevensey Bay Coastal Defence project under PPP outlined above, out of the inability of financing a project on this scale, it lead to the decision for the government to seek alternative methods for financing. The main concern for choosing to contract under PPP was that the capital costs of the projects would end up higher than if the public sector would have secured a loan for financing it. The interest rate on the Government's loan is generally lower than the one in the open market. However this concern proved unfounded, with procuring the project under PPP, the Environment Agency saving up to 15 per cent of the total costs through proper risk management and innovative solutions used by the consortia.

Later, it was shown by the National Audit Office that the PSC method used to indicate the 15 per cent savings by contracting under PPP, was a flawed method, comparing projects using the PSC method being just an expensive way of endorsing private participation and keeping capital investments off the public balance sheet.

The Public Sector Comparator method is used to perform a quantitative comparison between a PPP project and a public sector project that would deliver the same services, in an attempt to justify the involvement of the private sector. Achieving value-for-money, the PSC method needs to

be applied following a structured approach, using standardized spread sheet models, reflecting on the decision for a project to be contracted under PPP.

For contracting this project under PPP, a call for competition notice was placed in the Official Journal of the European Community in 1997, and from all the submissions, 6 consortia were chosen to receive the Agency's pre-tender documents. By the end of that year, the number of suitable consortia was reduced to three. These three received the initial Invitation to Negotiate documents in order for them to prepare formal bids.

In order to estimate the value of the project, the EA used its own preferred strategy for the area as a reference, with the Public Sector Comparator providing an estimation of the costs if the project was to be procured using a traditional DBB contract. The process was kept transparent with all three applicants being involved. The contract was awarded to the consortia Pevensy Coastal Defence Ltd (PCDL) with a total duration of 25 years.

Developing the contract details was time-consuming and complex, but a mandatory process for setting this pathfinder form of contracting for flood protection, it was finalized and put into action in 2000.

PCDL is a special purpose vehicle created for the sole purpose of performing the Pevensy Bay contract. The Consortia did not undertake any of the work, subcontracting all functions to the four forming shareholders:

- Westminster Dredging Co. Ltd
- Dean & Dyball
- Mackley Construction
- Mouchel Group

Contracted under DBFM, the SPV was responsible for financing, designing, building and maintaining the project, with the EA overseeing the works. The figure below shows the contract structure for the 25 year period.

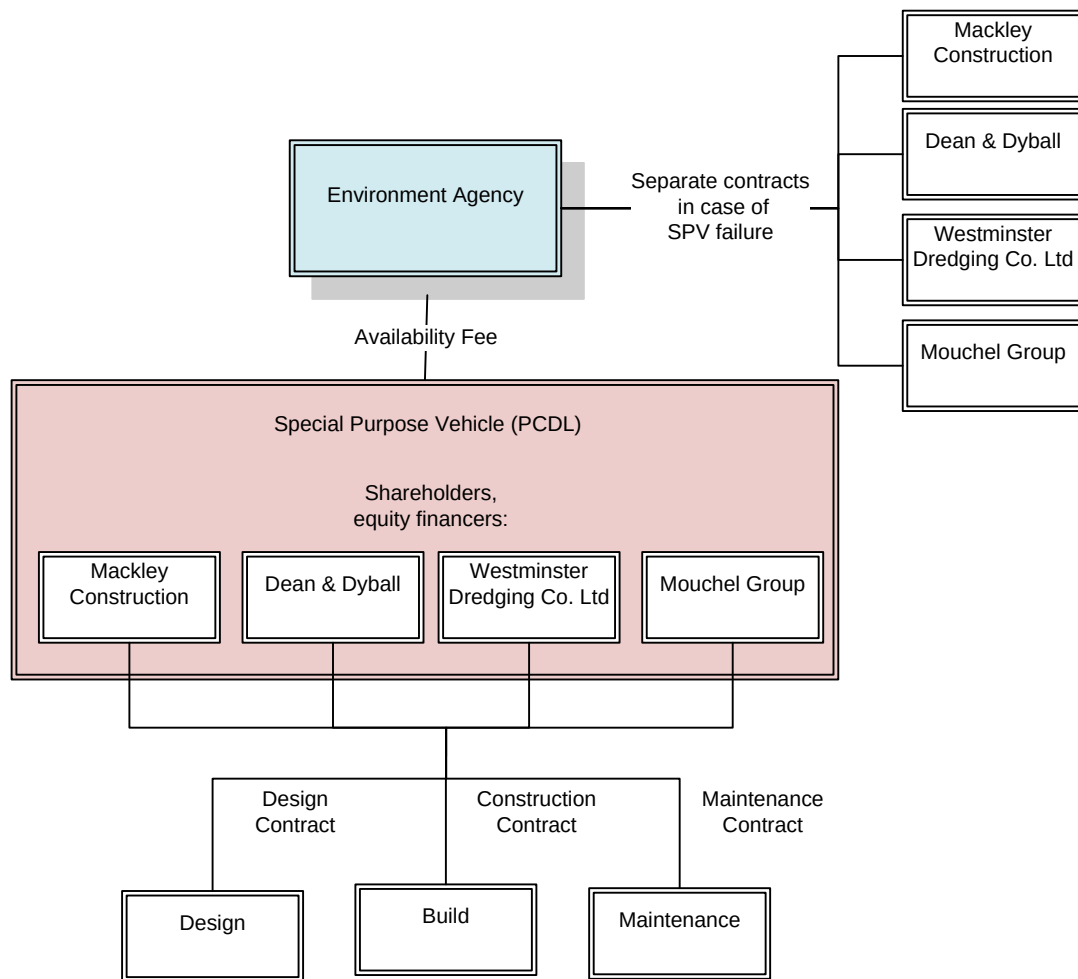


Figure 16: PCDL DBFM contract structure

The functions of designing, building and maintaining the project were all done by the four shareholders that formed PCDL. They act as contractors, each performing different services.

All shareholders have a contract with the PCDL and a similar, backup agreement with the EA, in case the PCDL fails to perform. Financing was provided by the forming shareholders, this being a one of the main features of contracting under PPP, and the PCDL consortia was the most cost effective out of the tenders submitted.

The main service procured is the provision of protection against flooding from the sea, and preventing a breach of the shingle embankments resulting of a storm with a return period of 1:400 years. A contract between two parties involves the exchange of money for goods or services, under an agreed system of measurement. Applying a PPP scheme to a flood protection project, implied that the service provided is for flooding not to happen. More than 99% of the specified duration of 25 years, the shingle embankments will not be tested, so specifying system conditions early in the contract was necessary, along with showing physical evidence of service provision.

The key issues addressed in the Pevensy Bay PPP contract are:

- Service definition and measurement for to give clear guidelines regarding the services to be provided by the SPV;
- Defining the key physical features of the flood defense;
- Risk identification and proper allocation between parties, so it is handled by the most suitable one;
- Stakeholder identification and involvement.

For loss of shingle as a result of a storm the PCDL bears the risk of replacing the shingles for a storm with a return of 1:50 years. For a storm between 1:50 and 1:400 the financial risks of replacing the lost shingle would be divided between PCDL and the EA, where for a storm with a return period of 1:400 or more the EA bears the risk.

Defining the key physical features of the Pevensey frontage stands at the basis of the payment mechanism used by the EA towards the PCDL. The core requirements for the PCDL contract were the distribution of roughly 2 million cubic meters of shingle to be distributed over the 9km frontage and that the shingle bank should have a minimum width of 22m at its crest.

4.5.2. Financial Structure

With the project being financed by the consortia, the Environmental Agency was responsible for making yearly payments to the SPV in the form of an availability fee. Using a progressive points and deduction system under the contract, it motivated the Contractor to maintain the prescribed key physical features at all times. The figure below presents the orientative cash-flow for the entire duration of the DBFM contract.

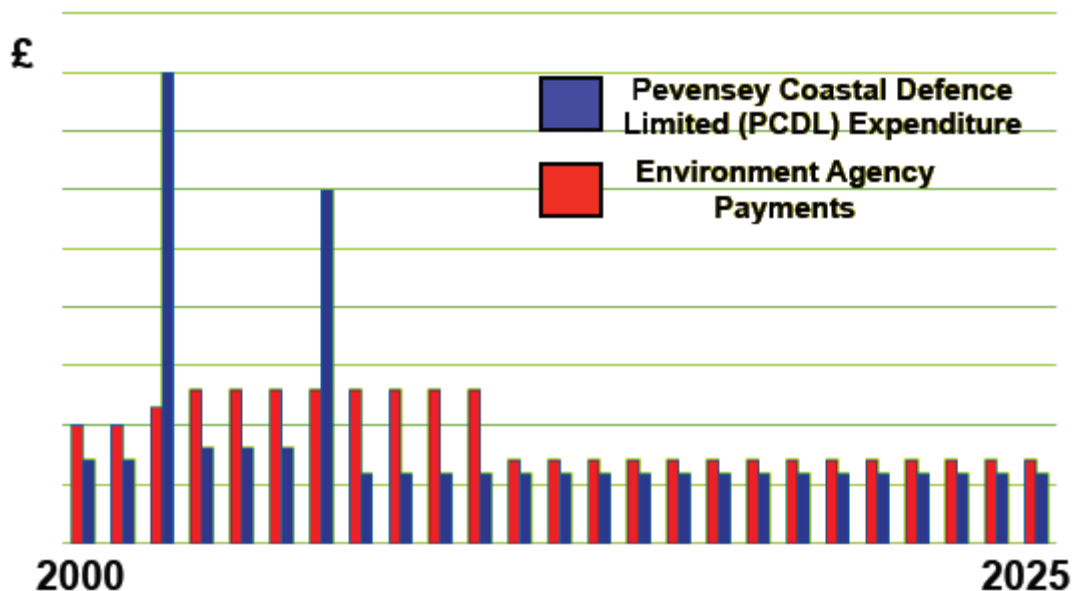


Figure 17: PCDL DBFM cash flow; source: Gilham (2000)

The total value of the project, indexed as of 2000, when the contract commenced was £30 million, with the current value of the contract, as of January 2013 £39 million, as a result of additional works executed under unforeseen storm conditions.

Through implementing the project under a DBFM agreement, the EA transferred the financial responsibilities and associated risks to the PCDL consortia. With the government not being able to fully finance a project on this scale, it allowed the private sector to develop the project and through performing annual payments to the consortia, it assured the feasibility of flood protection being developed under PPP. This allowed the EA to pay for the project over the extended contract duration instead of performing a onetime payment for the asset.

In the figure above it is shown that the EA performs annuity payments starting from year 1, higher in the first seven years, with all major works being executed during that time period. After that the payments are lowered based on the performance of the implemented measures.

Out of the total value of the project, an annual contribution of £200,000 is paid by residents to a Trust governed by the EA. The current value of the Trust is just short under £5 million. (Tanis & Vergeer, 2008). Even if through this tax the full expenses are not covered, it indicates that specific

taxes can potentially be implemented for flood protection measures, contributing to the periodical payments done by the EA.

This trust was established for the maintenance of the environment in Sovereign Harbor and it aims to supplement the incurring costs of maintaining the shoreline of Pevensey Bay. It is financed through a tax applied to all residents of the Sovereign Harbor. The total number of properties liable to pay the tax is around 3000 according to the Sovereign Harbor Association website. It is applicable to all residential properties at the Sovereign Harbor.

4.5. Risk Management

One of the key factors that lead to the decision to contract the project under a DBFM arrangement was risk identification and distribution between the consortia and the EA. As mentioned earlier, the more functions are integrated in the contract for the private sector, the more detailed the risk identification is.

Flood protection measures are generally surrounded by high uncertainty about the occurrence of a storm event, as it only relies solely on predicaments and forecasting. This translates into higher risks than in other infrastructure project. A clear definition of project risks and proper allocation would be the only mean to render the project attractive for the private sector.

4.5.1. Risk identification

Risk identification is an iterative process that should be commenced early before the implementation phase of the project, but should also be done regularly to identify new emerging risks in order to develop certain actions on how to reduce or mitigate them. In order for developing such actions the first step in this matter is to properly identify the risks.

