FINANCIAL ENGINEERING FOR BOT INFRASTRUCTURE PROJECTS

By

Juan C. Aguayo

B. S. in Civil Engineering
Princeton University (1986)

Submitted to the Department of Civil and Environmental Engineering
in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE
in Civil and Environmental Engineering
at the

Massachusetts Institute of Technology

February 1999

Signature of Author ______________________
Department of Civil and Environmental Engineering
December 30, 1998

Certified by ______________________
John B. Miller
Assistant Professor of Civil and Environmental Engineering
Thesis Supervisor

Accepted by ______________________
Andrew J. Whittle
Chairman, Department Committee on Graduate Studies

Financial Engineering For
BOT Infrastructure Projects

by
Juan C. Aguayo

Submitted to the Department of Civil and Environmental Engineering on December 30, 1998 in Partial Fulfillment of the Requirements for the Degree of Master of Science in Civil and Environmental Engineering

Abstract

The implementation of the Build-Operate-Transfer (BOT) model for the provision of infrastructure facilities in the United States constitutes a paradigm shift, and a recent innovation, in the delivery and financing of these socially and economically important projects. The main justification, for incorporating the BOT strategy as an alternative in the development of new infrastructure facilities, is the need to access private capital to leverage the insufficient government funds for the financing of these massive undertakings.

A key factor contributing to the sustainability of the BOT approach as a viable procurement strategy for infrastructure projects, and providing a decisive competitive advantage to prospective private sector respondents interested in pursuing these ventures, is the expertise in financial engineering. As defined in this thesis, financial engineering is the systematic process that enables a private company to decide first in which BOT project to invest, and then to design the most cost-effective funding structure for financing the venture.

This thesis proposes a formal procedure for the financial engineering and modeling of BOT infrastructure projects. Financial modeling, the cornerstone of the financial engineering process, involves the development of simplified scenarios, analytical tools and techniques that enable the objective evaluation of the economic attractiveness and financial viability of a BOT venture. After outlining the steps within the suggested financial modeling framework, a case study consisting of the Canada Confederation Bridge Project is presented.

Acknowledging that the recommended financial models for BOT infrastructure projects are simplified illustrations of mammoth and complicated construction programs, this thesis also investigated some of the most important issues associated with these types of investments to complement the quantitative analyses. This was accomplished through a literature review, and four mini case studies consisting of recent projects in the United States.

Thesis Supervisor: Dr. Professor John B. Miller
Title: Assistant Professor of Civil and Environmental Engineering

Acknowledgement

The following people are gratefully acknowledged for their valuable contributions to this thesis.

- My thesis advisor, Dr. John B. Miller, for mentoring me into the field of Infrastructure Development Systems
- Ms. Sandra Vivas, from The World Bank, for facilitating me important academic resources.
- My friends, Carlos I. Cabré and Joaquín Bacardí, for their valuable advice and continuous encouragement.
- My wife, Ritín, for her typing, proofreading, suggestions, patience and support during both, the development of this thesis and throughout my tenure at MIT.

Author

Juan C. Aguayo earned his undergraduate degree in Civil Engineering from Princeton University in 1986. He is a licensed professional engineer registered in Puerto Rico, where he worked for eleven years for a specialty contractor, Structural Steel Works, Inc., prior to attending MIT.

At S.S.W., Juan C. Aguayo served as Vice President, and was in charge of the manufacturing and construction operations of structural steel buildings for commercial, pharmaceutical and infrastructure projects in Puerto Rico and the Caribbean. Upon his graduation from MIT, he will work for the Development Company of the Americas, L.L.P., headquartered in Denver, CO as Director of Construction and Development. Among his responsibilities at DCA will be the coordination and management of the acquisition and development of industrial real estate in Mexico.

Juan C. Aguayo was born in Mayaguez, Puerto Rico in 1964 and is married to Ana R. Santaella Aguayo. They reside in Colorado with their three children.

To my wife

Ritín Aguayo

for her love and encouragement

and to my children

Carlos, Daniela and Fabiola

for inspiring and teaching me more than I realize

and to my parents

Maricucha and José Aguayo

for their understanding and unconditional support

Table of Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Historical Background

During the past sixty-five years, the United States' infrastructure development strategies have relied primarily on a segmented and directly funded approach in which the government plays the dual role of project promoter and sponsor. Through the enactment of various statutes aimed at promoting competition for all supplies and services, the federal government has limited the procurement for the provision of infrastructure facilities to fixed price sealed bids based on complete designs furnished to all bidders. This was legally reinforced in 1972, following the establishment of the Brooks Act, when the federal government was forced to procure professional design and construction services separately. Furthermore, in order to obtain competitive sealed bids, the government decided to control all infrastructure construction by engaging solely in direct funding mechanisms.

This "recent and traditional" American public infrastructure policy that relies almost exclusively on a segmented (separate design, construction, operation and finance) and direct (in terms of its dependency on public funding) process is in sharp contrast with procurement techniques used by the United States between 1780 and 1933. John B. Miller, through his research relating to sustainable models of infrastructure replacement and renewal, has identified four major principles that guided the procurement process for infrastructure development during this 150 year period:

"1. Cooperation between public and private entities to develop infrastructure in aid of private economic activity.

