Construction Project Financing: A Risk-based Model

By

Nasir Rasheed
(NUST201362145MSCE&M15413F)

A thesis submitted in partial fulfilment of
the requirements for the degree of

Master of Science
in
Construction Engineering and Management

DEPARTMENT OF CONSTRUCTION ENGINEERING AND MANAGEMENT
NATIONAL INSTITUTE OF TRANSPORTATION-NIT
SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING
NATIONAL UNIVERSITY OF SCIENCES AND TECHNOLOGY
SECTOR H-12, ISLAMABAD, PAKISTAN
(2017)

This is to certify that the

thesis titled

Construction Project Financing: A risk-based model

Submitted by

Nasir Rasheed

(NUST201362145MSCEE15413F)

has been accepted towards the partial fulfilment

of the requirements for the degree of

Masters of Science in Construction Engineering and Management

_____

Dr. Muhammad Jamaluddin Thaheem

Supervisor,

Department of Construction Engineering and Management,

NIT-SCEE, NUST, Islamabad.

This thesis is dedicated to my parents and my respected teachers!

ACKNOWLEDGEMENTS

First and foremost, I would like to thank Allah Almighty who always helped me throughout my life and to get through this degree and thesis.

I would like to pay debt of gratitude to my advisor Dr. Muhammad Jamaluddin Thaheem, for his profound guidance, and encouragement, to complete this research work. I am also extremely grateful to the committee members, Dr. Hamza Farooq Gabriel and Lec. Bilal Ayub for their support to complete this research work. I would like to pay my earnest and honest gratitude to my parents for their unconditional support, encouragement, prayers and patience.

Last but not the least, I would like to thank my elder brothers Tariq and Tasadduq for their absolute support and encouragement; and my dear friend Abdul Qadeer for sticking with me for the entire duration of this research.

ABSTRACT

The project risk is a given, which influences major management and financing decision. Choosing an optimum financing instrument has posed serious challenges to decision makers. Modern project systems rely on project financing strategy but the situation exasperates when factoring in the project risk and selecting a fitting debt-equity ratio. This research identifies and analyses the risks involved in project finance. Based on mathematical modelling, optimum debt ratio is estimated under project risk conditions. The findings are validated on two local case studies of road infrastructure projects. It is found that the local project participants are more risk averse owing to higher political risk, and potential cost and time overruns. The practical implications of this study involve decision support for project finance by offering risk-based debt-equity mix.

Table of Contents

List of Figure

List of Tables

LIST OF ABBREVIATIONS

PF	Project Finance
SPV	Special Purpose Vehicle
GDP	Gross Domestic Product
OECD	Organization for Economic Co-operation and Development
PFI	Private Finance Initiative
IRR	Internal Rate of Return
ROR	Rate of Return
PPP	Public Private Partnership
BOT	Build-Operate-Transfer
CA	Concession Agreement
CAPEX	Capital Expenditure
OPEX	Operating Expenditure
CRE	Cumulative Risk Effect
TIE	Times Interest Earned
NPV	Net Present Value
DSCR	Debt Service Coverage Ratio
ROE	Return on Equity

Chapter 1

INTRODUCTION

1.1 Brief Description

The domain of financing deals with the distribution of assets and liabilities over time under circumstances of certainty and uncertainty (Yescombe, 2002). Various areas covered by financing include personal, corporate and public. Time value of money is an essential point of order in the financial body of knowledge which is stated as the fluctuation in purchasing power of one unit of currency with respect to time (Merna et al., 2010). Financing concepts in terms of their application are major considerations in the project based industries where the overall complexities, long time spans, multidimensional stakeholders and constraints hurdle profit generation and project success. Project finance can be defined as *"the creation of a legally independent project company, commonly known as special purpose vehicle company, financed with equity from one or more sponsors and non-recourse debt for the purpose of investing in a capital asset"* (Esty, 2014).

The term '*project financing*' usually refers to the arrangement of finances in terms of debt and equity for construction, operation and maintenance of a specific revenue-generating facility in a capital-intensive endeavor (Esty and Sesia Jr, 2007). The incentive to sponsor a new scheme lies primarily in the strength of its expected profitability. The creditors look exclusively on the projected returns to be generated by the project for annual debt servicing, and not on the personal resources of the borrower (Schmidt, 2016). The undertaking is established by the venture promoters as a separate commercial entity, typically in the form of a project company or special-purpose vehicle (SPV) (Akbiyikli et al., 2006). The

development of an SPV ensures no financial obligation on the government or corporate sponsor in case of default by the project, making it liable in cases of delinquency suggesting risk sharing among the creditors. The use of Project finance (PF) is commonly limited to projects requiring large investments, transparent transactions, risky environments, long-term financing, or employment of detailed loan covenants (Merna and Njiru, 2002).

PF is a popular choice for project delivery and is growing in the recent years with a key reason being the unprecedented lack of economic growth all over the world (Merna and Smith, 1999; Kleimeier and Versteeg, 2010; Akbiyikli et al., 2006). The global GDP has increased at a compound annual growth rate of almost 5%, with growth in developing countries approaching 7% on average after 2003 (Esty, 2014). The population of world has increased to 7 billion in 2012 from 1 billion in 1800 (PRB, 2016). Such massive growth is accompanied by infrastructure development, such as harbours, bridges, roads, telecommunications networks, electricity generation and distribution facilities, airports, intra and intercity railway networks, and water and sewerage services (Merna et al., 2010). The Organization for Economic Cooperation and Development (OECD) predicts spending of 4%, amounting to $1.6 trillion annually, of national and global GDP on infrastructure every year to support ongoing expansion in the world (Iyer and Purkayastha, 2017). Governments cannot manage to invest in more than a fraction of these development requirements. So, they seek the help of private sector to finance these projects either as stand-alone or as public-private cooperative schemes commonly known as Private Financing Initiatives (PFI). PF is a certain way to meet the world's infrastructure investment demand, particularly in the developing countries (Marx, 1998).

The other face of project financing suggests that owing to the investor demands of certain return, it proves to be a non-promising candidate for financing risk heavy investments with tentative returns (Blanc-Brude and Makovsek, 2013). So, it is seldom utilized to finance research and development initiatives, product expansion, advertising operations, or other potential high-risk elusive investments. PF is used mostly for certain, large projects with acknowledged risks and well-established operating technology (Ashton et al., 2012). Brealey et al. (1996) also insist that one of the many important benefits of PF is its ability to allocate specific risks to the parties best capable of managing them. These include risks of completion and operation, revenue and price, and political interference and expropriation. PF is specifically good at limiting governments from expropriating cash flows after the project is operating, especially when the temptation to do so is great. At this stage, all the investments have been made and the project cash flows are devoted to servicing the project debt (Yescombe, 2002).

1.2 Problem Statement

Over the last decade, the understanding of project finance has tremendously improved thanks to both research and development in this sector and the utilization by project stakeholders (Muranyi, 1998; Walker and Smith, 1995; Akbiyikli et al., 2006). With a need of reducing the public sector debt and at the same time, develop and improve public services, governments seek help from private sector, and have invited private sector bodies to engage into long-term contractual undertakings which may take the form of construction or supervision of public sector infrastructure projects by the private sector organization, or the delivery of services by the private sector to the public on behalf of a governing body.

The prior research has focused more on the economic aspect of project financing but the aspects related to project risk, and its effects on the capital structure along with risk behavior are less explored (Li et al., 2017). Undeniably, there is an obvious need to ensure spending of finance economically, efficiently and effectively but consideration of risks associated with project financing and their integration in its process can ensure deeper understanding of project and its expected outcomes at the initial stage.

1.3 Objectives

Following objectives are set forth for this research:

- To study the debt servicing uncertainties related to large infrastructure projects.
- To find out an ideal mix of debt and equity and to analyze and model this debt equity ratio.
- To validate the proposed model in light of case study application.

1.4 Reasons / Justification for Selection of the Topic

Pakistan is classified is a developing country in the world. There are many construction projects which are being developed at the moment, public as well as private, but the projects tend to go over budget and schedule due to lack of funds and management. Many donor agencies are managing several projects at a time with limited budget. Project financing is a specific financing arrangement that focuses on the future revenues of a project as main source of repayment, and holds the project's assets, rights and interests as collateral security in case of default.

There are multiple ways of financing a projects but project financing is a very innovative way of handling the project cash flows without even having complete

fund before project start. In project financing, risk and responsibilities are shared between all the stakeholders. Project financing is flourishing in emerging economies although not as much as in developed nations. Infrastructure projects were mainly funded by the public sector itself. But that has begun to change now, primarily to decrease budget deficit and foreign debt.

Pakistan is in need of long term infrastructure, industrial or public services schemes and project financing is the way to do it.

1.5 Relevance to National Needs

Project finance is a necessity due to the ever growing population of the world and advancements in technologies. It is especially viable for long term projects particularly in emerging countries like Pakistan. Government used to finance most of the infrastructure development schemes earlier but due to budget deficit and foreign debt this trend is shifting. The primary sources of funding are now international organizations such as World Bank.

The State Bank of Pakistan has taken steps to introduce project financing which includes infrastructure task force and capacity building. The adverse economic situation in Pakistan and difficulties in international debt markets had an adversative effect on the number of infrastructure projects reaching financial close, particularly during 2008.

This research will be a much needed contribution to the construction industry of Pakistan. It will assist government and private entities involved in construction industry to finance long term infrastructure development in Pakistan.

The same topic with little expansion can also be used for the doctoral studies in this field and the future readers will have a baseline to start from, in order to carry out further research.

1.6 Advantages

Project financing offers a financial arrangement that does not hold sponsors responsible for the loan repayment on behalf of a project company in case of default of payments. This is the one of the reasons why it is chosen be project developers. It also allows for an off-balance sheet management of the debt financing, maximize the worth of the project, and avoid any limitations or bonds forcing the sponsors under their respective financial duties and to reduce political risks affecting the project.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

The use of project financing, to provide services and facilities, has been around for hundreds of years (Esty and Christov, 2002). Prior to public sector involvement, private financing was the only means to provide and improve general infrastructure. The public sector has turned to the private sector to provide infrastructure which was the responsibility of state. However, after the advent of project financing, several projects around the world have been and continue to be realized through this innovative financing arrangement. Though most projects procured through this type of financing deal with infrastructure, more recently there has been a great diversification as the concept of PF is applied to various other sectors. Concession contracts are the usual mode of choice by which private sector is engaged for provision of public infrastructure (Esty, 2004). Recently, with growing expertise and understanding of risk in PF, it has been realized that private financing is not a panacea. Hence, only certain projects are now considered for procurement through the private financing worldwide (Gatti, 2013).

The main stakeholders in PF are the project sponsors who invest in the SPV company, the local government and frequently some state organizations, the construction and engineering companies, legal teams who design the contracts necessary to assigning project risks and responsibilities, accounting, financial and risk assessment experts who advise the principle players and evaluate project risks, and the banks that organize and lead the banking syndicate financing the project debt (Gatti, 2013). An effective project finance scheme is built on cautious

examination of all project risks which it face in its commercial life. These risks can be related to operation phase or the construction stage, when the project is still unable to produce revenue. (Finnerty, 2013). These risks are a critical factor in project financing since these are the cause for unforeseen changes in the capability of the venture to reimburse cost, debt service and shareholder's disbursements. Typically, at its simplest, the governments seek to utilize PF to provide for infrastructure and utilities and thereby attain value for money by transferring crucial risks in execution to private sector bodies for them to manage and service the project loan (Morrison, 2016).

2.2 Previous Literature

Rajan Annamalai and Jain (2013) reported that the overall value of project financing arranged globally hit a record high of $321 billion during 2008, and plummeted only 9% to the second highest annual total of $293 billion in 2009. The advancement of PF has been strong, specifically in Asia, with volumes up to 57% over 2008 to a record of $104 billion during 2009. The level of penetration of project financing is evident from India's spending of $54.8 billion and USA's $13.42 billion during 2010 (Gardner and Wright, 2012). In addition to infrastructure projects, the power sector attracted more PF during 2009 than any other sector, and debt financing accounted for 81% of the total PF volume. Undoubtedly, PF has been gaining global financing market share over the past two decades, especially as a vehicle for channelling development capital to developing markets.

Due to its significance, many theoretical (Chemmanur and John, 1996; Daube et al., 2008; Byoun and Xu, 2014; Ismail, 2014; Miglo, 2016; Bayar et al., 2016), descriptive (Kensinger and Martin, 1988; Brealey et al., 1996; Kleimeier and

Megginson, 2000; Esty and Christov, 2002; Blanc-Brude and Strange, 2007; Corielli et al., 2010)] and empirical (Esty and Megginson, 2003; Sorge, 2004; Dailami and Hauswald, 2007; Sorge and Gadanecz, 2008; Chen et al., 2015) studies on PF have thus far been conducted.