This will be done using the ten general risk categories described by Grimsey and Lewis (2002). These risk categories are present in any infrastructure project, with a varying intensity based on context and situation. In this situation they will be described for the PCDL project. In Chapter 2 these risk categories were described. They are: technical risks, construction risks, operating risks, revenue risks, financial risks, force majeure risks, political risks, environmental risks, project default and asset risks. For these risk categories will be elaborated on for the PCDL case to further justify the selection of DBFM as the preferred project delivery method but also to outline the risk identification as one of the key features of the aforementioned contract.

For the Pevensey Bay Coastal Defence project, through researching official documents and the project website the risks taken into account through the DBFM contract. In general under DBFM, the technical, construction, operating, and financial risks are transferred to the private sector, with the revenue risks being limited only by the performance of the PCDL under agreed technical standards. In the following lines project risks for the PCDL will be identified according to the risk categories mentioned. These are all official identified risks from official documents.

Technical risks

- Unforeseen ground conditions, that require additional work;
- Impact to project area as a result of works outside the project area;
- Performance of the design against agreed weather standards;
- Changes instructed by the Environmental Agency.

Construction risks

- Additional works as a result of errors or required changes in design standards
- Shortcoming of contractors;
- Delays due to unavailable construction materials.

Operating risks

- Shingle movement;
- Completion of works within costs and time;
- All operational matters including health and safety;
- Provision of emergency storm response;
- Liability to third parties;
- Reinstallment costs for the loss of shingle as a result of a storm up to 1:50 return period;
- Reinstallment costs for the loss of shingle as a result of a storm between 1:50 and 1:400 return period;
- Reinstallment costs for the loss of shingle as a result of a storm with 1:400 return period or more.

Revenue risks

- Shortcoming of contractor to deliver and maintain key physical features.

Financial risks

- Costs for procuring all the materials.

Political risks

- Acceptable Environmental Statement;
- All statutory approvals;
- Changes in law or governmental policies regarding flood defence.

Asset risks

- Technical obsolescence of solution implemented;
- Termination of contract.

4.6. Value Capturing

In pursuing this paper's goal of finding alternative means of financing flood protection measures developing countries, the identification and suitability of value capturing policies stand at the core of the analysis as it can be an additional mean for the government to generate financing for the project by applying targeted taxes to end users and the main beneficiaries.

Having the main stakeholders identified, the next step in the analysis method described in the previous chapter is to identify if any taxation methods were used for stakeholders that benefited from the implementation of Pevensey Bay Coastal Defence project, and if it can relate to any of the described value capturing policies.

4.6.1. Used value capturing policies

It was mentioned that out of the total value of £39 million as of January 2013, an amount that totaled around £5 million was from a trust entitled the Sovereign Harbor Trust. Established in 1988³, the Sovereign Harbor Trust is a charity trust set up in order to protect the environment on the shoreline in front of Sovereign Harbor. Through the trust, the local authorities collect money for financing coastal defence activities on the frontage of the Sovereign Harbor.

According to the trust website⁴, the objectives of the established trust are:

- Promoting charitable actions for the benefit of the Sovereign Harbor community;
- Maintaining the environment in the frontage of Sovereign Harbor, Eastbourne, East Sussex;

³ http://www.sovereignharbourtrust.co.uk/estate_rent_charge.asp

⁴ http://www.sovereignharbourtrust.co.uk/mission_statement.asp

- Preserving the natural features of the land that hold ecological and educational value;
- Providing maintenance of recreational facilities for the benefit of the targeted community;
- Providing flood defence measures of the frontage of Sovereign Harbor;

The trust was initially established in 1988, in an agreement with a harbor developing company entitled Tarmac for the purpose of providing sea defence services in front of the 3,000 houses that the company was intending to build as part of the development of the area. The responsibility of bringing sea defences up to the standards of the EA were initially paid for Tarmac and the Trust. After completion of works, the EA took over and integrated the Sovereign Harbor frontage in the PCDL agreement to further provide sea defence services. Currently the Trust is the only out of the two that stays in effect and through it an annual contribution of £200,000 to the EA it contributes to the total costs maintenance of the shoreline.

Joint Development

Between 1988-2001, the housing developer Tarmac was interested in developing residential properties along the Sovereign Harbor, with the EA successfully implementing what can be identified as a value capturing policy. In order to develop 3,000 property just behind the frontage in the Sovereign Harbor area, the housing developer Tarmac was required to also develop the flood protection measures for the targeted area.

Through joint development, the private sector enters into an agreement with government to develop new areas, while also providing specific services for that specific area. The collaboration between the public and private sector includes cost and revenue sharing. The costs for developing and maintaining the flood defences, before the region was integrated in the PCDL project, were co financed with the earlier mentioned Trust. As of 2001, the Sovereign Harbor was included in the PCDL project for the consortia to provide flood defence measures, with only the Trust still in place.

Special assessments

The tax levied for the trust can be identified as a Special Assessment tax. Through using this policy it allows the creation of what is called Special Assessment Districts, referring to a specific targeted area where a tax is applied.

The Special Assessment District targeted all residents of the Sovereign Harbor. They hold a direct interest in the development of the project as it protects them against flooding. Having the population acknowledge the need for maintaining both the flood defences and the marina, the residents agreed to be taxated for generating additional funding in this matter. The benefits of the flood defence are taxated by local authorities, and divided into three parts.

Through the SW Charge, homeowners voluntarily agreed for this tax to be applied to their property, with the aim to maintain and improve the beach and sea defences in the Sovereign Harbor. Initially set up in 1988, the scope of this specific tax towards the Trust is for raising sufficient funding for maintaining the flood defences and beach functions. The current yearly value of the tax is £151.52⁵. This level of tax was agreed upon in collaboration with the home and land owners that benefit from the flood defence measures in Sovereign Harbor.

The Marina Charge which is a tax that covers the repair and maintenance of the Harbor afferent waterways. Not part of the initial Trust agreement, it was set up in 2006, the Marina Charge is an imposed tax by local authorities that targets around 3000 properties in the Sovereign Harbor Marina.

^{5 6} http://www.sovereignharbourtrust.co.uk/estate_rent_charge.asp

The additional funds raised are used for direct Harbor maintenance. The current yearly value of the Marina Charge equals to £50.73⁶.

The Berth Charge targeted homeowners that are not subjected to the earlier mentioned Marina charge. Owners of berths, also known as floating houses are not imposed to pay any land taxes. This tax allowed a separate group of marina users to be charged, and contribute to the established Trust.

4.7. Concluding remarks

The Pevensey Coastal Defence Project is the only known project that was implemented through a PPP scheme with the private sector financing it. It was selected on the basis that it is the only known one but also due to the overall success of the ongoing process that started in 2000.

The institutional framework for flood protection in the UK, even though complex, it has a top-down hierarchical approach, clearly defining regulating agencies and enforcing authorities. Under the main regulating public body, DEFRA, the Environment Agency serves as the main enforcing authority that oversees all flood protection works throughout the UK.

The project involves protecting against flooding of nine kilometers of coast with an opening to the Pevensey Bay, between the city of Eastbourne in the West and Bexill in the East. The project consists of shingles supported on 150 timber groynes distributed along the coast with the purpose of reducing and dissipating the wave power, decreasing flood risks.

Generally, flood protection projects are procured under DBB in the UK, but Pevensey Bay was a more sensitive situation, with various groups of stakeholders being directly affected by the works that needed to be executed. When the project was initiated, the Environment Agency sought after a solution for preventing the increasing flood risk in the region. Due to strict economic limitations, it choose to develop the project under a PPP scheme, the first of its kind worldwide, later, due to its success, becoming a “pathfinder” project.

Contracted under a DBFM agreement, with a duration of 25 years of operation and maintenance, the project requires frequent surveys by the Environment Agency to assure the correct implementation. The main service provided was for something not to happen, flooding. The initiation phase of the project represented an extensive learning process for all stakeholders, preparing the contract and tendering. Allowing the private sector to develop their in-house solutions lead to the use of new, innovative solutions to achieve the goals, resulting in significant savings. The key features of the Pevensey Bay PPP contract, that made the project to be considered successful were:

- Service definition and measurement for to give clear guidelines regarding the services to be provided by the SPV;
- Defining the key physical features of the flood defense;
- Risk identification and proper allocation between parties, so it is handled by the most suitable one;
- Stakeholder identification and involvement.

Among a variety of taxation methods applied in the UK, two of them were identified to be value capturing policies through which it allowed the EA to generate additional financing for the annuity payments to be executed towards the SPV. This shows that even with flood protection measures not generating any revenues, the government can deploy specific strategies for co financing flood defences developed under PPP.

5. Analysis of PCDL project

5.1. Power-versus-Interest Grid

Having described the interests of all relevant stakeholders and drawing up both the institutional framework of the UK and the hierarchical structure of the PCDL project, the next step of the stakeholder analysis is to apply the Power-versus-Interest grid, part of the method described in Chapter 3.

The purpose of the Power-versus-Interest grid drawn above is to point out the rationale behind involving specific stakeholders in the development of the PCDL by the operating authorities.

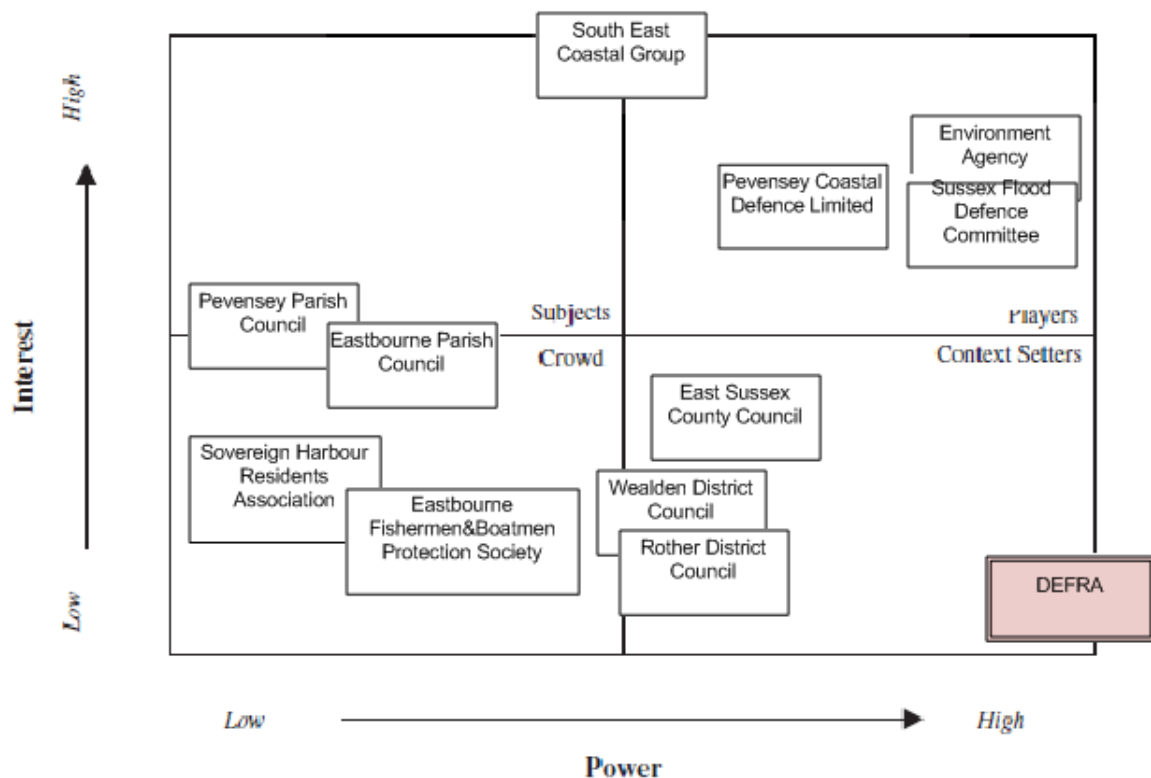


Figure 18: PCDL Power-versus-Interest

DEFRA hold very high power as it is the main enforcing authority in the UK regarding flood protection, issuing policies and guidelines for operating authorities to follow. Their overall interest with this specific project is considered low, as this is not the only flood protection project in the UK at the moment.

The Environment Agency is the main operating body in the UK with regards to flood protection. It holds high power with this specific project and also high interest. The PCDL has been given the “pathfinder” status, as mentioned earlier, with the Environment Agency being highly interested to set new standards in terms of contracting flood defence projects by assuring the project’s success.

The Sussex Flood Defence Committee oversees the correct implementation of the project, and assures that it is in line with the policies issued by DEFRA. It holds high power as it can influence decision making related to the project and also high interest as they represent the county in which the project is being developed.

The Pevensey Coastal Defence Limited SPV, formed by Dean & Dyball Civil Engineering, Mouchel Group, Mackley Construction, Boskalis Westminster Ltd holds both high power and high

interest as they are the ones developing and maintaining the project. The project is being developed under the Environment Agency's supervision, having less power than it.

The South East Coastal Group represents all regional and local authorities with matters in coastal regions. They have very high interest with the smooth implementation and success of the project, but their power is limited under the directive of the Environment Agency.

Holding high interest but limited power the Pevensey Parish Council and the Eastbourne Parish Council aim to give voice to the citizens that are subsequently affected by the ongoing works taking place in Pevensey Bay. They are kept involved in the overall process to increase acceptance of the project by the public, assuring a smooth operation.

The East Sussex County Council oversees that local authorities are taken into account in the decision making process, forming a direct link between them and the project operators. Their interest is limited to the smooth implementation of the project while their power is higher than Parish Councils, linking them to regional and national authorities.

With the project taking place across more than one district, the Wealden District Council and Rother District Council have higher power than local authorities, but still lower than the County Council. Their interest is limited to assuring that the operation of the project benefits the two districts, and they are kept involved in the decision making process.

The Sovereign Harbor Residents Association is a unification of local inhabitants that are directly affected by the works in Pevensey Bay. The association was formed in order to give limited power so that the project operators involve them in the decision making process. Their interest is restricted to the works undertaken in the area, assuring that it causes a limited amount of disturbance to leisure activities in the area.

Eastbourne Fishermen&Boatmen Protection Society's main interest is to make sure the project disrupts the fishing and maritime leisure activities to a minimum. Their power is also limited to the decisions of local authorities with regards to the project.

5.2. Project delivery methods alternatives

The next step in the analysis is to question the suitability of the DBFM contract used versus alternative contractual arrangements that could be suitable for the PCDL project. The goal of this comparison is to generate a Pros-and-Cons list to the application of DBFM to flood protection in order to potentially transfer lessons learned in this specific case to implementing flood protection measures in developing countries under PPP. One of the main reasons that justify the selection of a specific project delivery method is the distribution of risks between parties, based on who is more capable of handling them.

In the framework presented in Chapter 2, the full range of contractual arrangements that fall under the PPP spectrum were presented. These were:

- Operation and Management Contract;
- Lease/Affermage;
- Design-Build-Finance;
- Design-Build-Finance-Maintain;
- Design-Build-Finance-Operate-Maintain;
- Build-Operate-Transfer; and
- Build-Own-Operate.

Why DBFM ?

When the decision was taken to contract under PPP, the existing defence system was reaching the end of its technical life. The government searched for a solution to provide long-term protection against coastal flooding and erosion of the coastline of Pevensy Bay. In order to achieve this objective the decision was made to contract the private sector. This resulted in a 25 year agreement under which the PCDL consortia was to undertake the design, build, maintain functions.

A project on this scale would involve the whole flood protection budget assigned for the region to be spent only on this measure, with the government unable to provide financing. This led to also integrating the financing function under the long-term agreement with the private sector. The private sector would thus finance the project in one go, the government performing periodical payments to the consortia over the extended period of the contract.

The DBFM method was selected over others out of the following considerations:

- Transferring design, build, maintain and financing functions to the private sector;
- Financing the full project by the private sector, with the government performing yearly payments;
- Allow EA to monitor the works being developed under clear specifications;
- Allow innovative solutions that lead to reducing overall costs;
- Risk transferring to the private sector to an extent where they are capable of managing them, and it makes the project financially attractive.

With applying a DBFM contract structure, it allowed the EA to transfer the responsibility of designing, upgrading and maintaining the flood protection measures to the private sector, while also transferring the financing function to them, allowing this project to be implemented through sufficient finance. This way the EA is no longer required to finance a project on this scale in one go, instead, paying for this specific service of flooding not to occur over the whole 25 years of the contract. Having transferred the most important responsibilities to the PCDL consortia, the EA performs periodical monitoring to assure that the project is in accordance with the contract specifications. There is very little chance of a flooding event will occur to test the full capacity of the flood protection measures, so basically they are paying for the service of flooding not happening. Monitoring is essential to assure that the physical features of the infrastructure are kept.

DBFM was a preferred method over BOT, as this specific type of asset doesn't allow charging direct user tariffs, with these being non-existent. Instead, the government is responsible for repaying for this service, and is further responsible on how to charge the people that benefit from increased flood protection.

Operation and Management Contract

The Operation and Management Contract represents the simplest form of cooperation between the public and private sector. This contract could have been suitable in this specific case, even with the EA lacking the technical expertise to design, upgrade and maintain a project on this scale, they could have hired external consultants. This type of contract was not used out of financial considerations. The main reason for contracting under PPP is to transfer the financial responsibilities to private parties, allowing the project to be constructed and paying for it over the extended contract duration.

Lease/Affermage

Both Lease and Affermage would not have been suitable in the Pevensy case. Lease or Affermage would involve the private sector operating the asset and receiving all revenues generated by the asset. However, with the project being a flood protection measure there is no revenue

involved, so there is no clear financial structure through which the private sector could recover their investment. Another reason why Lease/Affermage would not have been suitable in this specific case is that it would involve transferring ownership to the private sector, with critical infrastructure in the UK being publicly owned.

DBF

Under a Design, Build, Finance agreement the private sector is responsible for developing and financing the project, recovering their investment through a periodical availability fee paid by the government, similar to the currently used DBFM contract. The only difference is that the public sector retains the operational and maintenance risks associated with the project. Even with the EA responsible for enforcing flood protection measures throughout the country, they lack the technical expertise to undertake the maintenance responsibilities of a project on this scale, with the private sector that developed the project being more capable of handling this function. Coordination between design, upgrade and maintenance required more expertise, justifying why the private sector was involved. The maintenance feature of the contract was essential for developing this project.

BOT

BOT represents the most suitable alternative for the project, having a similar structure to the already used DBFM contract. The Build Operate Transfer agreement would transfer the design, operate, finance and maintain functions to the private sector. The only difference is that, with the private sector being responsible for a project contracted under BOT, it empowers them to recover their investment costs through taxes applied by the government to direct users and beneficiaries of the asset. The only tax collected by the end users comes through an annual contribution paid by the residents of the targeted area, with the total amounts not being nearly sufficient for fully recovering the investment costs. Setting up a financial structure through which the consortia would collect direct user taxes would prove difficult in the case of flood protection.

With the benefits of flood protection measures being dispersed over a wide area, for the Pevensey project a wider array of stakeholders that benefit from the project need to be considered. Based on those identified stakeholders, the PCDL consortia could potentially develop focused taxes on various groups that hold a direct benefit. For this project delivery method to be applied on the Pevensey Bay project, strategies on how to create different taxation methods need to be formulated.

If the project would have been contracted under BOT it would have had the following features:

- Design, Build, Finance and Maintain functions undertaken by the private sector;
- Transferring of risks associated with the functions to the private sector;
- Further transferring financial risks to the private sector, with them being responsible to recover their investment through user taxes;
- Applying targeted taxes on various stakeholders that benefit;
- Less monitoring from the EA, as it is in the private sector's interest to implement the asset at a satisfactory level for the users in order for them to accept specific taxes to be paid.

BOO

The BOO agreement is similar to the earlier mentioned BOT, the only difference is that full ownership of the asset is transferred to the private sector over an extended period of time. This contractual arrangement would not have been suitable for the Pevensey Bay project as it would involve transferring ownership of the asset to the private sector, and earlier it was mentioned that that critical infrastructure in the UK, such as flood protection, is publicly owned.

DBFMO

Similar to the DBFM contract, the DBFMO further integrates operational responsibilities and associated risks with the private sector. The current contract structure gives clear guidelines on operational responsibilities and associated risks. Earlier it was mentioned that the more than 99 per cent of the contract duration the full technical capabilities of the shingle embankments will not be tested, as the chances of a storm powerful enough to breach them is unlikely. However, in the unlikely event of a storm with a return period of 1:400 years or more does hit Pevensy Bay, the risks associated with it are too high for the private sector to manage, as the costs for the loss of shingle of this magnitude would make the project financially unfeasible to them.

Pros-and-Cons of DBFM

Comparing the currently used project delivery method to other potentially viable methods, it is clear that the described key features of the contract lead to selecting DBFM as the most suitable for developing flood defences in the UK. However, using other similar contractual arrangements such as BOT or DBFMO the project could have still been implemented with the key difference being the risk distribution between the SPV and the government.

Based on the suitability of the currently used project delivery method against the potential use of other suitable ones elaborated on earlier, a Pros-and-Cons list for the use of DBFM will be done from the perspective of the public sector with regards to implementing flood protection measures in comparison to using traditional procurement methods.

Pros	Cons
• Integrated contract • Innovative solutions; • Clear definition of key physical features of the asset; • Reduction of public debt through private financing; • Extended maintenance period over contract duration; • Periodical performance based payments; • Ownership remains with public sector over contract duration;	• High transaction costs; • High tendering duration; • Complex project • Limits competition in tendering phase; • Not suitable for small-scale projects; • Uncertainty over the occurrence of a severe storm; • Uncertainty over performance during a severe storm; • Operational risks and responsibilities shared with public sector;

Tabel 7: Pros-vs-cons for DBFM PCDL project

5.3. Risk Allocation Matrix

Having the risks of the project identified through researching documents, the next step in the analysis is to adapt the Risk Allocation Matrix developed by Grimsey and Lewis (2002) presented in Chapter 2 to the Pevensy project. This will be done in order to outline the risk distribution for the project between the EA and the PCDL in accordance with the used project delivery method, DBFM.

Risk identification and distribution was one of the key features of the contract. The early identification of all relevant risks as well as their proper distribution between parties encouraged implementing this flood protection project as under a PPP contract. In the case of Pevensy Bay risks were identified under three categories: the contractor's risk, shared risks carried equally by PCDL and the EA and the client's risks. In the table below the Risk Allocation Matrix by Grimsey and Lewis (2002) is applied to the Pevensy Bay project.

	PCDL	Shared	EA
Technical risks			
Unforeseen ground conditions	X		
Impact to project area as a result of works outside the project area			X
Changes instructed by the Environmental Agency			X
Performance of the design against agreed weather standards	X		
Construction risks			
Additional works as a result of errors or required changes in design standards			
Shortcoming of contractors			
Delays due to unavailable construction materials			
Operating risks			
Shingle movement	X		
Completion of works within costs and time	X		
All operational matters including health and safety	X		
Provision of emergency storm response	X		
Liability to third parties	X		
Reinstallment costs for the loss of shingle as a result of a storm up to 1:50 return period	X		
Reinstallment costs for the loss of shingle as a result of a storm between 1:50 and 1:400 return period		X	
Reinstallment costs for the loss of shingle as a result of a storm with 1:400 return period or more			X
Revenue risks			
Shortcoming of contractor to deliver and maintain key physical features	X		
Financial risks			
Costs for procuring all the materials	X		
Political Risks			
Acceptable Environmental Statement		X	
All statutory approvals		X	
Changes in law or governmental policies regarding flood defence			X
Asset risks			
Technical obsolesce of solution implemented			X
Termination of contract			X

Tabel 8: Risk Allocation Matrix for PCDL

Site risks, technical risks, some operating risks, and financial risks are all carried by the PCDL, standard for a DBFM contract. The only technical risk carried by the public sector is, if the EA instructs changes in works, as opposed to the current practices. In case of severe storms the PCDL contract also specifies the distribution of technical risks, based on different storm intensities.

The revenue risks are limited to the performance of the PCDL against agreed standards. With the availability payment being done on a deductive points system as mentioned earlier, the extent to which the payment is reduced based on shortcomings against agreed standards by the contractors.

In the framework we mentioned that some of the risks will inherently reside with the private sector, risks such as force majeure or political risks. However, with the risk identification and

allocation more specific, identifying them lead to the public sector lowering the risk burden of the private sector for the project to be more appealing to invest in. In the case of Pevensey, political risks related to changes in law or policies regarding flood defence are a risk beared by the EA. Environmental risks are still carried by the private sector, so that, works executed are in compliance with the environmental statement.