Previous studies in the domain of PF examined various areas of general interest. Tung and Subramanian (2009) studied nonfinancial contracts for their impact on pricing of financial contracts. Corielli et al. (2010) inspected the credibility of lead arranging banks in PF loan covenants. Similarly, Borgonovo et al. (2010) investigated the impact of a nation's legal structure on PF arrangements and other forms of debt. Kleimeier and Versteeg (2010) examined the role of PF in 90 countries with data ranging from years 1991 to 2005. The study suggested that PF is at the heart of economic growth as is able to compensate for a lack of domestic financial resources. The study predicted that contractual structure unique to project financing leads to better management of investment and governance. Collectively, these studies have significantly increased the understanding of project financing and its importance in global economy.

2.3 Alternative Financing Approaches

There has been a shift in methods of financing in the previous few decades; from the use of limited-recourse financing in the 1970's through the early 1980's where there was a change from public into private sector financing, to the late 80's where innovations in limited recourse financing, debt, equity, swaps and barter arrangements, as well as some sophisticated co-financing arrangements using multilateral aid, and/or exports credits caused financial engineering to become a necessary ingredient for many, if not most major projects (Aaltonen et al., 2008).

Funding a project by either the private or public sector requires a financial evaluation and there are various approaches used when engineering the financing of a project. Giorgioni (2001), identified the public sector's financial evaluation methods as being based on a cost-benefit or cost-effectiveness philosophy; taking externalities into account such as the wider influence of the project on the community and atmosphere. The private sector on the other hand evaluates projects on the basis of the cost-benefit analysis to cover debt service, operational costs and capital repayments, and internal rate of return (IRR). Even though the capital costs of loan for government are lower than private borrowing, there could be a 20-40% difference (Muranyi, 1998). Follow-up costs must be considered when deciding to make the investment. Bruhn et al. (2010), report that a study conducted in the federal republic of Germany showed that follow-up costs of public investments, such as maintenance costs, could amount to more than 30% of the investment cost every year. These are some of the issues that must be considered when the choice of finance for a project is to be made.

2.3.1 Traditional Financing

Although not strictly a definitive term, the word *traditional* is used here to define financing arrangements that involve the client/principal (public sector) paying contractors for works carried out under contract. *"Traditionally, private sector involvement in road networks was limited to implementation tasks (detailed studies, civil engineering, material and equipment supply) and went through short term or medium term contracts"* (Sinding et al., 1998).

Road infrastructure provision was entirely public, and they were seen and managed as taxpayer supported facilities i.e. free. This method of financing projects resulted

from shifting responsibility for infrastructure provision to the public sector over the years (Esty, 2014).

The funds for these projects come from the tax receipts of the government, which are then allocated in the budget. The government can also borrow from the private sector at rates lower than the market rates to finance projects (Denis and Mihov, 2003). Although these borrowings are from the private sector they still appear on the government's balance sheets and are taken into consideration by lenders assessing a government's creditworthiness. The public sector provides facilities by awarding contracts for the various works that are involved in the realization of a project. The cost of such projects is arranged from public budget with no association of interest payments (Zhang, 2005). Aside from political interferences all projects risks are covered by guarantees from public sector with the private sector's liability i.e. warranty and liquidated damages, being limited to construction operation and maintenance. There is actually no need for the public organization to identify, assess and estimate the costs of each risk, as it accepts all project risks (Muranyi, 1998). This reflects the lack of a requirement to ensure a return on all costs incurred in realizing a project, and the fact that the public sector often considers the revenue generating potential of publicly funded projects as a secondary issue.

Although the share of projects financed from the public budget is decreasing, it is still one of the main sources of financing in Europe. Bousquet (1997), identifies Germany, Finland and Denmark as countries that have always financed their roadways from the state budget. However, these countries have to consider other possibilities for financing due to the increasing traffic volumes and escalating construction costs, and reliance on ever decreasing budgets. In Denmark where

there is no link between public road expenditure and road traffic taxes, the budget of Directorate of Roads fell from DKK3.7 billion in 1972 to DKK2.6 billion in 1995 with an overall traffic increase of 75% in the same period.

2.3.2 Design and Build

Very gradually, the building industry has evolved and introduced the concept of Design and Build to combat some of the problems that are symptomatic of traditional financing. Even though every stakeholder had been performing its assigned tasks, the motivation for stakeholders to cooperate was still lacking in order to maximize benefits for the client, especially in terms of life cycle cost and quality (Chan et al., 2001).

Design and build is the idea of one party being answerable to a client for designing and construction of a facility. Turner (1993) considered this concept to have been around for quite some time though under various other names, some of which were package agreements and turnkey projects.

Some features of Design and Build are, the client is providing an early monetary assurance and that the joint obligation for design and construction is beneficial for both the parties involved (Lam et al., 2008). Since the party responsible for designing and construction of the project is same, there is a considerable degree of ease involved which leads to the benefit of both parties in terms of monetary value. Uzzi and Gillespie (2002), highlight some of the concerns of clients that may wish to utilize the Design and Build approach. Many of the mainstream contractors tend to take these kind of positions where they are responsible for both aspects, design and build, of project. In doing so, they offer very competitive services (Walker and Smith, 1995).

2.3.3 Public Private Partnerships

It is the duty of the public sector to provide infrastructure. For this purpose the decision making is mainly dependent on the funding source. The decision can be postponed due to non-availability of funds. If the developments is very crucial and it cannot be delayed, the government will either need to reallocate public funds for this purpose or the funding will have to be obtained by other means such as private organizations and bank loans (Muranyi, 1998). The resource arrangements mentioned here also include borrowing that may be contributed by the public sector, as these are included in the government's balance sheet.

Projects can be financed by the private sector by various methods and examples are out and out privatization, and joint ventures between the private and public sector (PPP). Concession contracts is most commonly used way of employing PPP schemes. This consists of use of a concession period by the public sector for a private company to design, construct and operate a project. In this time span, the company 'owns' the revenue stream of the facility and from it any debt incurred is serviced and eventually paid off, operating costs are paid and returns are made to investors in the project.

At present, there is increasing complexity in the mechanisms that are applied to finance projects and some of these, although classed as private finance, involve the public sector to a degree. In PPP's involving concessions the public sector needless to say is at pains to limit its financial commitment to the project whilst still ensuring that it obtains value for money with regard to successful risk transfer (Esty, 2004).

2.3.4 Concession Projects

A concession contract is mostly an agreement, founded on the allocation of a concession by principal, , to a promoter also known as the concessionaire, who is accountable for the financing and execution of a project in the specified period, at the end of which he will transfer the facility to the principle (Kwak, 2002). The concessionaire has full authority over the facility in this period. He operates and collects the revenues generated from the facility in order to recover his investment and generate some profit if possible (Shrestha and Ogunlan, 2006).

Concession projects are also known as BOOT projects (Build, Own, Operate and Transfer) and have several documented definitions of which the above is one (Chege and Rwelamila, 2001). These governments, governmental agencies or regulated monopolies to obtain the provision of a service or facility to the public sector whilst incurring little or no cost. Contracts are awarded to organizations that commit to providing the service or facility in exchange for a concession to run the facility and generate revenue. For the promoters to 'own' the revenue stream or 'cash flow line' for the period of concession, they must ensure that the facility or service provided meets the required specifications and standards required by the principal (Athias and Saussier, 2007).

Concession contracts are described by many other acronyms, some of which include:

BOT	Build, operate and transfer
BOO	Build, own, and operate
BOOST	Build own operate subsidize and transfer
BTO	Build, transfer and operate
BRT	Build, rent and transfer

FBOOT	Finance, build, own, operate and transfer
DBOM	Design, build, operate and maintain
BOL	Build operate and lease
BOD	Build, operate and deliver
DBOT	Design, build, operate and transfer

Some of these are alternate names for BOOT schemes and are used to define projects that differ in some aspects to BOOT but have adopted the main function of the BOOT strategy. For instance, the transfer term of BOOT projects implies the handing over of the project to the principal after a concession period; this cannot be termed as real privatization (Hallmans and Stenberg, 1999).

2.3.4.1 The Lifecycle of Concession Projects

Like all civil engineering projects, each concession project is unique, has a definable beginning and end and is undertaken to achieve certain objectives. There are different stages all through the lifecyc1e involving different organizations. The duration of concession contracts differ based on the nature of the project and predicted revenue stream, which can last from 15 to 60 years (Mccowan and Mohammed, 2004).

During the conception stage of concession projects principals determine the need for a facility or service and then ask for conceptual designs. Promoters can also come up with a conceptual idea and then try and sell it to the principal. Once the concession is awarded the final detailed design of the project starts in earnest. Construction can only start after a design is sanctioned. It is during construction that most of the cost is incurred as can be seen from Figure 2.1. Maximum use must

be made of the concession period to generate revenue and hence the payback period must be protected (Bousquet and Fayard, 2001).

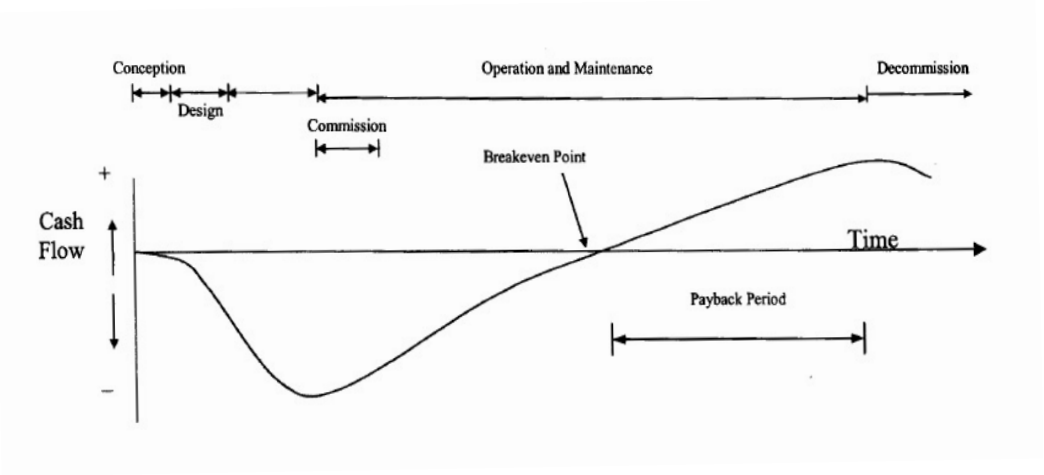

Figure 2.1: Cash flow chart during project lifecycle (Source: Bousquet and Fayard (2001))

Smith identifies two phases within the lifecycle where risks associated with financing concession projects occur (Frank and Goyal, 2009). These are:

- The construction phase
- The operations and maintenance phase.

The structuring of the contract is a key ingredient in attracting private finance; very rigid and inflexible contracts are regarded with suspicion by the private sector (Notteboom, 2006). For instance, a principal that reserves the right to terminate the concession at will (Shen and Wu, 2005), may frighten off promoters and may find the project impossible to finance.

2.3.4.2 The Principal

Normally referred to in traditional contracts as the client, the principal is the body responsible for awarding the concession for the provision of the facility, who on expiry of the concession period, takes on full ownership of the facility. Principals

are normally governments, government agencies or regulated monopolies (Merna and Njiru, 2002).

Principals are keen to transfer all the manageable risk to the promoter organization and their interests are normally limited to ensuring the continuous provision of a service or facility to the public (Dias Jr and Ioannou, 1996).

2.3.4.3 The Promoter

In concession contracts the promoter takes on the functions normally attributed to the client in traditional contracts. Also referred to as a Single Project Vehicle or Special Purpose Vehicle (SPV), the promoter organization is often a result of several organizations coming together and creating a single independent company for the purpose of realizing a particular project (Merna et al., 2010). An SPV often has minimal or no asset value and often consists of contractors or operators in a JV. The promoter, having no capital assets and yet bound by contract to the principal under the terms of the concession agreement, will therefore use secondary contracts to transfer the risks of the project to other parties (Merna and Smith, 1999). It is promoter's duty to attract finance for the project and for ensuring the success of the project, and that the following objectives, typical of concession contracts, are met:

a. Minimum financing cost;
b. Minimum cost overruns;
c. Minimum operating cost;
d. Maximum profits.

Some of the main challenges faced by promoters become apparent here - there is often conflict in achieving (a) and (b) together as projects that generally require minimum initial capital expenditure (CAPEX) often need large operating

expenditure (OPEX). Conversely, minimum OPEX normally implies large CAPEX (Grimsey and Lewis, 2002).

How do you attract the vast sums of money necessary to finance a project that is being undertaken by a company with no capital assets and hence minimal value upon liquidation? This can be difficult and complex due to the risks that are inherent in construction projects. More so for international construction projects where some of these inherent risks are not obvious from the start, even to experienced contractors. Contracting on the international stage brings with it more risks and variables such as politics, different economies, market fluctuations, inflation and devaluation (Ng and Loosemore, 2007).

2.4 Features of Project Financing

Simply put, project finance is the acquiring finances based solely on the intrinsic worth of the project (Finnerty, 2013). Hoffman elaborates rather lengthily on this definition by stating that it is a form of limited recourse financing in which debt and equity are arranged to construct and operate a facility (Hoffman, 2007).

Each project is unique in its nature but there are features associated to project finance which remain the same, and those highlighted below can be considered typical.

- An SPV is set as a separate entity. Sometimes also called a project company. It is a single independent company for the sake of realizing a certain scheme (Gatti, 2013).
- The main source of funding is debt from lenders. Equity obtained from project sponsors and shareholders is normally committed before acquiring debt (Esty and Christov, 2002). The decision of investing or lending equity and debt is based on projected cash flows of the project.

- The revenue generated from the project is used to service the debt as well as maintain the project. (Marx, 1998).

2.5 Finance for Projects: The Options

The need to remain competitive frequently necessitates investigation of various avenues for funds to finance a project. Hoffman describes the three macro variations that project finance schemes utilize as nonrecourse, limited recourse and project output interest financing (Hoffman, 2007). The first two look to the cash flows for debt repayment whilst the third is centered on the purchase of an interest in the project output.

Organizations that are involved in the provision of finance for projects include the public sector, commercial banks, pension funds and development banks. These organizations provide primary categories of funds, i.e. equity and debt, and the roles that these categories play as components of a project's financial structure (Yescombe, 2002).

With increasing demand for more privately financed projects and the application of project financing across sectors, there is increasing specializing by providers enabling the development of more efficient tools for private finance. The following sections explore the merits and demerits of the existing providers of finance for project financing.

2.5.1 The Public Sector

The public sector involvement in project financing schemes may be frowned upon since one of the major reasons involve transferring key risks to private sector through this scheme. Public sector sometimes provides a fraction of finances in

order to support the project's commercial viability. But its involvement as a guarantor is very limited.

In some projects like prisons, where there is no specific revenue stream to be generated by the project itself, public sector has to utilize the taxpayer money (Ismail, 2011). In the UK's rush to sign up private finance deals to provide infrastructure that would otherwise not be provided by public procurement, there is now a sudden realization that the government has committed itself to annual payments of over £200 million for 25 or so years into the distant future (Mackie, 2000).

2.5.2 Commercial Banks

Commercial banks are the key source of funding for projects which use private financing. Banks work as a third party between investors and borrowers. They obtain funds from the investors and lend them to borrower a certain interest margin (Williams and Conley, 2015).

According to Lewis (2013), there are three kinds of activities performed by the bank in relation to the currency used and the location; domestic, international and multinational banking.

2.5.3 Equity

Equity is basically capital assets which are provided by the investor who in return receive share of revenue according to his share in equity. Payments given to the investors are subordinate to all loan and financial liabilities of the venture. This means that dividends are paid only after debt service and other payments are made, and in the event bankruptcy, equity is lost.

Equity can be gathered by a number of sources which can include; the project sponsors, institutional lenders, insurance corporations and all participants in the project. Often it is a condition of the lenders and principals that the sponsors provide a level of equity as a degree of confidence in the project's success and to make sure that initial debt service is guaranteed. Lenders usually require that all equity available be utilized before any debt is drawn. Thus, the promoters of the projects shield the risk-averse lenders by absorbing the high risks of construction stage. The project sponsors equity contribution covers, in most cases, pre-construction, and is only part of the total equity although it can still run into millions of dollars (Blanc-Brude, 2013).

Equity is often gathered in the stock markets and from specialized assets. Equity is mainly collected through the following sources:

- Local capital markets
- International equity markets

2.5.4 Debt

Throughout the history of financing, debt is most used way of funding any development. There are a number of options available to promoters for debt, from senior loans, subordinated loans through to bonds and soft loans. The major types of debt are discussed in this section. Traditionally from an investment point of view, debt is considered a low risk low reward form of investment. This is because in theory, debt has a fixed term; the principal must be reimbursed by the final maturity date with the providers receiving interest and principal payments prior to equity distributions (Visconti, 2010).

Secured debt is obtainable for projects which have some value to its resources as a collateral; such resources must be marketable and easily exchangeable to cash. In most cases of privately financed projects mentioned in this study the value of the projects' assets is not significant relative to amount of debt incurred to realize the projects(Graham et al., 2008).

Syndicated loans enable loans to be made for single projects whose financing needs make them very large for individual banks. Numerous banks pool funds and arrange for the loan with one of these banks acting as lead. By dividing the risks related to large specific projects the banks circumvent overexposure and this in turn reduce the overall cost of finance. However, the complexity of the arrangements could be greatly increased when several banks are involved.

Types of syndicated bank loans (Esty and Megginson, 2000):

- *Traditional syndicated bank loans (floating rate).* These are based on variable rates but with a fixed maturity, drawn once and with repayments made to an agreed schedule. A period of grace is often included and the loan is normally negotiated and administered by a single lead bank, which will form a syndicate with other banks.
- *Syndicated bank loan (fixed rate).* These are very similar to the floating rate bank loans but the interest rate remains fixed throughout the term of the loan.
- *Revolving credit.* Similar to the syndicated bank loans, these allow the borrower to draw all or part of the loan and make repayments at its discretion or to an agreed schedule throughout the term of the loan.

2.5.5 Commercial Bank Loans

A commercial loan arrangement considers two project stages: the construction phase and the operation stage. For some projects the loan is separated into two agreements, one for each of the stages, with one institution providing the construction facility and another the loan for the operational phase. For other projects one agreement is devised but with different terms for the construction and operational phases (Hoffman, 2007). During the construction phase, the funds for construction are made available as required under the construction agreement. This is normally predicated on the submission of appropriate requests for funds accompanied by supporting reports.

With most new projects revenue is not generated during the initial stages and therefore interest is rolled up into the balance outstanding; the interest payments are allowed for and included in the construction loan proceeds.

Debt financing provides the bulk of funds for most projects to date, and with unsecured, secured and syndicated loan facilities, debt financing can be adopted at suitable terms tailored to each individual project.

2.5.6 Bonds

Bonds are pieces of paper that state that the issuer/the borrower promises to pay whoever owns the bond, i.e. the lender/bondholder, certain interest payments at specified dates in the future. The principal/loan is also paid off at a specified date, i.e. at maturity. Normally bonds are issued with coupons attached that bondholders can clip and send in every six months or every year and for this reason bonds are often referred to as *coupon securities* (Flandreau and Flores, 2009).

Lin et al. (2013), classify bonds into Domestic, International and Foreign bonds. Bonds issued by borrowers in their country of residence are domestic bonds. International bonds are issued by borrowers in countries other than that of their residence and can take the form of foreign bonds. Foreign Bonds are issued by non-resident borrowers, on the market of a single country and in that country's currency. Bonds issued without coupons are referred to as *zero coupon bonds.* These are sold at a value far less than their stated face value with the difference representing the interest that will be earned by the holder over the life of the security. *Perpetual bonds* are those that are issued without a finite maturity date and promise to pay interest indefinitely without any contractual obligation to repay the principal (Li and Richie, 2009).

Bonds differ on grounds of their taxability, call provisions and conversion features. Certain bonds issued by state governments have their interest payments exempted from taxation. This is obviously important to investors when considering investments.

In many ways, bond financing is the ideal source of finance for infrastructure. Although the costs are higher than with syndicated loans, bonds have much longer maturities (ten to thirty years with even longer maturities available to creditworthy issuers). Bond finance is one of the most rapidly developing financing instruments for infrastructure finance. However, there is the opinion that bonds provide a lower degree of flexibility relating to possible cost overruns, cost savings during the construction phase and repayment delays during the operations phase (Chan and Cheung, 2014).

2.5.7 Mezzanine Finance

Mezzanine financing has distinctiveness of both debt and equity. This type of loan falls somewhere between senior debt and equity. Preference shares and subordinated debt are examples of mezzanine capital. Mezzanine financing is used when there is a gap between senior debt and sponsors equity. It is supplied when senior debt providers are not prepared to increase the level of debt and the sponsors cannot invest more equity due to the small size of equity provided by the sponsors or specific project circumstances (Akbiyikli et al., 2006).

There is an acknowledgement by Jessop that there has been a move in the market for tranches of mezzanine debt to be provided in place of loan stock or equity (Jessop, 2013). Jessop also concurs with Levine by defining mezzanine finance as expensive debt as opposed to cheaper equity and though it is an important financial instrument for large scale, complex project deals its application in smaller deals may be limited.

2.6 Factors Affecting Debt Based Project Financing

Following table shows probable factors affecting debt based project financing collected from previous studies and literature review. It does not take into consideration any significant value, they are arranged on the basis of frequency in different studies.

Table 2.1: Frequency analysis of factors affecting debt financing

Sr.	Factors affecting debt based project financing	Frequency	References
1	Interest rate	8	(Gatti, 2013; Ng and Loosemore, 2007; Grimsey and Lewis, 2004; Cottle, 2003; Patramanis, 2006; Grimsey and Lewis, 2002;

			Bloomfield et al., 1998; Bing et al., 2005)
2	Inflation	7	(Gatti, 2013; Ng and Loosemore, 2007; Grimsey and Lewis, 2004; Cottle, 2003; Patramanis, 2006; Mojtahedi et al., 2010; Bing et al., 2005)
3	Market/Revenue	5	(Gatti, 2013; Grimsey and Lewis, 2004; Cottle, 2003; Patramanis, 2006; Dailami et al., 1999)
4	Design	5	(Gatti, 2013; Ng and Loosemore, 2007; Grimsey and Lewis, 2004; Grimsey and Lewis, 2002; Bloomfield et al., 1998)
5	Political	5	(Gatti, 2013; Ng and Loosemore, 2007; Grimsey and Lewis, 2004; Cottle, 2003; Patramanis, 2006)
6	Environmental	4	(Gatti, 2013; Ng and Loosemore, 2007; Grimsey and Lewis, 2004; Dailami et al., 1999)
7	Regulatory	4	(Gatti, 2013; Ng and Loosemore, 2007; Grimsey and Lewis, 2004; Cottle, 2003)
8	Operation	4	(Gatti, 2013; Grimsey and Lewis, 2004; Cottle, 2003; Grimsey and Lewis, 2002)
9	Cost overruns	4	(Gatti, 2013; Ng and Loosemore, 2007; Bloomfield et al., 1998; Dailami et al., 1999)
10	Performance	4	(Gatti, 2013; Grimsey and Lewis, 2004; Cottle, 2003; Dailami et al., 1999)
11	Legal	3	(Gatti, 2013; Ng and Loosemore, 2007; Grimsey and Lewis, 2004)
12	Supply	3	(Gatti, 2013; Ng and Loosemore, 2007; Grimsey and Lewis, 2002)
13	Planning	3	(Gatti, 2013; Cottle, 2003)
14	Force majeure	3	(Gatti, 2013; Ng and Loosemore, 2007; Grimsey and Lewis, 2004)
15	Time overruns	3	(Ng and Loosemore, 2007; Grimsey and Lewis, 2004; Cottle, 2003)

16	Exchange	2	(Gatti, 2013; Grimsey and Lewis, 2004)
17	Credit	2	(Gatti, 2013; Cottle, 2003)
18	Delays	2	(Gatti, 2013; Grimsey and Lewis, 2004)
19	Change in taxes	2	(Ng and Loosemore, 2007; Grimsey and Lewis, 2004)
20	Change in laws	2	(Ng and Loosemore, 2007; Grimsey and Lewis, 2004)
21	Expropriation and nationalization	2	(Patramanis, 2006; Bing et al., 2005)
22	Insurance	1	(Brealey et al., 1996)
23	Health and safety	1	(Mojtahedi et al., 2010)
24	Change in scope	1	(Mojtahedi et al., 2010)
25	Contract variations	1	(Bing et al., 2005)

2.7 Advantages of Project Finance to the Private Sector

Project financing is becoming ever more the option for major projects and particularly for infrastructure. The choice of project financing arises for many reasons; from corporations utilizing project finance to assist in undertaking large debt commitments with minimum risk, to entrepreneurial developers wishing to develop several projects in different geographical areas, each independent of the financial obligations of the other projects. Some of the observed and documented advantages of project financing with respect to financial management include the following:

- Non-recourse financing protects the project sponsor from any obligations in the event of failure or default. Unless otherwise agreed, recourse to the project sponsor is only to the limited extent of liability for fraudulent representations made in connection with the financing, (Chernov et al., 2015). Note that a project's financing structure may be such there is recourse to the project sponsor during a limited period. For example, if new

technology is involved the lender may take the view that there are additional risks for which the sponsor must provide full recourse or guarantee. After the successful implementation the lender releases the sponsor from recourse liability and shifts the risk to the project assets and revenue stream (Hoffman, 2007).