5.4. Alternative value capturing policies

Having identified two already implemented taxes used for the PCDL project, the next step in the proposed method is to further identify if any other policies could potentially be applied in the PCDL case, for generating additional financing, partly or fully covering the ongoing annuity payments the EA does toward the SPV. The purpose of identifying other suitable policies is to assess if it is a potential mean of additionally financing flood protections measures.

Land Value Taxes

Land value taxes are the most common used value capturing policy, with the purpose of increasing land value taxes based on the development and availability of infrastructure and services in a targeted area. With using Land Value Taxes it can enable local authorities to generate additional funding through raising property taxes, without the residents consent, with the goal to taxate the additional benefits certain infrastructure brings to properties. This tax can be implemented regardless of the position of targeted stakeholders, even if it causes dissatisfaction among them, willingness to pay is not affected, with the tax being levied through increasing the already existing land value taxes for a specific region.

Tax increment financing

Tax increment financing is a policy that makes use of already levied property taxes for covering development and operational costs of new developments. Instead of applying new taxes, through TIF it allows redirecting recurring property taxes for financing the development of new infrastructure the region, with are no additional obligations for existing homeowners. This type of value capturing policy is mainly associated with housing developments.

TIF is a policy that would not be suitable in the Pevensey case, as there are no guidelines that allow redirecting taxes from the government to local authorities. Also it is not suitable for flood protection, with the idea behind this policy to redirect property taxes with the target or further increasing the number of properties that will be subjected to land value taxes, it is seen as a public investment. Flood protection infrastructure would involve the redirected property taxes to become sunken costs for implementing such measures, with no clear means of recovering the investment.

Utility fee

Through utility fees, the government can regard flood defences as an utility, applying a user-pays principle. This policy can be implemented with the project already being set up, to all targeted residents that benefit from increased flood protection in a specific area. The downside of this policy is that, if the project was developed in a wider area, involving different districts, coordinating local authorities to levee such a tax in multiple regions is complicated. Coordination, from regional authorities for local councils, to collect this tax is required in order to apply this tax throughout the whole Pevensey Bay area.

One of the benefits of using this value capturing policy in the case of flood protection is that it targets not only properties that are directly behind the defences but more inland in the district as well. If a flooding event would have occurred, the damage would not only involve the closest

properties from the bay but in a wider area, giving the rationale why this policy would be one of the most suitable to use in the case of flood protection.

With the flood defence already set up, regarding flood protection as another utility that residents need to pay for can potentially generate the most additional funding out of all the policies described.

Development impact fees

Through the use of development impact fees, it can empower the local governments to impose a one-time tax to be paid by residents for a specific area, with the purpose of financing new infrastructure in that area. The tax is usually calculated based on the potential impact infrastructure might have in the region. Through developing flood defences, a higher level of safety is assured to the residents, also affecting the insurance premiums to be paid by homeowners in a specific area.

By applying this tax in the PCDL case, it could potentially empower the government to further raise additional funding up to a point where, the full annuity payment to be executed towards the SPV can be covered by applying development impact fees throughout the whole area covered by the flood defences of Pevensey Bay.

Negotiated exactions

Negotiated exactions are similar to development impact fees, the only difference is that the level of tax to be paid is set as a result of negotiation between property owners in the area and local governments. This is generally used in the provision of infrastructure and services in already developed areas, it can be a potential mean of co-financing the PCDL project, by involving local level stakeholders in the process.

By having homeowners understand the need and benefits of flood defence infrastructure, and entering a negotiation process with them, it will help understand how much they are willing to pay for flood protection.

Through negotiated exactions, the funding generated might not be significant but it can potentially contribute to financing flood protection measures while making residents feel involved in the development process.

Air rights

Air rights is a policy most commonly associated with road and transport infrastructure in areas with a high density population. By applying special taxes to properties above a designated height, it can potentially allow governments to capture the overall value of new infrastructure, against high populated areas where tall residential buildings exist or are to be developed.

This policy is not suitable regarding the PCDL project, as the population density in the area is not that high to create the need of developing housing above a certain height.

For flood protection in general, air rights can potentially be a suitable replacement for land value taxes for financing such measures, if the targeted area has tall residential buildings constructed, resulting in a large number of residents benefiting from implementing flood defences.

5.5. Applicability of value capturing for flood protection

As mentioned in the problem statement part of this report, flood protection projects generally hit a number of implementation barriers, one of them being that such projects do not generate any revenues, mostly only generating social and environmental benefits for the general

population. This means that private investors have no reasons to invest in this type of projects, governments being obligated to fully subsidize them.

However, there are ways of shifting from this problem to some extent through value capturing policies. To do so first the problem must be acknowledged by the general public, the threat that climate change poses and the importance of flood protection.

Governments must identify what values are created by implementing flood protection measures, with both social and environmental benefits needed to be considered. If the values created through flood protection measures are clearly underpinned, it can also be established who benefits the most from them, for example local businesses , insurance companies or communities. Knowing the main beneficiaries, the same for other types of infrastructure, allows governments to use value capturing policies, as described earlier. Monetarizing the added values to consumers will allow the creation of revenue streams so that flood protection projects can become feasible with private investments.

In the table below we summarize the potential values that governments can use value capturing policies for flood protection infrastructure.

Financial benefits
• Reduced number insurance claims from insurance companies; • Reduced disaster funds used from governments; • New businesses; • Stable revenues from regional taxes; • Stable agricultural yields; • Increase in property values;
Social benefits
• Reduced deaths from floods; • Reduced risks of diseases as a result of floods; • High level of protection for the population; • Better quality of life for the population; • New business opportunities; • Increased job opportunities; • Increased social interaction and cohesion;
Environmental benefits
• Protection of eco-systems; • Expansion of agricultural land; • Increased flood free land; • Reduced pollution;

Tabel 9: Values of flood protection projects. Source: CTOD (2008)

With identifying the already used value capturing policies for the PCDL project, and comparing the suitability of alternative policies, figure 16 will be adapted for the potential use of value capturing to finance flood protection.

Figure 16 referred to the stage of the project life-cycle in which the value capturing policies described could be applied. The figure below further elaborates on that based on which value

capturing policies could be applied to flood protection and at which stage of project development could they be applied.

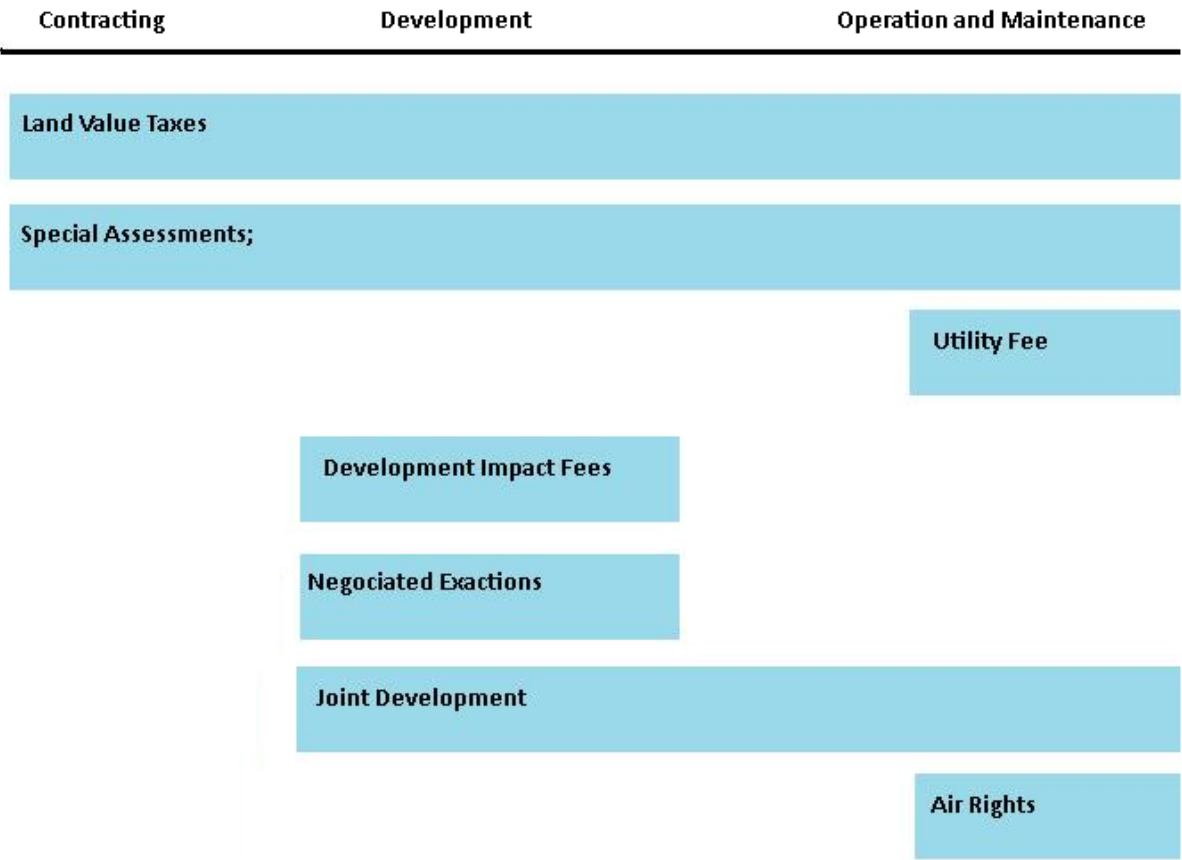


Figure 19: Applicability of value capturing policies for flood protection based on development stage. Adaptation from:Zhao et al. (2012)

Contracting flood protection under PPP allows transferring the financial responsibilities towards the private sector. This can only be implemented if value-for-money is achieved, but also if it proves more cost efficient than the government financing the project through government loans. Instead of the government financing flood defences in one go, it allows them to perform periodical payments to the private sector. This provide the rationale of applying specific value capturing policies, by identifying who benefits from the implementation of flood defences and taxing them accordingly.

Having identified the use of value capturing in the PCDL case, specific taxes can be set up for providing additional funding for the annuity payments the government is responsible for. The use of value capturing policies in developing countries may be more challenging. Developing countries face high poverty level, even with a structured approach on how to apply a specific value capturing policy there is no assurance that the population has the means to pay for it.

The application of value capturing policies is heavily dependent on context, the economic and social environment of specific countries, with some policies being more suitable than others. Through this analysis, the intention was to point out that there is potential use for such policies in generating additional financing for flood protection. By applying targeted taxation policies, even governments of developing countries can show private investors that they have the potential of financing the incurring annuity payments of a privately financed flood protection project.

6. Project evaluation

The present research aims to provide answers to the main research question: *Can private finance be made a viable option for implementing flood protection measures in developing countries?* Through the presented analysis method, the only known case where flood protection measures were implemented under PPP was analyzed in order to generate key lessons .

Examining factors presented as part of the framework, conclusions will be given on how can private investments can be enabled for flood protection measures. These conclusions have the potential of allowing governments and policy makers to make better decisions for implementing flood protection projects. Moreover recommendations on how these key lessons can be transferred to developing countries will be given in accordance with the empirical research, providing, invaluable lessons on how flood protection measures can potentially be privately financed using a PPP structure.

The successful implementation of the Pevensey Bay Coastal Defence project is what gave it the “pathfinder” status on how flood protection measures can be privately financed. With the PCDL project setting an example on how flood protection can be implemented under PPP, there is a follow up project. Through the proposed analysis method, aspects that lead to the project’s feasibility will be presented as valuable lessons that can potentially be applied on other flood protection projects.

This research project aimed into breaking down the most relevant factors of the PCDL project, providing clear answers for the secondary research questions, formulating a conclusive answer for this paper’s main research question.

6.1. Conclusions of PCDL analysis

Based on the design variables explored for the PCDL project, a set of key lessons can be drawn for developing flood protection measures under PPP.

Stakeholder management is an important factor for developing infrastructure. Proper identification of actors is essential for understanding who should be involved in the process and to what extent. With one of the key features of the PCDL project being stakeholder identification and involvement, it shows that involving a wider array of stakeholders in the development process of infrastructure can lead to a higher level of acceptance from the public. Even if project works disrupt the daily functions of the targeted area, by having even low power stakeholders involved, it can increase their tolerance with the project, increasing their level of acceptance, which can also lead to increased willingness-to-pay of any taxes regarding the project.