- Off-Sheet debt financing is an attraction of project finance from the perspective of the project sponsor. In certain countries, nonrecourse financing coupled with an appropriate ownership structure can lead to the project debt commitments being kept off the balance sheets. In these cases, the equity method of accounting is used where the investment in the sponsors Spy subsidiary is shown as a one-line entry in the balance sheet. This could maintain or even improve the company's financial ratios.
- Highly leveraged debt is often available to developers to finance projects although lenders may often require a high level of equity investment. This is related primarily to the level and nature of the initial risks involved and also to the view that there is a direct relationship between the level of equity invested and the project sponsors commitment to the project; the higher the equity level, the higher the sponsors commitment (Brusov et al., 2012).
- In the event of default or project failure lenders are more likely to participate in a workout rather than foreclose. This is as a result of the non-recourse nature of project financing. As the assets of the project have value only together with the project contracts, and the project contracts have value only if the facility operates, the lender is probably only able to recoup losses or have its debt repaid, by the continued operation of the project, i.e. not opting to foreclose and sell the assets.

2.8 Disadvantages of Project Finance to the Private Sector

As is to be expected there are disadvantages with project finance and some of these are mentioned here.

- Documentation associated with project finance is almost always lengthy and complex. The requirement of a project company to provide information to the lender is also significantly increased in project financing.
- The process of due diligence conducted by the lenders, legal counsel and experts results in higher transaction costs than would be from typical asset based lending. As the practical remedies that are available to the lenders are limited, there is a high level of due diligence coupled with strong, restrictive borrowing covenants.
- Due to lenders' reliance on the revenue stream for debt repayment, their supervision of the project is understandably greater than would be required for a corporate loan facility.
- As the financing is non-recourse in nature, insurance plays an important role for lenders and equity investors. To the extent that risks can be covered insurance is employed in the project finance structure. This may be very expensive in comparison to other financing structures.
- Risk allocation is often complex and this affects the speedy financial closure of projects, particularly in developing countries where credible assets or payment promises cannot always cover risks.
- Interest rates higher than would apply to direct loans made to the project sponsor may be incurred.

- As the promoter/project company has no recourse liability, it might be argued that the SPV may be more likely to aggressively accept risks, which may lead to a deviation from optimal risk transfer.

All in all, project finance provides another means for the realization of projects; it may be an appropriate approach for certain situations and for certain governments who are unable to provide urgently required infrastructure, but project finance is not a panacea. Its implementation must be only after consideration of the long-term implications, and extensive cost/benefit analysis by both the public and private sectors. These will reflect the differing overall time, cost and quality objectives of both sectors.

Chapter 3

RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is a body of knowledge which enables researchers to explain and analyze methods, indicating their limitations and resources, identifying their presuppositions and consequences and relating their potentialities to research advances (Miller and Salkind, 2002). Appropriation between research paradigm, type of data and collection methods has significant implications upon the research findings.

Detailed methodology of this research which is adopted to meet the objectives set forth in chapter 1 is discussed in this chapter. The research is done in six distinct phases as stated under the heading of “Research Design”.

3.2 Research Design

In first phase, after development of research proposal, extensive literature review was done to understand the basics of project financing, debt servicing and its associated risks. Probable factors affecting debt based project financing were collected from previous studies and literature review. Google Scholar was mainly used as a search tool for different scholarly papers and writings.

In second phase, an online pilot survey was developed from extensive literature review, and then it was floated to professionals. Data collected from survey was analyzed using MS Excel. Factors were ranked based on the combination of risk score from survey and frequency analysis carried out on the literature identified factors.

In third phase, outputs from the survey were used to generate a visual model of risks affecting the debt-equity ratio in a software namely Vensim PLE. The inter relation of risks was also taken into consideration in this model.

In the fourth phase, data were collected by personally interviewing seasoned construction professionals occupying managerial and decision making positions. Every participant was briefed about the nature and scope of research to receive most realistic response.

In next phase, data collected from interviews was analyzed and mathematically modelled using software tools such as MS Excel. Generated model was used to predict the debt-equity ratio based on a number of inputs. In final phase conclusions and recommendations were formulated.

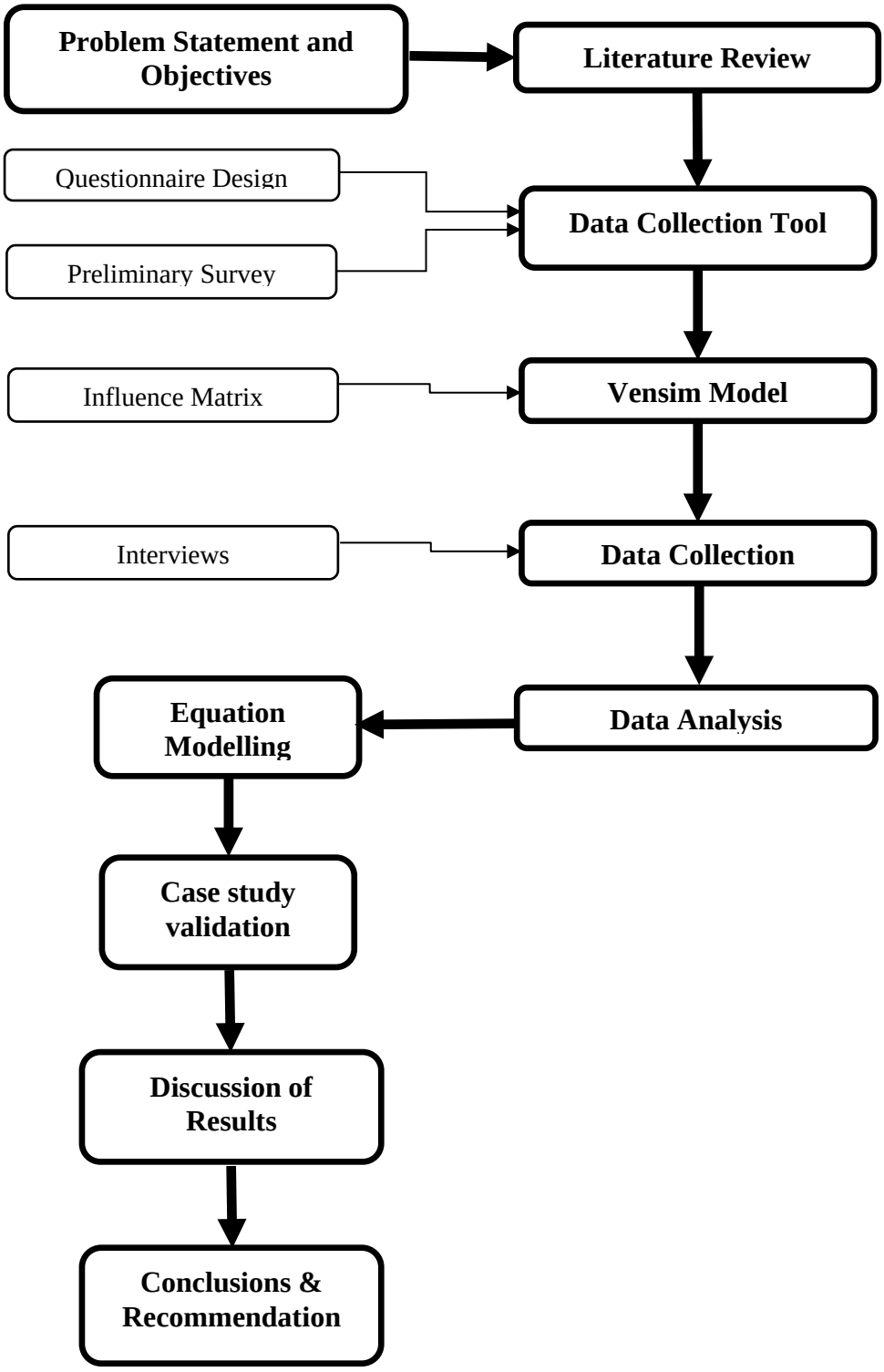

Figure 3.1: Research methodology

3.3 Preliminary Survey

In order to come up with factors affecting debt-equity ratio scholarly papers regarding project finance were studied. Over 103 writings were collected and 24 were found relevant giving a relevance index of approximately 23%. A total of 25 factors were identified as a result.

Preliminary survey were conducted by online and physical meetings to rank and find the respective weights for identified risk factors. To perform representative and significant data collection, a sample of 23 respondents, as suggested by Babar et al. (2016), is selected. Respondents are asked to score the impact and probability of the factors on debt-equity ratio on a Likert scale of 1 to 5 where 1 represents minimum impact or probability and 5 represents maximum impact or probability. Adopting methodology from (Barlish et al., 2013), a combined rank list incorporating both ranks of pilot survey and literature frequency was generated. Top 13 factors from the list were considered for further study.

Questionnaire survey is attached in Annexure I.

3.4 Data Analysis

Statistical tests that include Cronbach's alpha to check reliability of data, Anderson Darling to check normality, and Spearman's Rho to find correlation between the frequencies of identified risks in literature and pilot survey were applied. The shortlisted factors were then checked for their effect on each other by forming an influence matrix based on expert opinion using Delphi technique of data gathering.

3.5 Model Development

For the purpose of model generation systems dynamics software tool Vensim PLE was used. A graphical model was generated to study the behavior of factors

affecting the debt-equity ratio. By studying the model, it was observed that inter-relation of factors must also be taken into account to generate a realistic model.

3.5.1 Interviews

To establish a link between the factors identified via the literature, 10 field professionals were engaged for detailed interviews where they were asked open ended questions. Main method for interviews was one to one interview with the exception of one which were taken over phone. Projects managers were asked of their personal information, professional experience and the designed questions for the study. Interviews usually lasted between 30 to 40 minutes. Interview questionnaire is attached in Annexure II.

3.5.2 Equation Modelling

Equation modelling was done over MS Excel in the form of a decision support sheet. The equations derived from the data were fed into the model and results were generated. To illustrate the working model, Vensim PLE modelling software was used to generate a hybrid simulation model using system dynamics. Vensim PLE simulation helped us to observe the random behavior of factors and their effect on each other, and their impact on debt-equity ratio. Sensitivity analysis of the mathematical model was performed using @Risk® 5.5.

3.5.3 Case Studies

To validate the proposed model and check its behavior when applied to real life construction projects, two case studies are done. The case studies include ongoing road infrastructure projects with known debt-equity parameters. Project managers were asked to apply their knowledge of their respective project to the model in

order to come up with the forecasted debt-equity ratio. Comparison is established between actual and forecasted values of financial mix afterwards.

Chapter 4

RESULTS AND ANALYSIS

4.1 Introduction

This chapter consists of the analysis on the collected data. Results are drawn and discussion is done over various findings in relevant sections.

4.2 Literature Review

Pertinent literature regarding PF, debt-equity ratio and debt servicing for monitoring project success and investment risk behavior were studied to develop a methodology for this research. A total of 25 risk factors were identified from 17 research papers published between years 1995 – 2016. The years of publication were constrained to encapsulate a larger body of risk factors contributing to better decision-making. The corresponding frequency for each risk was recorded for assessing the relative importance of factors in the published literature. Highest ranked 10 factors are given in Table 4.1 with their normalized score out of 10.

Table 4.1: Literature based factor ranking

Rank	Performance Indicator	Frequency	Criticality Percentage	Score (out of 10)
1	Interest rate fluctuation	8	72.7273	7.272727
2	Inflation	7	63.6364	6.363636
3	Market/Revenue risks	5	45.4545	4.545455
4	Design Changes	5	45.4545	4.545455
5	Political risks	5	45.4545	4.545455
6	Environmental risks	4	36.3636	3.636364
7	Regulatory risks	4	36.3636	3.636364
8	Operational risks	4	36.3636	3.636364
9	Cost overruns	4	36.3636	3.636364

10	Performance risks	4	36.3636	3.636364

4.3 Pilot Survey

To perform representative and significant data collection, a sample of 10-40 respondents, as suggested by Babar et al. (2016), is selected. Respondents are asked to score the impact and probability of the factors on debt-equity ratio on a Likert scale of 1 to 5 where 1 represents minimum impact or probability and 5 represents maximum impact or probability. Statistical tests that include Cronbach's alpha to check reliability of data, Anderson Darling to check normality, and Spearman's Rho to find correlation between the frequencies of identified risks in literature and pilot survey are applied.

Geographic segmentation of respondents is given in Table 4.2. Similarly experience segmentation of respondents is given in Table 4.3.