The PCDL experience shows that an integrated flood protection project, including development, upgrading and maintenance is financially feasible for the private sector. By clearly defining the key physical features of the project early in the design phase while still giving the contractor enough design freedom for developing innovative solutions it can reduce the government’s role to only supervision to assure that the project is in line with the contract specifications. In the PCDL contract it was mentioned the quantity and materials needed to be distributed along the 9km frontage, namely 2 million cubic meters of shingle distributed and that the shingle bank should have a minimum width of 22m at its crest.

The most suitable project delivery methods for flood protection are DBFM, BOT or any variations of the two, described in the framework. These would allow the private sector to finance flood protection measures, with each project delivery method having different means for them to recover their investment. The DBFM structure allowed the private sector to design, build, finance and maintain under the ownership and supervision of the EA. Over the specified contract duration, in the PCDL case 25 years, the government took the responsibility of performing annuity payments towards the established SPV that developed the project. Using this contract structure, the project

was financially attractive to the private sector, clearly showing that a return-of-investment is possible for flood protection services in this specific case, with the government being able and agreeing to perform annuity payments for service provision.

Large unforeseeable risks, such as severe weather events, were not allocated to third parties as this would have resulted in the overall project costs to be higher. It was mentioned that the private sector is willing to take more risks with the development of the project in return for higher profits. The government kept the severe storm risks over 1:400, make project attractive for private sector by minimizing the project risk profile. Clear guidelines in the contract on how to act in case of a storm surge of a certain magnitude were given, so that the, the risk of failure of the flood defence that the PCDL undertakes is limited to an extent where the project is financially viable to them. In the unexpected event of a storm with a return rate over 1:400 years, the public sector assumed responsibility of replacing the damaged shingle fields.

Value capturing policies, even if not exclusively specified were used to generate additional financing for the government to perform the annuity payments. As it was identified, two policies were used to cofinance flood protection measures in the area. With the region having mainly residential estates, before the project, the EA entered an agreement with a housing developer, transferring the responsibilities of taking flood protection measures along with the properties to be developed. This was one of the identified policies used and it can be described as joint development. This type of policy is only applicable if the private sector is interested in developing residential or office buildings. Through the establishment of what can be identified as a Special Assessment District, it allowed the EA to apply a targeted tax to all affected landowners, for upgrading and maintaining the Sovereign Harbour.

There is great variety to the applicability of value capturing policies to cofinance flood protection infrastructure. One of the most suitable ones is the Utility Fee Policy. Considering the government views the flood protection measures as a service rather than a physical asset, it can establish a specific level of tax for the service to be provided to all residents of the afferent area. Governments and policy makers should implement value capturing policies with caution, as overlapping policies implemented at the same time can cause high dissatisfaction among stakeholders resulting in a decreased willingness-to-pay. The number of acting policies to be implemented at the same time regarding a specific project is to be decided based on the stakeholders identified, institutional setting of the country, but also the average income for the targeted area. If a policy is implemented in an area with increased poverty, the inability of the population to pay for the tax would render the implemented policy useless.

6.2. Recommendations for developing countries

Based on the key lessons underpinned through analyzing the PCDL project, recommendations will be given in order to reach this paper's goal and answering the main research question: *Can private finance be made a viable option for implementing flood protection measures in developing countries ?*

Public-Private Partnerships can provide many advantages compared to traditional procurement. One of that is that it can enable the private sector to finance infrastructure where governments are unable to cover the capital costs for such development. By analyzing how flood protection was contracted to the private sector under PPP with transferring the financial responsibilities in the Pevensy Bay Coastal Defence project. The next lines will provide the results

of this research, a list of recommendations for developing countries on how to implement flood protection measures under PPP with the private sector financing them.

Recommendation 1. Make the PPP process transparent to avoid corruption and increase public acceptance

Transparency in different phases of a PPP project should be assured through proper legislative action. Information about procedures should be made openly available to the public. This would decrease the chances of corruption and avoiding strategic behaviour, which can be easily identified in developing countries. Also, by assuring a high level of transparency, the public has access to information about the project, further contributing to their acceptance of the project. This recommendation is general as it addresses contracting under PPP in both developing and developed countries, however, developing countries have this issue more acute, requiring more caution regarding the PPP process.

Recommendation 2. The contract needs to be formulated based on the provision of a service rather than the creation of a physical asset

Instead of focusing on developing hard flood protection infrastructure, governments should focus on contracting the private sector to provide flood protection as a service. By applying more performance based contracts, it allows governments to shift their role towards mainly monitoring functions to assure the level of service agreed upon is maintained throughout the contract duration. Through establishing a clear set of objectives and measurements for the service, the contractor's performance can be monitored upon the agreed key physical features based on the service provision.

Key physical features of the infrastructure need to be specified early in the design phase, giving clear guidelines on the type of materials and quantity to be used in the development, while still allowing sufficient freedom to the contractor to apply innovative solutions. By applying bonuses and sanctions based on performance the contractor can be motivated to improving its practices and solutions, which can lead to overall cost reductions of the project.

Recommendation 3. Governments should choose the most suitable project delivery method when contracting under PPP

Flood protection measures can in fact be implemented under PPP by selecting a suitable project delivery method. If governments lack the capability of financing the project it can choose to develop the project under different PPP models, based on the responsibilities and risks it is willing to share with the private sector. However, the private sector will only undertake financial responsibilities if it is feasible for them to achieve return-of-investment.

The DBFM model, and other variations such as DBF or DBFMO should be implemented if governments can provide the means of repaying the private investment through periodical payments, in this way the private sector achieves return-of-investment. Transferring the maintenance and/or operational responsibilities to the private sector should only be done if government agencies lack the knowledge to perform these functions themselves. These responsibilities also imply the private sector expecting higher returns.

If possible, the BOT contract should be used over the DBFM, as it further decreases the financial burden of the government. Under BOT, the private sector enters an agreement where he develops, operate and also recovers their investment through direct user tariffs of the specific infrastructure. One of the ways the private sector can achieve return-of-investment with using this project delivery method, by charging levees to users of the service provided.

Recommendation 4. Large unforeseeable risks should not be allocated to third parties as they generally drive project costs higher

It was mentioned that the private sector is only willing to take higher risks in exchange for higher profits. Even with current practices of predicting severe weather events, they are still surrounded by high uncertainty of their occurrence, representing a large risk, a risk that the private sector should not bear, in order to keep project costs under control. By defining storm conditions in the contract, it should be established up to which point it falls in the responsibility of the private sector. Any storm higher than the specified one should be a risk for the public sector. The chances of a severe storm occurring are low, and the public sector should keep that risk and financial responsibilities, so that, the project remains financially attractive to the private sector.

Recommendation 5. Value capturing policies can be used to make use of the dispersed benefits of flood protection

One of the implementation barriers of flood protection measures was that the benefits of such asset being rather dispersed throughout a large targeted area. By using specific value capturing policies, governments can create functional taxation systems, based on the income of the population, creating additional funds for financing the maintenance and operational costs of flood protection infrastructure.

Following the example of the PCDL project, governments should support establishing national and regional level Trust Funds for financing critical infrastructure such as flood protection. These funds can potentially be financed through the government applying certain value capturing methods discussed earlier, capturing the newly created value by having stakeholders that benefit contribute to these funds. However, governments should keep in mind areas with high poverty, and should be wary when applying more than one policy, to make sure their purpose does not overlap, creating high dissatisfaction among the public, resulting in a decreased willingness-to-pay.

Through these funds, if successful, it can increase the attractiveness of flood protection measures towards the private sector, by showing clear means for them for achieving return-of investment. Value capturing policies can be a potential mean to increase the financial feasibility of flood protection measures, by showing the private sector that a steady revenue stream can be established if they would make the financial investment.

6.3. Answering the research questions

This part of the report answers the research sub-questions in order to formulate a coherent answer for the main research question. The answers for these questions, each follows the next, contributing to the overall answer to the main research question that stands at the basis of this research.

6.3.1. Secondary research questions:

What are the main barriers that inhibit the implementation of flood protection measures in developing countries ?

This question identifies the problem that further builds the rationale for the present research. It is addressed early in the paper, in Chapter 1.

Developing countries in particular face institutional and financial limitations that do not allow them to fully address the effects of climate change and most often they have economic dependencies climate-sensitive sectors such as water supply, agriculture or fishery. One of these climate sensitive sectors is flood protection, which faces a number of barriers in the implementation of measures to counter climate change effects.

Flood protection projects are capital-intensive. With basic flood defence infrastructure underdeveloped or missing completely, the level of investment required to bring levels of safety to at least an acceptable level for the public would require significant amounts of capital expenditures that governments in developing countries are lacking. This builds the rationale to seeking alternative financing methods for flood protection infrastructure, one alternative being to involve the private sector in the financing, development and maintenance of flood protection infrastructure.

With the effects of climate change not being uniform, some developing countries experience climate change more intense than others. This involves that flood protection measures cannot be replicated, requiring unique solutions tailored to each particular situation.

Even with building flood protection measures, financial benefits, if any, would be delayed. Contracting under PPP generally has a payback period of 25-30 years for the private sector, however, flood protection may not even begin its payback in that timeframe.

The benefits of flood protection are dispersed through a specific region, and there will always be free-riders of a specific service. Collecting payments for the service throughout a large designated area is complicated and governments need to formulate specific policies that can empower them to do so.

Flood protection measures generally bring more non-financial benefits than financial ones. To assure an acceptable level of safety for the population that in some places is below the poverty levels. Implementing flood protection measures may not generate large revenues, but will protect the population from the risk of flooding. Such welfare value is generally hard to monetarize by governments, the need of developing specific methods arise.

Out of these considerations, further research was conducted in order to find a solution of implementing flood protection projects through alternative methods, such as private financing.

What aspects should be taken into account and analyzed for generating key lessons with regards to their potential transfer to developing countries?

In order to learn how the Pevensy Coastal Defence Project was implemented, the design variables need to be defined for the analysis of the selected case study.

The institutional environment plays an essential role in fostering private investments in public infrastructure. Moreover, it provides the main background setting for developing projects under PPP, leading projects to success or failure. The first step is identifying the institutional framework regarding flood protection that enabled the project to be implemented. Stakeholder analysis is an important factor for developing infrastructure. Proper identification of actors is essential for understanding who should be involved in the process and to what extent.

There is great variety on different PPP models that can be applied, based on the institutional settings of a country. Contracting under PPP brings both advantages and disadvantages. A potential advantage of developing a project under PPP is that it can provide additional Value-for-money in comparison to a traditional procurement model. Also, it can potentially decrease the financial burden to the government by transferring financial responsibilities to the private sector, it can also be seen as improvement in quality of service. On the downside, the complexity of the contract can result in higher capital costs of the project overall, leading to a reduced value-for-money.

Risk identification and distribution plays an essential role when attempting to contract infrastructure under PPP. For contracting under different project delivery methods, the public sector is required to identify all risks afferent to the project in order to properly distribute them with private sector. It is important to understand that, private financiers and corporation are generally driven by increasing profit, balancing against project risks. This translates into the investors willingness to take higher risks only in exchange for higher returns. Risks should only be transferred to the private sector if they are the only ones capable of handling it. In order to achieve value-for-money, governments must take the decision on which risks they are capable of handling and which risks should be

transferred to the private sector. For achieving an optimal distribution, the public and private sector must be fully aware of the risks, with the risk allocation being done on the basis that the specific party is the most suitable to manage the risk effectively and efficiently.

Value capturing is a method used for financing capital infrastructure, a concept that is mainly associated with financing transport infrastructure and services. The purpose of this research is to find a potential use for certain value capturing policies for flood protection in an attempt to generate additional financing by applying specific taxation methods to targeted groups of stakeholders. Through value capturing policies, governments can potentially identify what additional value infrastructure development brings, and who profits from this newly created value in order to apply specific taxing methods. It is not expected that through such policies, projects would not be fully financed, but they can be a potential source of additional income for paying ongoing operation and maintenance costs of an asset.

What were the factors that lead the implementation of the PCDL project under private financing?