Table 4.2: Geographic segmentation of respondents

Country	Responses
Pakistan	11
UAE	4
Australia	2
USA	1
Kingdom of Saudi Arabia	1
Thailand	1
UK	1

Table 4.3: Experience segmentation of respondents

Years	Number of Respondents
Entry Level (0 to 3)	6
Intermediate Level (3 to 8)	12
Managerial Level (more than 8)	5

4.3.1 Cronbach's Coefficient Alpha Method

For the checking of reliability of the data collected on Likert scale Cronbach's Alpha method was used. If this value is greater than 0.7, the data is reliable. Further, if the value is greater than 0.9, the data is highly consistent for use (Gliem and Gliem, 2003). The value of Cronbach's Alpha came out to be 0.87 so the data was reliable for further analysis.

4.3.2 Shapiro-Wilk Test

Before using other test first normality of data was checked. It is important to check the normality of the data because if the data is not normal then further tests are different for non-parametric data. As the sample size was less than 2000 Shapiro-Wilk test was used to check the normality of the data. After the data analysis, it was found that the data parametric. The value of Rs was 0.52 and the two-tailed value of p was 0.04. By normal standards, the association between the two variables would be considered statistically significant.

The data collected through the questionnaire survey was analyzed and ranked using the RII as per Chinyio et al. (1998). Using equation 4.1, RII was calculated for each factor available in the questionnaire by transforming the scale and assigning weighting. It was then used to determine the ranks of each factor.

$$\boldsymbol{RII = \frac{\sum W}{A\,x\,N} \quad (0 \leq RII \leq 1)} \qquad \textbf{Equation } 4.1$$

Where:

w = Weight given to each factor by the respondents

A = Highest weight (i.e. 25 in this case)

N = Total number of respondents (i.e. 23)

On the basis of the analysis, the results of the findings are ranked and top 10 factors are presented in Table 4.4.

Table 4.4: Pilot survey ranking

Rank	Performance Indicators	PI score	RII	RII (out of 10)
1	Design Changes	338	0.587826087	5.878261
2	Cost overruns	302	0.525217391	5.252174
3	Interest rate fluctuation	296	0.514782609	5.147826
4	Legal risks	294	0.511304348	5.113043
5	Market/Revenue risks	275	0.47826087	4.782609
6	Delay risks	260	0.452173913	4.521739
7	Inflation	259	0.450434783	4.504348
8	Planning risks	259	0.450434783	4.504348
9	Scope changes	247	0.429565217	4.295652
10	Contract variations	246	0.427826087	4.278261

Pilot study resulted in a diverse background led response which provided insight to the mentalities of project managers and what do they think about these factors in general regarding the project.

4.4 Variation in PI Scores

To illustrate the difference between the PI scores of literature review and pilot survey, a line chart is plotted and given in Figure 4.1. This chart illustrates the difference between the thinking of researchers as in posted literature and field professionals.

The chart shows that the two main criteria of the project success i.e. cost and time, are of prime concern to both researchers and field professionals but some other indicators such as contract variations and safety, there is still a lack of adoption from both sides showing resilience of traditional managerial mind set.

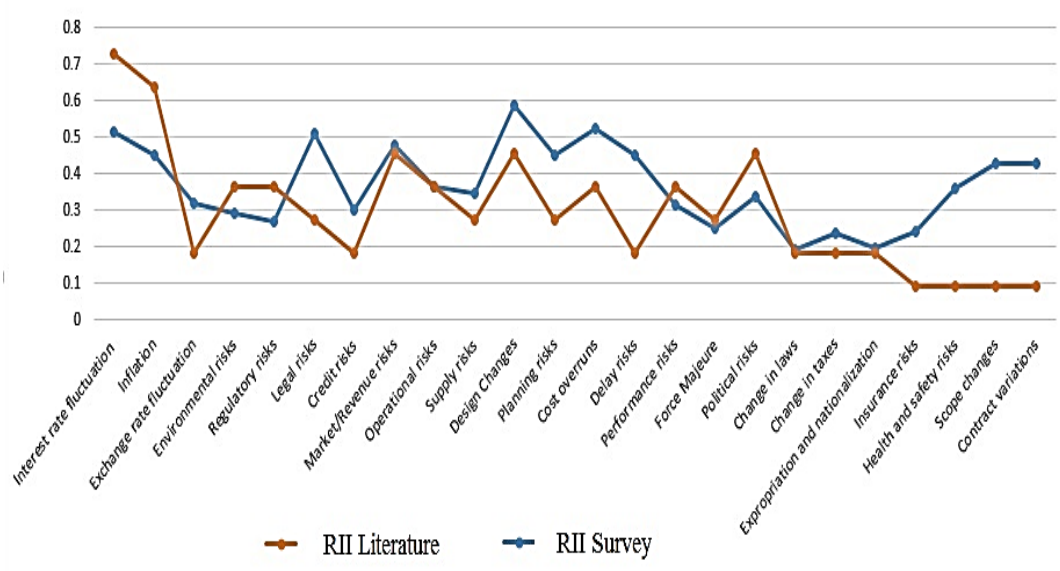

Figure 4.1: Variance of survey vs literature

4.5 Combination of PI Scores

Both scores of factors from literature and pilot study were then averaged to get a total combined score for a respective factor. Factors were then ranked in order of their highest to lowest scores. Since it was unfeasible to consider all the PIs for further study, decision was made to consider 13 factors that lie above the 80% cumulative score. Maximum score for any factor was 37.43 and minimum score of the factor considered for further study was 9.43 whereas lowest score obtain in all these factors was 2.21. List of factors retained for further study are highlighted in the given Table 4.5.

Table 4.5: Combine ranks from literature review and pilot survey

Rank	Performance Indicator	Pilot Survey Score	Literature Review Score	Total Score
1	Interest rate fluctuation	5.147826	7.272727	37.43874
2	Inflation	4.504348	6.363636	28.66403
3	Design Changes	5.878261	4.545455	26.71937
4	Market/Revenue risks	4.782609	4.545455	21.73913

5	Cost overruns	5.252174	3.636364	19.09881
6	Political risks	3.391304	4.545455	15.41502
7	Legal risks	5.113043	2.727273	13.94466
8	Operational risks	3.652174	3.636364	13.28063
9	Planning risks	4.504348	2.727273	12.28458
10	Performance risks	3.165217	3.636364	11.50988
11	Environmental risks	2.921739	3.636364	10.62451
12	Regulatory risks	2.713043	3.636364	9.86561
13	Supply risks	3.46087	2.727273	9.43874
14	Delay risks	4.521739	1.818182	8.22134
15	Force Majeure	2.521739	2.727273	6.87747
16	Exchange rate fluctuation	3.182609	1.818182	5.78656
17	Credit risks	3.026087	1.818182	5.50198
18	Change in taxes	2.4	1.818182	4.36364
19	Scope changes	4.295652	0.909091	3.90514
20	Contract variations	4.278261	0.909091	3.88933
21	Expropriation and nationalization	1.965217	1.818182	3.57312
22	Change in laws	1.947826	1.818182	3.5415
23	Health and safety risks	3.6	0.909091	3.27273
24	Insurance risks	2.434783	0.909091	2.21344

4.6 Polarity of Factors

In order to determine the polarity of each factor on other factors an influence matrix was developed which is shown in Figure 4.2 below. Delphi technique was used in order to come up with polarities of each relation of the selected factors.

Table 4.6: Influence matrix

INFLUENCE MATRIX	Interest rate fluctuation	Inflation	Design Changes	Market / Revenue risks	Cost overruns	Political risks	Legal risks	Operational risks	Planning risks	Performance risks	Environmental risks	Regulatory risks	Supply risks
Interest rate fluctuation				-1						-1			1
Inflation	1		1		1		1			-1			1
Design Changes				-1	1	0	1		0	0			0
Market/Revenue risks							0						
Cost overruns			0	0			-1			-1			
Political risks	0	0	0		1								
Legal risks			0	1	1				1			1	
Operational risks							1						
Planning risks			0		1		1			1			1
Performance risks			0		1		1						
Environmental risks				1	1					1			
Regulatory risks								0					
Supply risks					1								

4.7 Graphical Model

For the purpose of coming up with a model which will give us a reliable debt-equity ratio a model was developed using the short-listed factors and influence matrix developed in previous phase. Vensim PLE a system dynamics tool was used to generate the model. A graphical representation of the model in shown in the Figure 4.3.

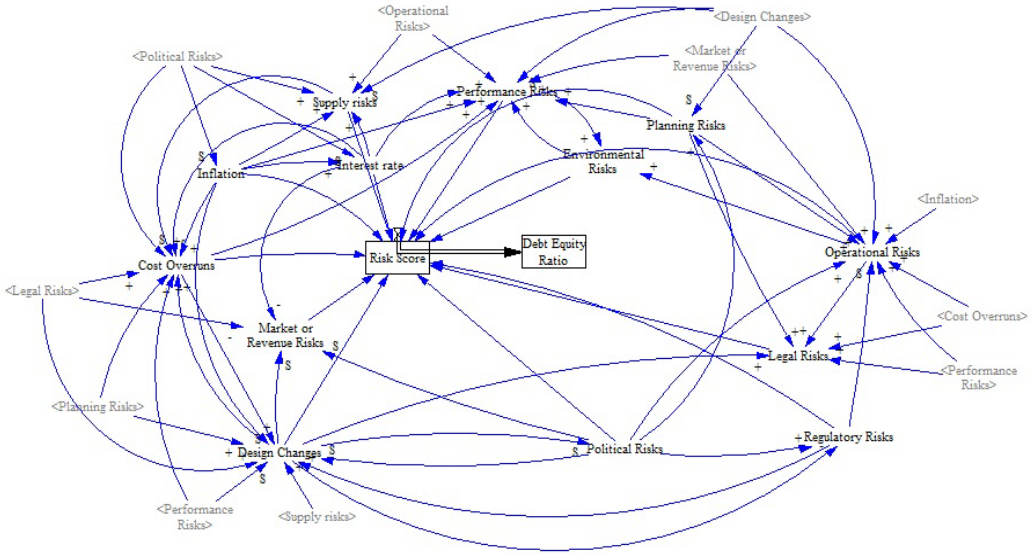

Figure 4.2: Graphical model of interrelationship of factors

4.8 Interview Questionnaire

In order to transform this model into a decision making tool for the purpose of modelling debt-equity ratio the relation of inter dependent factors had to be quantified. For this purpose, a questionnaire based study in the form of interviews was conducted. Ten interviewees having significant knowledge and experience of project financing were short listed and contacted. They were asked to rate the effect of each factor on other factors based on their understanding of project financing. Their responses and suggestions had been noted down and the results are shown in Table 4.6. The interview questionnaire is attached in Annexure II for review.

Table 4.7: Interview results

Factor	Influencing Factor	Polarity	Avg. Score	Std. Dev	Mean Weight	Normalized Weight
Interest Rate Fluctuation	Market / Revenue risks	-	3.2	0.92	0.64	0.2644
	Cost overruns	+	3.8	1.14	0.76	0.3140
	Performance risks	+	2.3	0.82	0.46	0.1901
	Supply risks	+	2.8	1.13	0.56	0.2314
Inflation	Interest rate fluctuation	+	3.2	0.78	0.64	0.1561
	Design Changes	+	2.1	0.87	0.42	0.1024

	Market / Revenue risks	+	3.1	0.87	0.62	0.1512
	Cost overruns	+	3.4	1.07	0.68	0.1658
	Operational risks	+	3.1	0.73	0.62	0.1512
	Performance risks	+	2.6	1.07	0.52	0.1268
	Supply risks	+	3	1.05	0.6	0.1463
Design Changes	Market / Revenue risks	+	2.7	1.05	0.54	0.1205
	Cost overruns	+	3.3	0.94	0.66	0.1473
	Political risks	+	1.6	1.07	0.32	0.0714
	Legal risks	+	2.3	1.15	0.46	0.1026
	Operational risks	+	2.6	0.96	0.52	0.1160
	Performance risks	+	2.5	0.84	0.5	0.1116
	Environmental risks	+	2.1	1.28	0.42	0.0937
	Regulatory risks	-	2.6	1.17	0.52	0.1161
	Supply risks	+	2.7	1.05	0.54	0.1205
Market/ Revenue risks	Operational risks	+	3.3	0.82	0.66	0.5409
	Performance risks	+	2.8	0.78	0.56	0.4590
Cost Overruns	Design Changes	+	4	0.94	0.8	0.3101
	Legal risks	+	3.1	1.10	0.62	0.2403
	Operational risks	+	3.1	0.73	0.62	0.2403
	Performance risks	+	2.7	0.94	0.54	0.2093
Political risks	Interest rate fluctuation	+	3.6	0.69	0.72	0.1276
	Inflation	+	3.5	0.84	0.7	0.1241
	Design Changes	+	3	0.94	0.6	0.1063
	Market / Revenue risks	+	3	0.81	0.6	0.1063
	Cost overruns	+	3.7	1.25	0.74	0.1312
	Operational risks	+	2.8	0.78	0.56	0.0993
	Planning risks	+	2.9	0.99	0.58	0.1028
	Regulatory risks	+	2.9	1.37	0.58	0.1028
	Supply risks	+	2.8	1.22	0.56	0.0992
Legal risks	Design Changes	+	2.3	0.82	0.46	0.2875
	Market / Revenue risks	-	2.7	1.25	0.54	0.3375
	Cost overruns	+	3	0.81	0.6	0.375
Operational risks	Legal risks	+	2.9	1.10	0.58	0.3625
	Performance risks	+	3	0.94	0.6	0.3750
	Environmental risks	+	2.1	1.10	0.42	0.2625
Planning risks	Design Changes		3.7	1.25	0.74	0.1778
	Cost overruns	+	4.1	0.99	0.82	0.1971
	Legal risks	+	2.6	0.96	0.52	0.1250
	Operational risks	+	3.5	1.08	0.7	0.1682
	Performance risks	+	3.6	0.96	0.72	0.1731