In the case of UK, flood management is governed by a complex framework of institutions. Having a long outstanding history in effect, the national policy for flood management successfully distributes power between national, regional and local level authorities. Having a structured, hierarchical, top-down approach, there is clear role distribution between acting authorities, facilitating a smooth implementation of projects under PPP. Having a long history of implementing projects under PFI/PPP it is clear the UK has improved the framework over time, in order to foster the development of infrastructure projects under PFI/PPP. Clear policies and guidelines for implementing projects under PPP is a must for successfully involving the private sector in infrastructure development.

For the PCDL project, the decision to develop the flood defence under PPP was taken with the EA using their Public Sector Comparator model to provide an estimation of costs if the project was to be developed under traditional contracting. Keeping the process transparent, it showed that while contracting under PPP the EA would achieve savings up to 15 per cent of the total costs. However a later paper by the National Audit Office unveiled that the Public Sector Comparator method's results of 15 per cent savings was flawed, only representing a way of endorsing private involvement in infrastructure projects. The inability of the government to fully finance a project on this scale led to contracting under PPP, entering an agreement with the private sector for developing and financing the project over the extended period of the contract. Through the DBFM structure the project was financed in one go, with the government performing annuity payments over the contract duration. Using a deductive points system, where the annuity payment could potentially be decreased if any shortcomings from the private sector to maintain the flood defences under an agreed standards.

Risk distribution plays an essential role when contracting under PPP. The use of a DBFM contract structure allowed the private sector to assume financial responsibilities and risks, and receiving annuity payments over the contract duration. Revenue risks that reside with the PCDL were limited to their performance under agreed technical standards. Operational responsibilities were not integrated in the contract, due to the operational risks being too high for the PCDL to handle. Clear guidelines in the contract on how to act in case of a storm surge of a certain magnitude were given, so that the risk of failure of the flood defence that the PCDL undertakes is limited to an extent where the project is financially viable to them. In the unexpected event of a storm with a return rate over 1:400 years, the public sector assumed responsibility of replacing the damaged shingle fields.

Value capturing policies were identified for the PCDL project, with one of them still on going. Between 1988 and 2001 the EA successfully applied a value capturing policy what can be identified as Joint Development. A housing developer, Tarmac, was interested in developing residential properties along the Sovereign Harbour frontage. In order to develop over 3,000 properties, the housing developer Tarmac entered an agreement with the EA to co finance the flood protection measures, restoring the shingle fields in the area. The measures were cofinance in combination with a trust entitled The Sovereign Harbour Trust, which collects three types of taxes that also represent a form of value capturing.

Through the trust, the EA performed three taxes that can be identified as Special Assessment, a form of value capturing. Having homeowners in the region acknowledge the need for maintaining the flood defences but also the marina, the residents agreed for a tax to be levied. This tax was divided into three parts. The first was The SW Charge that involved homeowners agreeing to pay the tax with the purpose of maintaining the flood defences and beach functions of the Sovereign Harbour. The second part of the Special Assessment tax applied was the Marina Charge which came in form of a tax for users of the marina to cover the maintenance of the Harbour and afferent waterways. The third part of the tax was The Berth Charge, which targeted homeowners that were not subjected to the earlier mentioned SW Charge. Berths are also known as floating houses, and through this tax, it allowed the EA to target a distinctive group of users of to contribute to the established Trust.

What lessons can be drawn from the PCDL project? Can value capturing play a role in financing flood protection measures?

One of the key features of the PCDL contract was stakeholder management, in an attempt to identify all afferent stakeholders in order to keep them involved in the process. By keeping stakeholders from all levels involved in the development process it lead not only to a higher level of acceptance from the public, even with works on the Pevensey Bay frontage disrupted daily functions of the beach, but to an increased willingness-to-pay of taxes towards the Trust Fund established for the maintenance of the bay area.

The smooth operation of the PCDL project for over 13 years now shows that an integrated flood protection project is possible. By clearly providing functional specifications in the contract while allowing enough design freedom for the contractor to develop innovative solutions and practices, it allowed the governmental agency to perform only a supervision function assuring that works executed are in line with the contract specifications.

The use of DBFM for contracting under PPP allowed the private sector to finance the flood protection measures in one go, with the government agency performing annuity payments towards the specially created SPV, clearly showing that a return-of-investment for the private sector is possible. The DBFM structure allowed the consortia to design, build, finance and maintain the flood protection measures.

Large unforeseeable risks should not be transferred to third parties, as this would increase overall project costs. Based on monitoring, storm conditions were defined in the contract. In the unlikely event of a storm with a return period of over 1:400 years occurring, the public sector retained the financial risks related to the damage this might cause. By keeping the project risk profile at advantageous levels for both the public and private sector, it created an even distribution of risks based on the most suitable party to manage them.

Two value capturing policies were identified as used related to the PCDL project, showing the potential applicability of them to flood protection infrastructure. With the coast line being mainly a residential area, targeted taxation methods were applied to homeowners to contribute to the maintenance costs of the bay in exchange for an increased level of safety against flooding. By identifying that value capturing policies can in fact be applied to other infrastructure assets and

services besides the transport sector, an analysis of the potential applicability and usefulness of existing policies resulted in showing their transfer to flood protection.

Governments should however be vary about the number of acting policies to be implemented based on aspects such as the stakeholders identified, institutional setting of the country or the average income per capita for the targeted area. A value capturing policy applied in an area with increased poverty where the population has no proper means to pay the tax value would render the policy useless.

What recommendations can be given to make private financed flood protection measures in developing countries viable based on the UK example and taking different institutional settings into account ?

The formulated recommendations come as a result of the factors that lead to the success of the PCDL project for the outstanding period of 13 years as of this moment.

The first recommendation refers to the transparency in the tendering procedure, the PCDL tendering phase was a lengthy and learning process for all parties involved. Transparency should be assured through proper legislative actions. When taking the decision to contract under PPP most governments use their national PSC method as a comparison. Even in a highly developed country such as the UK it was shown that the PSC method was biased, and that without having accurate, standardized balance sheets to show real savings while contracting under PPP, it can lead to project failure before the project's actual implementation. Also, by assuring a high level of transparency for the public to access information about the project will lead to them accepting the need and implementation of that specific project. The lack of transparency leads to corruption and strategic behavior of certain governmental groups, an issue that is present both in developed and developing countries alike, however these issues are more acute in developing countries.

Based on the contract formulation of the PCDL project, it became clear that while contracting flood protection measures to the private sector, the contract needs to be formulated based on the provision of a service, namely protection against flooding, rather than the creation of the physical asset. This is done by applying more performance based contracts, where clear objectives and measurement systems are given, allowing the government to only monitor the private sector upon their performance. These objectives and physical features of a contract need to be specified early in the design phase, clearly defining the preferred method to be used while allowing sufficient freedom for developing innovative solutions and practices.

With flood protection infrastructure in developing countries being capital-intensive, the government needs to select the most suitable project delivery method when contracting under PPP, in order to show the private sector that through their involvement return-of-investment can be achieved. The DBFM structure used for the PCDL project facilitated the implementation of the project by having the private sector retain the design, build, finance and maintenance functions, allowing the project to be paid for in one go, and the government performing annuity payments over the specified contract duration.

Risks that have the potential to impact the project severely, with an uncertain occurrence possibility should be retained by the public sector, the private sector expecting higher returns if they would handle such risk. Even with the current prediction methods of severe weather events, their actual occurrence is still surrounded by high uncertainty. By defining clear storm conditions and responsibilities in the contract, it was established to what extent the private sector should carry the risk of severe storms.

With the benefits of flood protection measures being dispersed through a large targeted area, value capturing policies represent a alternative way of using these benefits to create special

taxation systems. The PCDL experience showed that the creation of special Trust Funds for financing critical infrastructure can be a real success, if the government takes all the variables mentioned into consideration. These variables can be the number of policies that can be issued concurrently, the income of the population in that region, the enabling institutional environment that facilitates the setup of such taxes or the acknowledgement of the population for the need of increased flood protection.

6.3.2. Main research question

Can private finance be made a viable option for implementing flood protection measures in developing countries?

Taking into consideration all the previous sub-questions, a coherent answer can be formulated for answering the main research question of this research.

As a result of this research it can be concluded that value capturing can be a viable way of attracting private investments for flood protection. The application of one or several of these policies is heavily regulated by factors such as the economic environment, institutional framework and national policies for flood control, contract structure, financial mechanism and risk management. Only by taking all of them into consideration can governments formulate these taxation methods based on the situation.

By applying targeted taxation policies, even governments of developing countries can show private investors that they have the potential of financing the incurring annuity payments of a privately financed flood protection project. Having identified these value capturing policies, they can be applied in various stages of project development for flood protection as seen below.

For contracting the private sector to develop flood protection measures, governments formulate the contract for the provision of a service rather than the creation of the physical asset, allowing them to perform strictly monitor functions, assuring that the successful development of the project.

There are various ways of contracting the private sector, project delivery methods that transfer the financial responsibility to them are the ones analyzed in this paper, with the PCDL project making use of a DBFM structure over 25 years. The PCDL experience shows that flood protection projects can in fact be implemented under PPP with the private sector financing the development and maintenance, leaving the government responsible for performing annuity payments for the services provided by the consortia. Alternatively, it was shown that BOT is a solid alternative to the use of a DBFM structure, based on how many responsibilities and risks the government is willing to transfer to the private sector, while keeping the project financially attractive to both parties, balancing risks with benefits.

However, these project delivery methods may not be fully applied to developing countries, with governments there being unable to repay the private sector on the services provided. By analyzing the potential applicability of value capturing policies, it represents a mean for governments to generate additional financing with the purpose to create a steady revenue stream for the private sector to achieve return-of-investment, in this way, making private financing of flood protection project viable. Two value capturing policies were identified for the PCDL project showing their potential applicability to flood protection.

Value capturing policies can address the dispersed benefits of flood protection measures, by allowing governments to create targeted taxation methods for stakeholders that benefit from an increased level of safety against flooding as a direct result of flood protection infrastructure

development. The application of value capturing policies is heavily dependent on context, the economic and social environment of specific countries, with some policies being more suitable than others. Through this analysis, the intention was to point out that there is potential use for such policies in generating additional financing for flood protection. By applying targeted taxation policies, even the governments of developing countries can show private investors that they have the potential of financing the incurring annuity payments of a privately financed flood protection project.

Governments must identify what values are created by implementing flood protection measures, with both social and environmental benefits needed to be considered. If the values created through flood protection measures are clearly underpinned, it can also be established who benefits the most from them, for example local businesses, insurance companies or communities. Knowing the main beneficiaries, the same for other types of infrastructure, allows governments to use value capturing policies, as described earlier. Monetizing the added values to consumers will allow the creation of revenue streams so that flood protection projects can become feasible with private investments, showing private investors that return-of-investment is possible.

6.4. Limitations and further research

Taking into consideration the earlier mentioned, it can be said that through identifying potential value capturing policies that can be applied to flood protection, this research's goal has been reached, by generating an insight on alternative ways through which governments can make private investments in flood protection viable.

The present research represents the first step to solving a complex problem. Firstly the research addressed not how to set up a project so that private financing is viable, but it aimed to show that it is possible. This created the means for further research, addressing how it can be done. The analysis has a general character as it is based on publicly available information thus being limited by the actual amount of data available. One of the main limitations of this research is giving clear guidelines on how the contractual arrangement can be structured in order to repay back the investments. This matter needs further research, by applying the proposed framework to a specific country. Also, the proposed framework needs to be thoroughly applied in order to generate conclusive recommendations on which value capturing are more suitable and which could be applied.

As further research, setting up the financial mechanism in order to generate return-of-investment for the private sector for making private investments viable needs to be assessed. Value capturing represents only one of the ways through which governments can create additional financing for repaying the incurring annuity payments if the private sector was to retain financing functions for developing the project.