	Supply risks	+	3.3	0.94	0.66	0.1586
Performance risks	Design Changes	+	2.3	1.15	0.46	0.1678
	Cost overruns	+	3.9	0.87	0.78	0.2846
	Legal risks	+	2.4	0.84	0.48	0.1751
	Operational risks	+	3.3	0.94	0.66	0.2408
	Environmental risks	+	1.8	0.78	0.36	0.1313
Environmental risks	Performance risks	+	2.2	0.78	0.44	0.5116
	Regulatory risks	+	2.1	0.99	0.42	0.4883
Regulatory risks	Design Changes	+	3.2	1.03	0.64	0.4923
	Operational risks	+	3.3	0.67	0.66	0.5076
Supply risks	Design Changes	+	3.3	1.15	0.66	0.4714
	Cost overruns	+	3.7	1.06	0.74	0.5285

4.9 Mathematical Model

The model using MS Excel was created as a decision support tool in which inputs are given according to the specified project and combined factor score is obtained as a result which can be interpolated to obtain debt-equity ratio of that project.

In order to calculate the combined risk effect (CRE) on the project debt ratio, as given in Equation 2, the value of a particular risk is determined by summing the normalized individual weight of a risk multiplied with the perspective effect of other risks, which is based on the project risk behavior. This behavior is subjectively quantified through expert opinion. The value of CRE is calculated by adding these individual values for each risk multiplied with their respective normalized group weightings.

$$\boldsymbol{CRE_i = \omega_i * \alpha_i} \qquad (\mathbf{0 \le CRE_i \le 1}) \qquad \textbf{Equation 2}$$

In Equation 2, ω_i is the factor weight for risk behavior, 'α_i' is perspective normalized value of factor calculated using Equation 3, where κ_i is the initial factor value assigned to each factor as an input, ranging from 0 to 1, when running the model and $\gamma_i$is the factor interaction influence.

$$\boldsymbol{\alpha_i = (\kappa_i + \gamma_i)/2} \qquad (\mathbf{0 \le \alpha_i \le 1}) \qquad \textbf{Equation 3}$$

The factor interaction influence that quantifies the total effect of influencing factors is determined by using Equation 4.

$$\gamma_i = \sum_{j=1}^{n} k_j * \beta_j \qquad \textbf{Equation 4}$$

Incorporating Equation 3 into Equation 4 gives us;

$$\alpha_i = \left(\kappa_i + \sum_{j=1}^{n} k_j * \beta_j \right) / 2 \qquad (0 \leq \alpha_i \leq 1)$$

Similarly,

$$CRE_i = \omega_i (\kappa_i + \sum_{j=1}^{n} (k_j * \beta_j)) / 2 \quad (0 \leq CRE_i \leq 1) \qquad \textbf{Equation 5}$$

In Equation 5, β_j is the effect of an influencing factor on other corresponding factors. To find the complimentary weightings of this influence, detailed interviews of highly experienced professionals associated in decision making of debt-equity ratio are conducted. Sample size for number of interviews is kept to 11. Cronbach's Alpha test is applied to check the reliability of the data obtained through interviews. The results obtained for each index are normalized and are incorporated in Equation 5 to develop the final equation for forecasting.

Table 4.8: Mathematical model

Factors	Influencing Factors	Initial Value	Factor Influence	Influenced Value	Nor. Infl. Value	Factor Weight
Interest Rate fluctuation	Market / Revenue	1	0.471	1.471	0.735	0.374
	Cost overruns					
	Performance risks					
	Supply risks					

Inflation	Interest rate fluctuation	1	1	2	1	0.286
	Design Changes					
	Market / Revenue					
	Cost overruns					
	Operational risks					
	Performance risks					
	Supply risks					
Design Changes	Market / Revenue	1	0.767	1.767	0.883	0.267
	Cost overruns					
	Political risks					
	Legal risks					
	Operational risks					
	Performance risks					
	Environmental risks					
	Regulatory risks					
	Supply risks					
Market/ Revenue risks	Operational risks	1	1	2	1	0.217
	Performance risks					
Cost overruns	Design Changes	1	1	2	1	0.19
	Legal risks					
	Operational risks					
	Performance risks					
Political risks	Interest rate fluctuation	1	1	2	1	0.15
	Inflation					
	Design Changes					
	Market / Revenue					
	Cost overruns					
	Operational risks					
	Planning risks					
	Regulatory risks					
	Supply risks					
Legal risks	Design Changes	1	0.325	1.325	0.6625	0.139
	Market / Revenue					
	Cost overruns					
Operational risks	Legal risks	1	1	2	1	0.132
	Performance risks					
	Environmental risks					
Planning risks	Design Changes	1	1	2	1	0.122
	Cost overruns					
	Legal risks					
	Operational risks					

	Performance risks					
	Supply risks					
Performanc e risks	Design Changes	1	1	2	1	0.115
	Cost overruns					
	Legal risks					
	Operational risks					
	Environmental risks					
Environmen tal risks	Performance risks	1	1	2	1	0.106
	Regulatory risks					
Regulatory risks	Design Changes	1	1	2	1	0.098
	Operational risks					
Supply risks	Design Changes	1	1	2	1	0.094
	Cost overruns					

The calculations for combined risk effect of the factor interest rate fluctuation are shown for a better understanding of the model. Substituting the corresponding value in Equation 5 for interest rate fluctuation, assuming maximum effect i.e. $\kappa_i = 1 \; and \; \kappa_j = 1$, give us

$$CRE_{interst\ rate\ fluctuation} = \omega_{interst\ rate} * 0.5\ (\kappa_{interest\ rate} + \sum_{j=1}^{n}(k_j * \beta_j))$$

$$CRE_{interst\ rate\ fluctuation} = 0.37 * 0.5\ (1 + (-\kappa_{market} * \beta_{market} + \kappa_{cost} * \beta_{cost} + \kappa_{performance} * \beta_{performance} + \kappa_{supply} * \beta_{supply}))$$

$$CRE_{interst\ rate\ fluctuation} = 0.186\ (1 + (-1 * 0.2644 + 1 * 0.3140 + 1 * 0.1901 + 1 * 0.2314))$$

$$CRE_{interst\ rate\ fluctuation} = 0.2754$$

It is deduced that a maximum effect of 0.2754 can be exerted by interest rate fluctuation on the debt-equity ratio. Similarly, minimum combined risk effect of interest rate fluctuation can be calculated by substituting the minimum values of market, cost overruns, performance and supply risks in the equation. The value comes out to be zero. In this way, maximum and minimum effect exerted by top 13 factors are calculated. The minimum value is always zero and therefore not reproduced. However, the maximum value for each factor is show in Table 4.9.

Table 4.9: Maximum CRE scores

Rank	Factor	Maximum CRE
1	Interest rate fluctuation	0.2753
2	Inflation	0.2866
3	Design Changes	0.2361
4	Market/Revenue risks	0.2174
5	Cost overruns	0.1909
6	Political risks	0.1541
7	Legal risks	0.0924
8	Operational risks	0.1328
9	Planning risks	0.1228
10	Performance risks	0.1151
11	Environmental risks	0.1062
12	Regulatory risks	0.0986
13	Supply risks	0.0943
Total		2.1231

Calculating the maximum *CREs* for all the factors and adding them gives us a maximum score of $CRE_{total} = 2.12$.

4.10 Co-relating debt-equity ratio

Factor score obtained from mathematical model correlates to debt-equity ratio established in previous studies and existing practices. A typical debt-equity ratio ranges between 90:10 and 50:50 (Yescombe, 2002). A project with greater than average risk exposure tends to scare away the investors which in turn leaves debt as the dominant instrument for project funding. Equity investors on the other hand are risk averse in nature and tend to go with projects having lower than average risk (Chaplinsky and Haushalter, 2010).

Following this rationale, the current study correlates the total CRE score with maximum and minimum acceptable debt ratio range to find an optimal capital structure for a project. A graph is plotted between CRE scores (R) and debt ratios (D) in Figure 4.3.

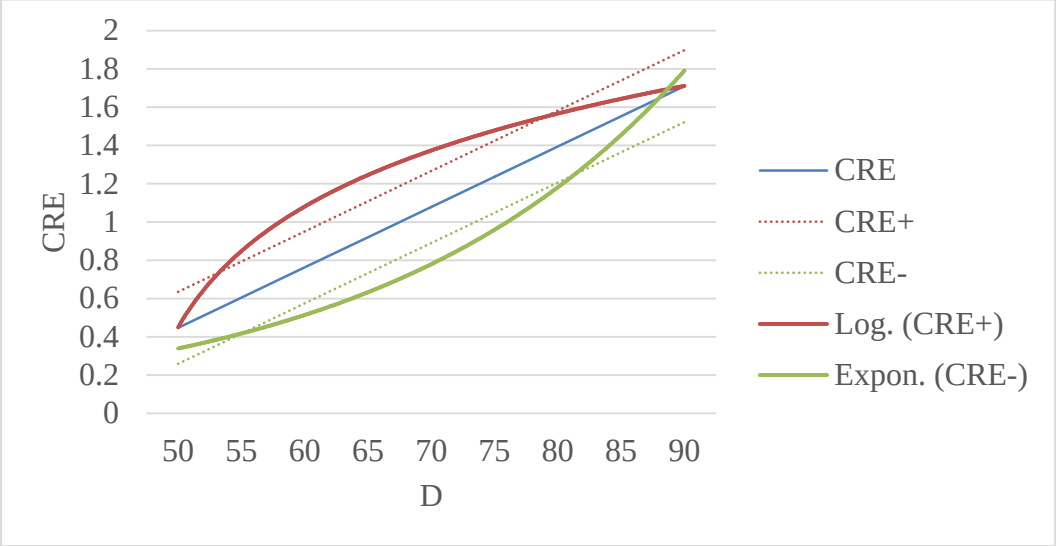

Figure 4.3: CRE score vs Debt ratio graph

Using Figure 4.3, debt (D) can be calculated from the project CRE score. Debt ratio can then be used to find the equity ratio as their sum is 1. This ratio varies from project to project. Gardner and Wright (2012) suggest that it is rare for projects to have a debt-equity ratio of less than 60-40 and it increases to 90-10 in certain projects such as social infrastructure. Yescombe (2002) found these debt-equity limits to range between 50-50 and 90-10. The current study banks upon these findings and fixes the debt between 50% and 90%.

Further, CRE score is categorized into upper limit CRE (R+) and lower limit CRE (R-) to account for the behavioral aspect of decision maker in determining debt ratio. This is done by dividing debt ratio into equal intervals. Against each ratio of debt, the corresponding CRE score is calculated. Standard deviation of these CRE scores is calculated and a range for each point of debt ratio is calculated by adding

and subtracting one standard deviation to obtain lower CRE and upper CRE limits. Further, these scores are attributed to the decision maker's risk attitude.

Since there is an element of uncertainty involved due to introduction of risk in the decision making process, risk behavior of decision maker is taken into account by applying the Bernoulli utility function (Schoemaker, 2013). Stakeholder's attitude towards risk is either averse, neutral or seeking. Risk-averse behavior is represented by a concave Bernoulli utility function or a logarithmic function. A convex Bernoulli utility function like an exponential function captures risk-loving behavior. And a linear Bernoulli function represents a risk-neutral behavior (White, 2016).

By analyzing the maximum CRE scores, it is evident that the risks of *interest rate, inflation, revenue, design changes* and *cost overruns* are of critical importance for determining debt-equity ratio. These five risks account for over 50% impact on the total CRE score which is dependent on a total of 13 risk factors. It also explains why projects tend to have difficulties in servicing the debt at the beginning of the operation stage. The decision maker's nature towards dealing with project risks is also a key factor in determining the capital structure. A risk averse investor will be willing to invest his equity if the project debt-equity mix comprises of lesser debt since a debt heavy project is riskier. On the other hand, a risk seeking investor might be willing to take the risk which accompanies the debt heavy mix.

4.11 Case Studies

To validate the proposed model, two case studies of ongoing construction projects are run. The data are obtained by interviewing project managers to provide values for the input variables (κ_i) of the modelled equation, as stated in the methodology, and the developed equation is applied over these variables. As the actual debt-

equity ratio of these projects was already known, the findings are validated by comparing it with the results obtained from the model. This allows for ex-post ratification of the behavior of proposed model when applied on a real construction project. The description and financial aspects of cast study projects are listed in Table 4.10.

Table 4.10: Project Details

Project Name	Karachi - Hyderabad Motorway (M-9)	Lahore Ring Road Southern Loop Package 1 & 2
Type	Motorway	Orbital Highway
Length	134 km	22.6 km
Client	National Highway Authority	Lahore Ring Road Authority
Consultant	NESPAK	Zeeruk & BNA (JV)
Contractor	FWO	FWO
Start Date	September 2015	August 2016
Completion Date	December 2017	August 2017
Total Project Cost	310 million USD	231.72 million USD
Concession Period	25 years	17 years
Debt-Equity Ratio	70-30	60-40

The inputs regarding the initial weightings of the factors are taken as per the average perspective of interviewed project participants. Table 4.11 shows the average values ($\bar{x}$) as entered in the developed model along with standard deviation (σ) and the resulting value of CRE for each factor.

Table 4.11: Case study comparison

Factor	**Case Study 1**			**Case Study 2**		
	$\bar{x}$	**σ**	**CRE**	**$\bar{x}$**	**σ**	**CRE**
Interest rate fluctuation	0.73	0.11547	0.1883	0.67	0.11547	0.1773
Inflation	0.67	0.11547	0.1935	0.60	0.2	0.1764
Design Changes	0.87	0.11547	0.1847	0.80	0.2	0.1698

Market/Revenue risks	0.73	0.11547	0.1411	0.60	0.2	0.1245
Cost overruns	0.73	0.23094	0.1352	0.80	0	0.1388
Political risks	0.73	0.11547	0.1091	0.80	0.2	0.1107
Legal risks	0.67	0.11547	0.0661	0.67	0.11547	0.069
Operational risks	0.60	0.2	0.0784	0.67	0.11547	0.0775
Planning risks	0.73	0.11547	0.0861	0.53	0.11547	0.0718
Performance risks	0.53	0.11547	0.0699	0.40	0.2	0.0629
Environmental risks	0.53	0.11547	0.0547	0.40	0.2	0.0458
Regulatory risks	0.47	0.11547	0.0593	0.53	0.11547	0.0623
Supply risks	0.60	0	0.0659	0.47	0.11547	0.0599
Total			1.4322			1.3477

Using the graph from Figure 2, debt ratios for a risk averse, seeking and neutral decision scenarios are established for both case studies. For case study 1 and 2, debt ratios come out to be 71, 78, 82 and 66, 76, 80 respectively. Comparing these values to the actual debt ratios of both projects, 70 and 60, it can be said that the modelled debt ratios of both projects have increased. The difference is due to a number of factors such as political instability of the region, and time and cost overruns. Since the construction industry is mostly reluctant to risky situations (Fiolet et al., 2016) and often displays severe risk aversion (Han et al., 2005), project managers of case study projects tend to overestimate the inherent risks due to their past experiences and uncertain future. Such behavior supports the modelled debt ratios for risk averse nature of project managers and offers additional safety in the face of project failure.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter concludes the research by stating and summarizing the inferences, findings, limitations, and recommendations.

5.2 Conclusions

The optimal capital structure of the project is the debt-equity mix that maximizes the project value (Matsa, 2010). Debt management is of key importance for PF projects, and the identification of an optimal financing mix is the first and one of the most important decisions to be made at the negotiation stage (Nikolić et al., 2011). The construction industry is lagging in developing modern methods that integrate relevant information and uncertainties for project financing techniques. The traditional approach for determining the debt-equity mix of PF schemes focuses on the project's ability to service its debt. Thus, the decision is based on the financial aspects of the project such as NPV, IRR, TIE, ROR, ROE and DSCR. Project risk and its implication are not quantified at this stage and is left out to be dealt in the execution phase of the project mostly with the help of contingency reserves.

This study aims at assisting the decision makers to forecast better debt-equity ratio by integrating risk into the capital structure. In doing so, a combined risk effect formula is developed which is based on the significant project risks and their interaction with each other and culminates in the form of CRE.

The results of the case studies reveal that the developed equation shows a variance of 10 to 20% from the actual debt ratios. The difference can be explained by

accounting the risk averse nature of construction industry as well as project participants' tendency to overestimate project risks due to political risks, and time and cost overruns. The proposed model is practical and forecasts reliable figures helping stakeholders in better and timely decision making.

5.3 Limitation and Recommendations

The current model is based on 13 factors for measuring combined risk effect scores to be used in the modeled equation. Other factors can be incorporated to cater for more complexity and diversity in construction projects. Future research may also benefit from incorporating the risk behavior in quantitative form in the proposed model.

The model does not take into account the traditional parameters such as NPV, IRR, ROR, ROE and DSCR. These parameter once incorporated in the model can lead to a more suitable and realistic debt-equity ratio for projects.

References:

Aaltonen, K., Jaakko, K. & Tuomas, O. 2008. Stakeholder salience in global projects. *International Journal of Project Management,* 26**,** 509-516.

Akbiyikli, R., Eaton, D. & Turner, A. 2006. Project finance and the private finance initiative (PFI). *The Journal of Structured Finance,* 12**,** 67-75.

Ashton, P., Doussard, M. & Weber, R. 2012. The financial engineering of infrastructure privatization: What are public assets worth to private investors? *Journal of the American Planning Association,* 78**,** 300-312.

Athias, L. & Saussier, S. 2007. Contractual flexibility or rigidity for public private partnerships? Theory and evidence from infrastructure concession contracts. *Theory and Evidence from Infrastructure Concession Contracts (May 13, 2007).*

Babar, S., Thaheem, M. J. & Ayub, B. 2016. Estimated cost at completion: Integrating risk into earned value management. *Journal of Construction Engineering and Management,* 04016104.

Barlish, K., De Marco, A. & Thaheem, M. J. 2013. Construction risk taxonomy: An international convergence of academic and industry perspectives. *American Journal of Applied Sciences,* 10**,** 706.

Bayar, O., Chemmanur, T. J. & Banerji, S. 2016. Optimal Financial and Contractual Structure for Building Infrastructure using Limited-Recourse Project Financing.

Bing, L., Akintoye, A., Edwards, P. J. & Hardcastle, C. 2005. The allocation of risk in PPP/PFI construction projects in the UK. *International Journal of project management,* 23**,** 25-35.

Blanc-Brude, F. 2013. Towards efficient benchmarks of infrastructure equity investments. *Investment Magazine,* 42.

Blanc-Brude, F. & Makovsek, D. 2013. Construction risk in infrastructure project finance. *Research, EDHEC Risk Institute, February*.

Blanc-Brude, F. & Strange, R. 2007. How Banks Price Loans to Public-Private Partnerships: Evidence from the European Markets. *Journal of Applied Corporate Finance,* 19**,** 94-106.

Bloomfield, P., Westerling, D. & Carey, R. 1998. Innovation and risk in a public-private partnership: financing and construction of a capital project in Massachusetts. *Public Productivity & Management Review,* 460-471.

Borgonovo, E., Gatti, S. & Peccati, L. 2010. What drives value creation in investment projects? An application of sensitivity analysis to project finance transactions. *European Journal of Operational Research,* 205**,** 227-236.

Bousquet, F. Analysis of the interface between road financing and road management: observation of current trends in europe. Infrastructure: Finance, Provision and Operation: Proceedings of Seminar J Held at the European Transport Forum Annual Meeting, 1997.

Bousquet, F. & Fayard, A. 2001. *Road infrastructure concession practice in Europe,* World Bank Publications.

Brealey, R. A., Cooper, I. A. & Habib, M. A. 1996. Using project finance to fund infrastructure investments. *Journal of Applied Corporate Finance,* 9**,** 25-39.

Bruhn, M., Karlan, D. & Schoar, A. 2010. What capital is missing in developing countries? *The American Economic Review***,** 629-633.

Brusov, P., Filatova, T., Eskindarov, M., Brusov, P., Orehova, N. & Brusova, A. 2012. Influence of debt financing on the effectiveness of the finite duration investment project. *Applied Financial Economics,* 22**,** 1043-1052.

Byoun, S. & Xu, Z. 2014. Contracts, governance, and country risk in project finance: Theory and evidence. *Journal of Corporate Finance,* 26**,** 124-144.

Chan, A. P. & Cheung, E. 2014. *Public Private Partnerships in International Construction: Learning from Case Studies,* Routledge.

Chan, A. P., Ho, D. C. & Tam, C. 2001. Design and build project success factors: multivariate analysis. *Journal of construction engineering and management,* 127**,** 93-100.

Chaplinsky, S. & Haushalter, D. 2010. Financing under extreme risk: Contract terms and returns to private investments in public equity. *Review of Financial Studies***,** hhq035.

Chege, L. W. & Rwelamila, P. Private financing of construction projects and procurement systems: an integrated approach. Proceedings of the CIB World Building Congress, 2001.

Chemmanur, T. J. & John, K. 1996. Optimal incorporation, structure of debt contracts, and limited-recourse project financing. *Journal of Financial Intermediation,* 5**,** 372-408.

Chen, B., Mao, C.-K. & Hu, J.-L. 2015. The optimal debt ratio of public–private partnership projects. *International Journal of Construction Management,* 15**,** 239-253.

Chernov, S., Pacheco Soto, J. A. & Kulack, E. Assessment of the Impact of Sources of Funding on Project Successes Criteria of Energy Saving. Applied Mechanics and Materials, 2015. Trans Tech Publ, 403-409.

Chinyio, E. A., Olomolaiye, P. O., Kometa, S. T. & Harris, F. C. 1998. A needs-based methodology for classifying construction clients and selecting contractors. *Construction Management & Economics,* 16**,** 91-98.

Corielli, F., Gatti, S. & Steffanoni, A. 2010. Risk shifting through nonfinancial contracts: effects on loan spreads and capital structure of project finance deals. *Journal of Money, Credit and Banking,* 42**,** 1295-1320.

Cottle, G. 2003. Risks associated with public private partnership arrangements and private finance initiatives. *Through the Looking Glass*.

Dailami, M. & Hauswald, R. 2007. Credit-spread determinants and interlocking contracts: A study of the Ras Gas project. *Journal of Financial Economics,* 86**,** 248-278.

Dailami, M., Lipkovich, I. & Van Dyck, J. 1999. INFRISK: a computer simulation approach to risk management in infrastructure project finance transactions. *World Bank Policy Research Working Paper*.

Daube, D., Vollrath, S. & Alfen, H. W. 2008. A comparison of Project Finance and the Forfeiting Model as financing forms for PPP projects in Germany. *International Journal of Project Management,* 26**,** 376-387.

Denis, D. J. & Mihov, V. T. 2003. The choice among bank debt, non-bank private debt, and public debt: evidence from new corporate borrowings. *Journal of financial Economics,* 70**,** 3-28.

Dias Jr, A. & Ioannou, P. G. 1996. Company and project evaluation model for privately promoted infrastructure projects. *Journal of Construction Engineering and Management,* 122**,** 71-82.

Esty, B. 2014. An Overview of Project Finance and Infrastructure Finance-2014 Update. *HBS Case*.

Esty, B. C. 2004. Why study large projects? An introduction to research on project finance. *European Financial Management,* 10**,** 213-224.

Esty, B. C. & Christov, I. L. 2002. *An overview of project finance-2001 update*, Harvard Business School.

Esty, B. C. & Megginson, W. L. 2000. Syndicate structure as a response to political risk in the project finance loan market. *Boston: Harvard Business School.*

Esty, B. C. & Megginson, W. L. 2003. Creditor rights, enforcement, and debt ownership structure: Evidence from the global syndicated loan market. *Journal of Financial and Quantitative Analysis,* 38**,** 37-60.

Esty, B. C. & Sesia Jr, A. 2007. An overview of project finance & infrastructure finance s2006 update. rHarvard Business School Teaching Note 9'207'107.

Finnerty, J. D. 2013. *Project financing: asset-based financial engineering*, John Wiley & Sons.