References

- Agrawala, S., Ota, T., Ahmed, A. U., Smith, J., & van Aalst, M. (2003). Development and climate change in Bangladesh: focus on coastal flooding and the Sundarbans. *OECD, France*.
- Akintoye, A., Beck, M., & Hardcastle, C. (2003). *Public-private partnerships*: Wiley Online Library.
- Alam, S. N. (1990). Perceptions of flood among Bangladeshi villagers. *Disasters*, 14(4), 354-357.
- Asia Foundation, T. (2010). Promoting Public-Private Partnership in Bangladesh. *The Asia Foundation. Dhaka, Bangladesh*.
- Australia, I. (2008). National PPP Guidelines—Overview: Commonwealth of Australia.
- Bouwer, L. M., & Aerts, J. C. (2006). Financing climate change adaptation. *Disasters*, 30(1), 49-63.
- Brammer, H. (1990). Floods in Bangladesh: geographical background to the 1987 and 1988 floods. *Geographical Journal*, 12-22.
- BRAMMER, H. (2010). After the Bangladesh Flood Action Plan: Looking to the future.
- Brown, J. D., & Damery, S. L. (2002). Managing flood risk in the UK: towards an integration of social and technical perspectives. *Transactions of the Institute of British Geographers*, 27(4), 412-426.
- Bryson, J. M. (2004). What to do when stakeholders matter: Stakeholder identification and analysis techniques. *Public management review*, 6(1), 21-53.
- Bryson, J. M. (2011). *Strategic planning for public and nonprofit organizations: A guide to strengthening and sustaining organizational achievement* (Vol. 1): Jossey-Bass.
- Bryson, J. M., & Crosby, B. C. (1992). *Leadership for the common good: Tackling public problems in a shared-power world*: Jossey-Bass San Francisco.
- Canada. (2011). Public-private partnerships. A guide for municipalities. *Canadian Council for Public-Private Partnerships*.
- Choudhury, N. Y., Paul, A., & Paul, B. K. (2004). Impact of costal embankment on the flash flood in Bangladesh: a case study. *Applied Geography*, 24(3), 241-258.
- Commission, E., & Policy, D. R. (2003). Guidelines for Successful Public-Private Partnerships: Brussels, European Commission.
- CTOD. (2008). Capturing the Value of Transit. *Center for Transit-Oriented Development*.
- Dasgupta, S., Huq, M., Khan, Z. H., Masud, M. S., Ahmed, M. M. Z., Mukherjee, N., & Pandey, K. (2010). Climate proofing infrastructure in Bangladesh : the incremental cost of limiting future inland monsoon flood damage. *Policy Research working paper ; no. WPS 5469. Washington D.C. - The Worldbank*.
- Eden, C., & Ackermann, F. (1998). *Making strategy: The journey of strategic management*: SAGE Publications Limited.
- Feldman, M. S., & Khademian, A. M. (2002). To manage is to govern. *Public Administration Review*, 62(5), 541-554.
- Felsinger, K. (2008). *Public-Private Partnership Handbook*: Asian Development Bank (ADB).
- Frank, B., & Bryan, J. (1993). *Agendas and instability in American politics*: Chicago: University of Chicago Press.
- Freeman, R. E. (2010). *Strategic management: A stakeholder approach*: Cambridge University Press.
- Gidman, P., Blore, I., Lorentzen, J., & Schuttenbelt, P. (1995). *Public-private partnerships in urban infrastructure services*: UNDP/UNCHS/World Bank-UMP.
- Gilham, A. (2000). Pevensey Bay Sea Defences: The Public Private Partnership *Environment Agency*.
- Gleijm, A., & Gerdes, E. (2012). Bridging the gap in water related climate adaptation projects. The role of private initiative. *RebelGroup Advisory bv*.
- GOB. (1992). FAP 25, flood modelling and management. *Flood Hydrology Study, Main Report, Government of Bangladesh, Dhaka*.
- Grimsey, D., & Lewis, M. K. (2002). Evaluating the risks of public private partnerships for infrastructure projects. *International Journal of Project Management*, 20(2), 107-118.

- Johnson, G., Scholes, K., & Whittington, R. (2008). *Exploring corporate strategy: text & cases*: Prentice Hall.
- Katsuhama, Y. (2010). *CAPACITY BUILDING FOR FLOOD MANAGEMENT IN DEVELOPING COUNTRIES UNDER CLIMATE CHANGE*. Colorado State University. Retrieved from http://digitool.library.colostate.edu/exlibris/dtl/d3_1/apache_media/L2V4bGlicmlzL2R0bC9kM18xL2FwYWNoZV9tZWRpYS84NzgyNQ==.pdf
- KfW. (2011). Adaptation to climate change. COOPERATION WITH DEVELOPING COUNTRIES – CLIMATE AND DEVELOPMENT.
- LACMTA. (2012). VALUE CAPTURE - TRANSIT INVESTMENT DIVIDENDS. *Los Angeles County Metropolitan Transportation Authority. PLANNING AND PROGRAMMING COMMITTEE*.
- MCBOC. (2011). DESIGN-BID-BUILD vs DESIGN-BUILD. *Marion County Board of Commissioners, Oregon*.
- Miller, J. B. (2000). *Principles of public and private infrastructure delivery* (Vol. 101): Kluwer Academic Pub.
- Mitchell, T., Tanner, T., & Wilkinson, E. (2006). Overcoming the barriers: mainstreaming climate change adaptation in developing countries. *Institute of Development Studies and Tearfund*.
- Monirul Qader Mirza, M. (2002). Global warming and changes in the probability of occurrence of floods in Bangladesh and implications. *Global Environmental Change*, 12(2), 127-138.
- Ng, A., & Loosemore, M. (2007). Risk allocation in the private provision of public infrastructure. *International Journal of Project Management*, 25(1), 66-76.
- Nutt, P. C., & Backoff, R. W. (1992). *Strategic management of public and third sector organizations: A handbook for leaders*: Jossey-Bass.
- OECD. (2007). *OECD Principles for Private Sector Participation in Infrastructure*: OECD Publishing.
- OECD. (2008). *Public-Private Partnerships: In Pursuit Of Risk Sharing and Value For Money*: OECD.
- Paul, B. K. (1997). Flood research in Bangladesh in retrospect and prospect: a review. *Geoforum*, 28(2), 121-131.
- Pereira, J., Orenstein, K., & Chan, M. (2013). -poor Climate Finance: Is There a Role for Private Finance in the Green Climate Fund? *Friends of the Earth U.S.*
- Peters, B. G. (1996). *The future of governing: Four emerging models*: University Press of Kansas Lawrence.
- PMI. (2000). *A guide to the project management body of knowledge (PMBOK guide)* (Vol. 2): Project Management Institute.
- Rasid, H., & Pramanik, M. (1993). Areal extent of the 1988 flood in Bangladesh: How much did the satellite imagery show? *Natural Hazards*, 8(2), 189-200.
- Ryan-Collins, L., Ellis, K., & Lemma, A. (2011). Climate Compatible Development in the Infrastructure Sector. *UK Institution of Civil Engineers (ICE)*.
- Rybeck, R. (2004). Using value capture to finance infrastructure and encourage compact development. *Public Works Management & Policy*, 8(4), 249-260.
- Sarraf, M., Dasgupta, S., & Adams, N. (2011a). The cost of adapting to extreme weather events in a changing climate. *Bangladesh development series paper ; no. 28. Washington D.C. - The Worldbank*.
- Sarraf, M., Dasgupta, S., & Adams, N. (2011b). Sarraf, Maria; Dasgupta, Susmita; Adams, Norma. *Bangladesh development series paper ; no. 28. Washington D.C. - The Worldbank*.
- SCA. (1998). Sixth report: flood and coastal defence. *Select Committee on Agriculture. HMSO, London*.
- Smit, B., & Pilifosova, O. (2001). Chapter 18: Adaptation to Climate Change in the Context of Sustainable Development and Equity. *IPCCC. CLIMATE CHANGE 2001: IMPACTS, ADAPTATION, AND VULNERABILITY*, 878-912.
- Tanis, M., & Vergeer, T. (2008). Long-term Coastal Defence and Management at Pevensey Bay, UK: A Public Private Partnership
Terra et Aqua | Number 113 | December 2008.

- Thomas, I., & Amies, P. (2009). Pevensey Bay PFI: An Example of Best Practice in provision of Sea Defence Services.
- Thompson, P. M., & Sultana, P. (1996). Distributional and social impacts of flood control in Bangladesh. *Geographical Journal*, 1-13.
- UNFCCC. (1992). UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE.
- Vickers, B., & Vickers, G. (1998). The Art of Judgment. *HarperCollins*.
- WB. (1989). Bangladesh action plan for flood contr. *World Bank, Dhaka: World Bank Asia Region Country Department*.
- WB. (2010). The Costs to Developing Countries of Adapting to Climate Change. New Methods and Estimates. *The Global Report of the Economics of Adaptation to Climate Change Study. Consultation Draft*.
- WB. (2011). The Cost of Adapting to Extreme Weather Events in a Changing Climate. *Bangladesh development series paper ; no. 28. Washington D.C. - The Worldbank*.
- WB. (2012). World Development Indicators. *World Bank*.
- Wescott, C., & Breeding, M. (2011). Bangladesh - World Bank country-level engagement on governance and anticorruption. *Independent Evaluation Group (IEG) working paper series no. 7. Washington D.C. - The Worldbank*.
- WITTERS, L., MAROM, R., & STEINERT, K. (2012). Chapter 2: The Role of Public-Private Partnerships in Driving Innovation.
- Zhao, Z., Iacono, M., Lari, A., & Levinson, D. (2012). Value Capture for Transportation Finance. *Procedia-Social and Behavioral Sciences*, 48, 435-448.

Appendices

Appendix A: Project delivery methods

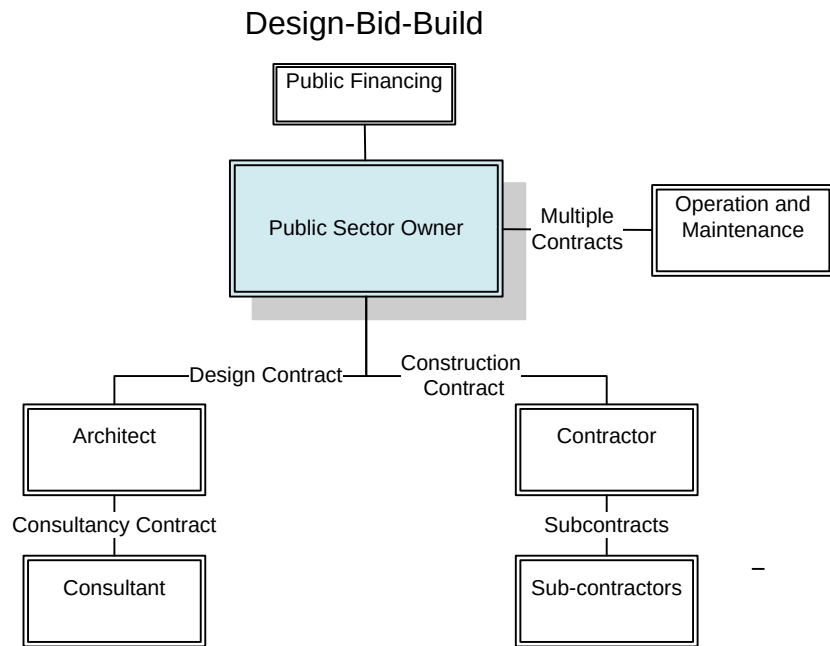


Figure 20: DBB

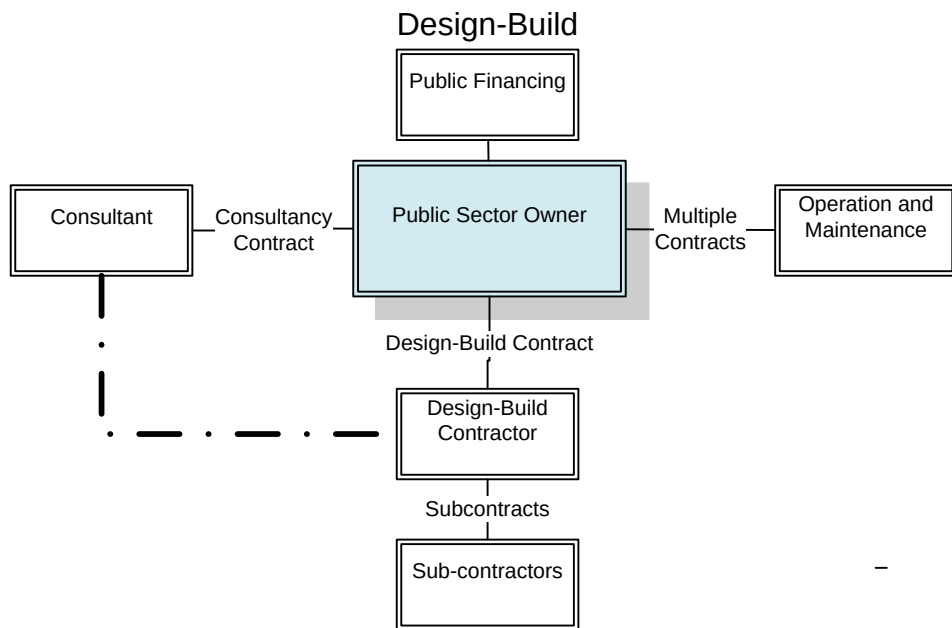


Figure 21: DB

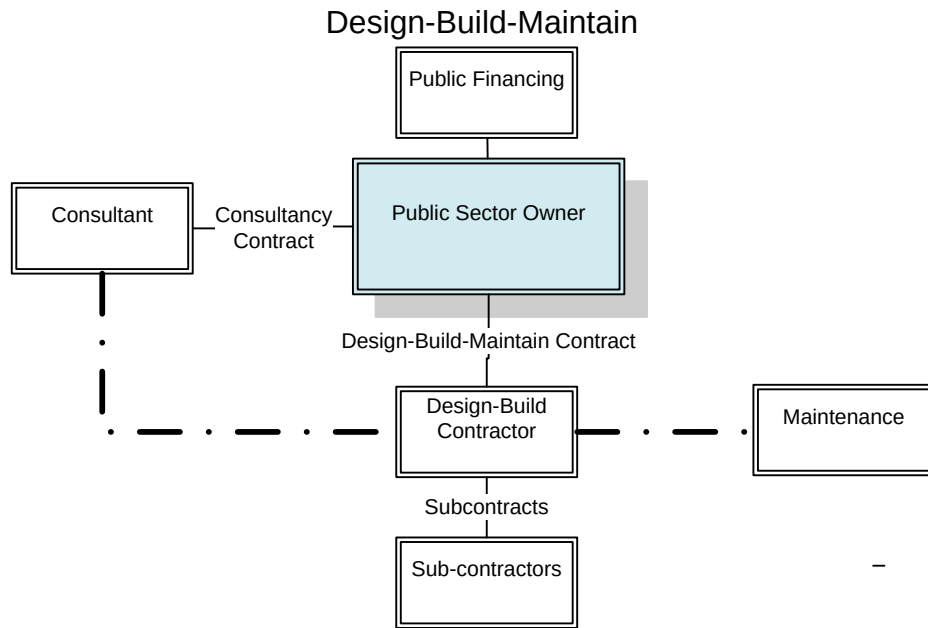


Figure 22: DBM

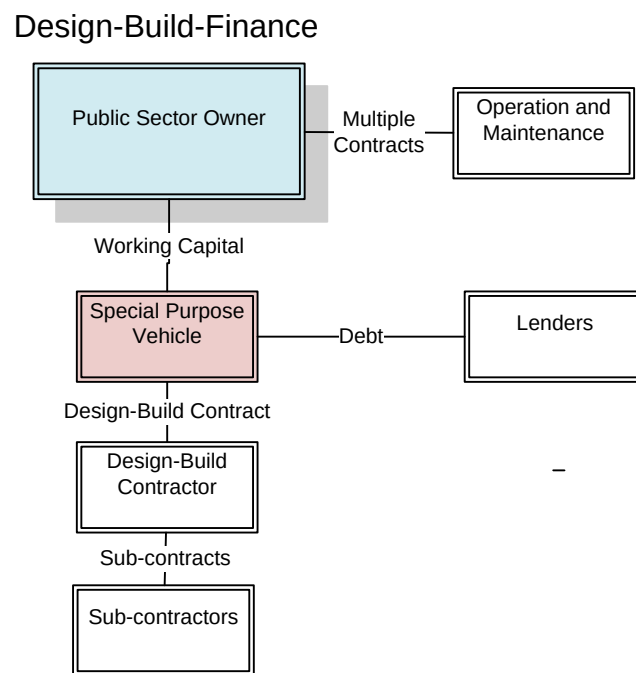


Figure 234: DBF

Design-Build-Finance-Maintain

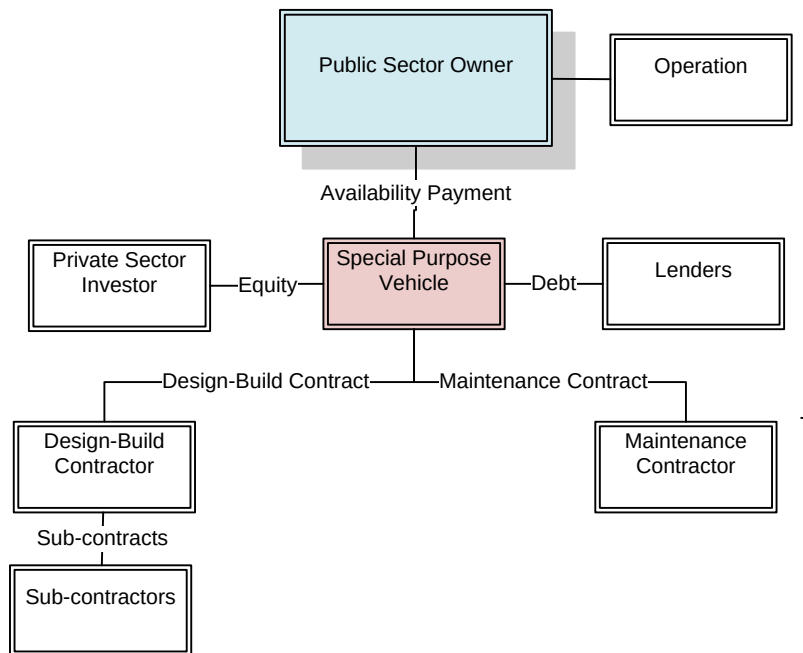


Figure 24: DBFM

Design-Build-Finance-Operate-Maintain

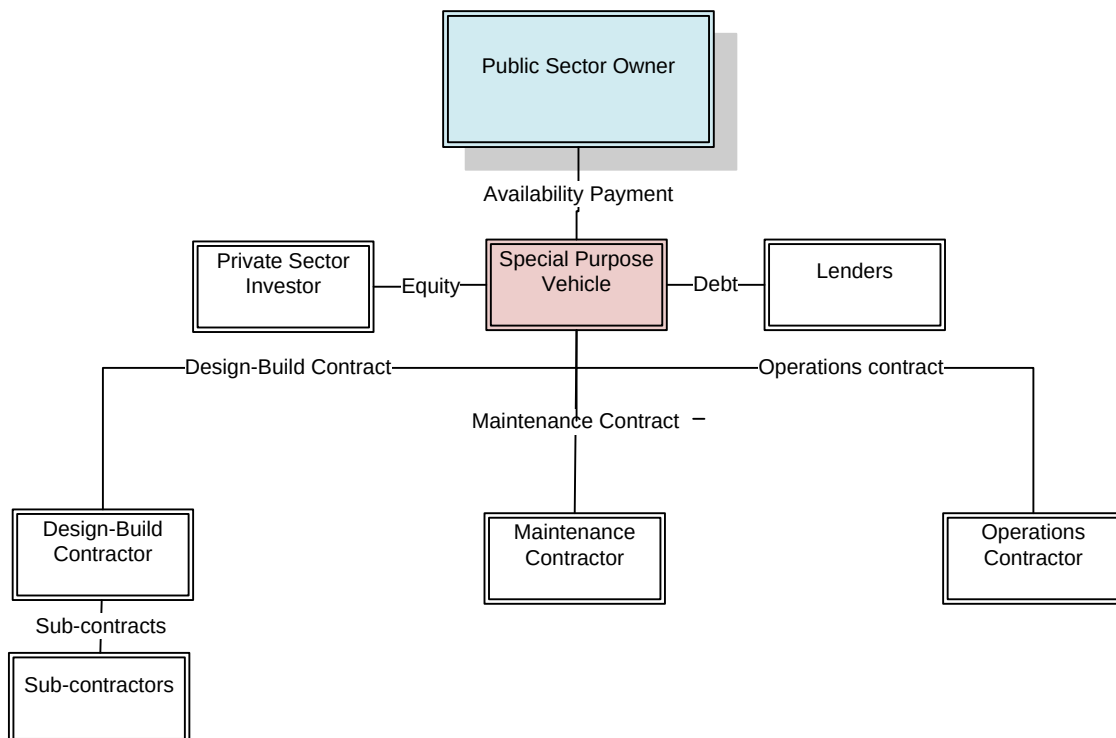


Figure 25: DBFMO

Build-Operate-Transfer

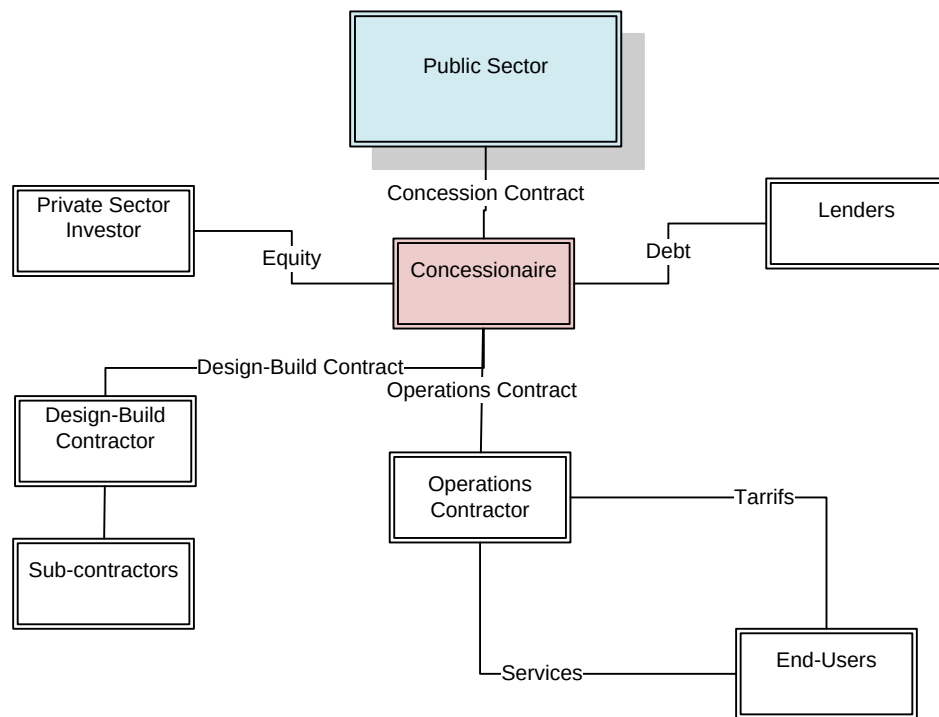


Figure 26: BOT

Appendix B: List of interviewees

1. *Ruud Termaat* 11-03-2013
Company: *Deltares*
2. *Peter Letitre* 12-03-2013
Company: *Deltares*
3. *Victor Lagenberg* 19-03-2013
Company: *Deltares*
4. *Gerard Van Der Kolff* 19-03-2013
Company: *Deltares*
5. *Maya Sule* 21-03-2013
Company: *Deltares*
6. *Bart Budding* 12-07-2013
Company: *Rebel Group*

Appendix C: List of questions, interview with Bart Budding of Rebel Group

1. Which project delivery methods are most commonly used for implementing flood protection measures in developing countries ?
2. How are risks identified and allocated with these project delivery methods ?
3. What function does the private sector generally undertake with a flood protection project?
4. What is the role of Rebel Group with regards to flood protection projects?
5. Where there any attempts of privately financed flood protection projects worldwide ?
6. If yes, how was a return-of-investment assured to make it attractive for the private sector to invest in ?
7. What incentives were offered to capture the private sector's attention ?
8. Are there any examples with enough public information available for using in this research ?
9. Who are the main beneficiaries of flood protection in developing countries?
10. Are there examples of policies or strategies that governments use to exploit the beneficiaries of flood protection measures ?