Fiolet, J.-C., Haas, C. & Hipel, K. 2016. Risk-chasing behaviour in on-site construction decisions. *Construction Management and Economics,* 34**,** 845-858.

Flandreau, M. & Flores, J. H. 2009. Bonds and brands: foundations of sovereign debt markets, 1820–1830. *The Journal of Economic History,* 69**,** 646-684.

Frank, M. Z. & Goyal, V. K. 2009. Capital structure decisions: which factors are reliably important? *Financial management,* 38**,** 1-37.

Gardner, D. & Wright, J. 2012. Project finance. *Encyclopedia of debt finance*.

Gatti, S. 2013. *Project finance in theory and practice: designing, structuring, and financing private and public projects*, Academic Press.

Giorgioni, G. 2001. New evidence on the output-inflation trade-off from developing economies: the case of the CFA Franc zone. *Applied Economics,* 33**,** 1077-1082.

Gliem, R. R. & Gliem, J. A. Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. 2003. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education.

Graham, J. R., Li, S. & Qiu, J. 2008. Corporate misreporting and bank loan contracting. *Journal of Financial Economics,* 89**,** 44-61.

Grimsey, D. & Lewis, K. 2004. Public private partnerships.

Grimsey, D. & Lewis, M. K. 2002. Evaluating the risks of public private partnerships for infrastructure projects. *International Journal of Project Management,* 20**,** 107-118.

Hallmans, B. & Stenberg, C. 1999. Introduction to BOOT. *Desalination,* 123**,** 109-114.

Han, S. H., Diekmann, J. E. & Ock, J. H. 2005. Contractor's risk attitudes in the selection of international construction projects. *Journal of Construction Engineering and Management,* 131**,** 283-292.

Hoffman, S. L. 2007. *The law and business of international project finance: a resource for governments, sponsors, lawyers, and project participants*, Cambridge University Press.

Ismail, R. H. 2014. The Determinants of Financial Covenants on Private Debt: The Case of Listed French Companies. *Research Journal of Finance and Accounting,* 5**,** 176-183.

Ismail, S. 2011. A Systematic Review of Research on Private Finance Initiative (PFI) and Public Private Partnership (PPP). *International Journal of Economics, Management and Accounting,* 19.

Iyer, K. & Purkayastha, D. 2017. Credit Risk Assessment in Infrastructure Project Finance: Relevance of Credit Ratings. *The Journal of Structured Finance,* 22**,** 17-25.

Jessop, B. 2013. Credit money, fiat money and currency pyramids: reflections on financial crisis and sovereign debt. *Financial Crises and the Nature of Capitalist Money: Mutual Developments from the Work of Geoffrey Ingham***,** 248.

Kensinger, J. W. & Martin, J. D. 1988. Project finance: raising money the old-fashioned way. *Journal of Applied Corporate Finance,* 1**,** 69-81.

Kleimeier, S. & Megginson, W. L. 2000. Are project finance loans different from other syndicated credits? *Journal of Applied Corporate Finance,* 13**,** 75-87.

Kleimeier, S. & Versteeg, R. 2010. Project finance as a driver of economic growth in low-income countries. *Review of Financial Economics,* 19**,** 49-59.

Kwak, Y. H. 2002. Analyzing Asian infrastructure development privatization market. *Journal of Construction Engineering and Management,* 128**,** 110-116.

Lam, E. W., Chan, A. P. & Chan, D. W. 2008. Determinants of successful design-build projects. *Journal of Construction Engineering and management,* 134**,** 333-341.

Lewis, M. K. 2013. Off-balance sheet activities and financial innovation in banking. *Moneta e Credito,* 42.

Li, S., Abraham, D. & Cai, H. 2017. Infrastructure financing with project bond and credit default swap under public-private partnerships. *International Journal of Project Management,* 35**,** 406-419.

Li, S. & Richie, N. 2009. Income smoothing and the cost of debt. *Available at SSRN 1621760*.

Lin, C., Ma, Y., Malatesta, P. & Xuan, Y. 2013. Corporate ownership structure and the choice between bank debt and public debt. *Journal of Financial Economics,* 109**,** 517-534.

Marx, L. M. 1998. Efficient venture capital financing combining debt and equity. *Review of Economic Design,* 3**,** 371-387.

Matsa, D. A. 2010. Capital structure as a strategic variable: Evidence from collective bargaining. *The Journal of Finance,* 65**,** 1197-1232.

Mccowan, A. & Mohammed, S. 2004. Evaluation and comparison of concession projects. *Globalisation and Construction***,** 759.

Merna, A. & Smith, N. Privately financed infrastructure in the 21st century. Proceedings of the ICE-Civil Engineering, 1999. Thomas Telford, 166-173.

Merna, T., Chu, Y. & Al-Thani, F. F. 2010. *Project finance in construction: A structured guide to assessment,* John Wiley & Sons.

Merna, T. & Njiru, C. 2002. *Financing infrastructure projects,* Thomas Telford.

Miglo, A. 2016. Corporate Capital Structure vs. Project Financing. *Capital Structure in the Modern World.* Springer.

Miller, D. C. & Salkind, N. J. 2002. *Handbook of research design and social measurement,* Sage.

Mojtahedi, S. M. H., Mousavi, S. M. & Makui, A. 2010. Project risk identification and assessment simultaneously using multi-attribute group decision making technique. *Safety Science,* 48**,** 499-507.

Morrison, R. 2016. *The principles of project finance,* Routledge.

Muranyi, M. Methods and alternatives of financing transport infrastructure development in central and eastern europe. Infrastructure Development, Financing and Implementation. Proceedings of Seminar H Held at Aet European Transport Conference, Loughborough University, Uk, 14-18 September 1998. Volume P427, 1998.

Ng, A. & Loosemore, M. 2007. Risk allocation in the private provision of public infrastructure. *International Journal of Project Management,* 25**,** 66-76.

Nikolić, D. M., Jednak, S., Benković, S. & Poznanić, V. 2011. Project finance risk evaluation of the Electric power industry of Serbia. *Energy Policy,* 39**,** 6168-6177.

Notteboom, T. 2006. Concession agreements as port governance tools. *Research in Transportation Economics,* 17**,** 437-455.

Patramanis, T. 2006. *Structure finance for hybrid infrastructure models: the application of project finance into public-private partnerships for the construction and operation of infrastructure.* Massachusetts Institute of Technology.

Prb, P. R. B. 2016. World Population Data Sheet.

Rajan Annamalai, T. & Jain, N. 2013. Project finance and investments in risky environments: evidence from the infrastructure sector. *Journal of Financial Management of Property and Construction,* 18**,** 251-267.

Schmidt, S. 2016. Using Project Finance to Fund Infrastructure Investments. GRIN Verlag.

Schoemaker, P. J. 2013. *Experiments on decisions under risk: The expected utility hypothesis*, Springer Science & Business Media.

Shen, L. & Wu, Y. 2005. Risk concession model for build/operate/transfer contract projects. *Journal of Construction Engineering and Management,* 131**,** 211-220.

Shrestha, R. & Ogunlan, S. 2006. Comparative study of Power Purchase Agreements in the Nepalese environment. *Journal of Financial Management of Property and Construction*, 11**,** 133-148.

Sinding, K., Anex, R. & Sharfman, M. 1998. Environmental uncertainty, corporate strategy and public policy. *The Graduate Management Review,* 1**,** 1-18.

Sorge, M. 2004. Stress-testing financial systems: an overview of current methodologies.

Sorge, M. & Gadanecz, B. 2008. The term structure of credit spreads in project finance. *International Journal of Finance & Economics,* 13**,** 68-81.

Tung, F. & Subramanian, K. 2009. Law and project finance. working paper, Emory University.

Turner, R. K. 1993. Sustainability: principles and practice. *Sustainable Environmental Economics and Management: principles and practice***,** 3-36.

Uzzi, B. & Gillespie, J. J. 2002. Knowledge spillover in corporate financing networks: Embeddedness and the firm's debt performance. *Strategic Management Journal,* 23**,** 595-618.

Visconti, R. M. 2010. The Cost of Debt for a Project Finance Initiative in the Italian Healthcare Sector. *SSRN Working Paper Series*.

Walker, C. T. & Smith, A. J. 1995. *Privatized infrastructure: The build operate transfer approach*, Thomas Telford.

White, J. 2016. Practical Utility, Risk Aversion, and Investment Sizing.

Williams, C. A. & Conley, J. M. 2015. The Social Reform of Banking. *Responsible Investment Banking.* Springer.

Yescombe, E. R. 2002. *Principles of project finance*, Academic Press.

Zhang, X. 2005. Critical success factors for public–private partnerships in infrastructure development. *Journal of construction engineering and management.*

ANNEXURE-I

Construction Project Financing: A Risk-based Model

A successful project financing initiative is based on careful analysis of all the risks the project will bear during its economic life. Such risks can arise either during the construction phase, when the project is not yet able to generate cash, or during the operating phase. These risks are a crucial factor in project finance since it is responsible for unexpected changes in the ability of the project to repay the cost and shareholders' dividends, and service the debt.

The objective of this study is to identify and analyze these risk factors and use the results to propose a model which will guide towards an ideal debt to equity ratio for maximizing the benefits to project stakeholders. Your feedback in this regard will be highly appreciated.

In case of any queries please contact me through given channels.

Nasir Rasheed

nrasheed.cem5nit@nust.edu.pk

Personal Information

*Required

Experience: * _____

Career: * _____

Organization type: * _____

Country: * _____

Please rate the probability and impact of following risk factors in deciding the debt-equity ratio in project finance.

Assign scores ranging from 1 to 5 based on probability and impact of given risk factors.

1: Rare/Trivial 2: Unlikely/Minor 3: Moderate/Moderate

4: Likely/Major 5: Very Likely/Extreme

No.	**Factor**	**Probability (P)**					**Impact (I)**				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
1.	Interest rate fluctuation										
2	Inflation										
3	Exchange rate										
4	Environmental										
5	Regulatory										
6	Legal										
7	Credit										
8	Market/Revenue										
9	Operational										
10	Supply										
11	Design Changes										
12	Planning										
13	Cost overruns										
14	Delay										
15	Performance										
16	Force majeure										

17	Political										
18	Change in laws										
19	Change in taxes										
20	Insurance										
21	Health and safety										
22	Scope changes										
23	Contract variations										

ANNEXURE -II

Construction Project Financing: A Risk-based Model

A successful project financing initiative is based on careful analysis of all the risks the project will bear during its economic life. Such risks can arise either during the construction phase, when the project is not yet able to generate cash, or during the operating phase. These risks are a crucial factor in project finance since it is responsible for unexpected changes in the ability of the project to repay the cost and shareholders' dividends, and service the debt.

The objective of this study is to identify and analyse these risk factors and use the results to propose a model which will guide towards an ideal debt to equity ratio for maximizing the benefits to project stakeholders. Your feedback in this regard will be highly appreciated.

In case of any queries please contact me through given channels.

With thanks,

Nasir Rasheed

nrasheed.cem5nit@nust.edu.pk

Please rate the effect of these interdependent risks by following scale.

1: Very low 2: Low 3: Medium 4: High 5: Very high

E.g. how does Interest rate fluctuation effect on given risks?

1	Interest rate fluctuation	Remarks (If any)
Market / Revenue risks		
Cost overruns		
Performance risks		
Supply risks		

2	Inflation	Remarks
Interest rate fluctuation		
Design Changes		
Market / Revenue risks		
Cost overruns		
Operational risks		
Performance risks		
Supply risks		

3	Design Changes	Remarks
Market / Revenue risks		
Cost overruns		
Political risks		
Legal risks		
Operational risks		
Performance risks		
Environmental risks		
Regulatory risks		
Supply risks		

4	Market/Revenue risks	Remarks
Operational risks		
Performance risks		

5	Cost overruns	Remarks
Design Changes		
Legal risks		
Operational risks		
Performance risks		

6	Political risks	Remarks
Interest rate fluctuation		
Inflation		
Design Changes		
Market / Revenue risks		
Cost overruns		
Operational risks		
Planning risks		
Regulatory risks		
Supply risks		

7	Legal risks	Remarks
Design Changes		
Market / Revenue risks		
Cost overruns		

8	Operational risks	Remarks
Legal risks		
Performance risks		
Environmental risks		

9	Planning risks	Remarks
Design Changes		
Cost overruns		
Legal risks		
Operational risks		
Performance risks		
Supply risks		

10	Performance risks	Remarks
Design Changes		
Cost overruns		
Legal risks		
Operational risks		
Environmental risks		

11	Environmental risks	Remarks
Performance risks		
Regulatory risks		

12	Regulatory risks	Remarks
Design Changes		
Operational risks		

13	Supply risks	Remarks
Design Changes		
Cost overruns		