2. Recognition that infrastructure is best provided through a combination of public means, private means, and often a mixture of both.

3. A constant search for different, more effective ways for government to encourage private participation in infrastructure development.

4. Almost exclusive reliance on a system approach for delivering infrastructure."[1]

Although nowadays the planning, finance, design, construction and operation of major public works are still largely considered to be within the government's range of activities, the public sector is increasingly experimenting with the "old" system approach and indirect funding for providing infrastructure facilities. The current prevalent practice, which consists of a segmented design-bid-build project delivery system and the direct financing of infrastructure projects through the general tax funds or special tax or bond issues, is becoming progressively inadequate. The growing insufficiency of the public sector budget to meet the growing demand for world-class infrastructure facilities is motivating all levels of government to look beyond their coffers to implement "new" ways of funding and delivering these strategically important projects. As history has proven, through public-private partnerships in the form of integrated approaches and indirectly financing techniques, the government can leverage its funds to effectively deliver more and better infrastructure facilities. In doing this, nations not only improve

---

[1] John B. Miller, *America's Emerging Public/Private Infrastructure Strategy: The End of Privatization*, Draft, MIT, 1997, p. 3-3.

the quality of life of their constituents, but also ameliorate their respective competitive position in the global marketplace.

1.2 Definitions of Terms

Within the content of this thesis, the term ***infrastructure*** is used to mean the physical facilities in conjunction with the transportation of people, goods and information, as well as with the provision of public services. Included in this broad definition are major capital undertakings such as roads, bridges, telecommunication facilities, airports, shipping ports, water resources and electric utilities, general government buildings, etc. Furthermore, in contrast to the association of infrastructure with the public sector, ***privatization*** is the process that alludes to the participation of the private sector in the provision of services and facilities that have been "traditionally" under the control of the government.

An infrastructure project ***promoter*** refers to the government agency or body inviting interested parties to submit proposals for a Build-Operate-Transfer (BOT) infrastructure project. As will be discussed in more detail in the following two sections, a ***BOT*** is one model, among several alternatives, for the development and provision of an infrastructure facility. The BOT strategy is based on a system approach for the delivery of infrastructure and on an indirect funding structure. In this scheme, a single private sector entity is responsible for all of the project's elements (design, construction and operation), as well as for the financing of the undertaking.

Finally, the ***sponsor*** is the successful respondent from the private sector companies that participated in the project's procurement process. The sponsor, also referred to as the concessionaire, often consists of a joint venture of private companies grouped together to design, finance, construct and operate a specific BOT infrastructure facility for a definite franchise concession period (e.g. 30 years). Because infrastructure projects are often large and complex capital undertakings requiring a plethora of different abilities from its sponsor, a ***joint venture*** is a special-purpose partnership used for spreading the risks and pooling the resources needed for these ventures (Refer to Figure 1.2.1).

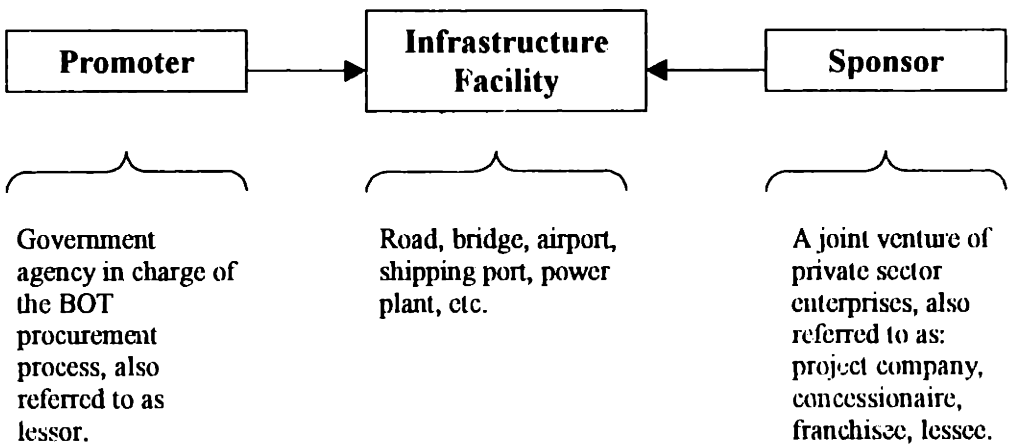

Figure 1.2.1: Definition of Promoter, Infrastructure Facility and Sponsor

1.3 Infrastructure Project Delivery and Financing Strategies

As previously mentioned, there are several methods by which an infrastructure facility can be developed and delivered. One of the most effective ways of visualizing the major differences among the various approaches is through the use of the analytical framework proposed by John B. Miller.

Figure 1.3.1 is a graphical representation of the framework in which the models for providing infrastructure facilities are classified in terms of their financing and delivery strategies.[2] The vertical axis segregates delivery strategies based on the degree to which the various project tasks (design, construction, finance and operation) are provided by the contracting private party. On the other hand, the horizontal axis divides them depending on the government's responsibility towards the financial risk for providing, operating and maintaining the facility throughout its lifecycle.

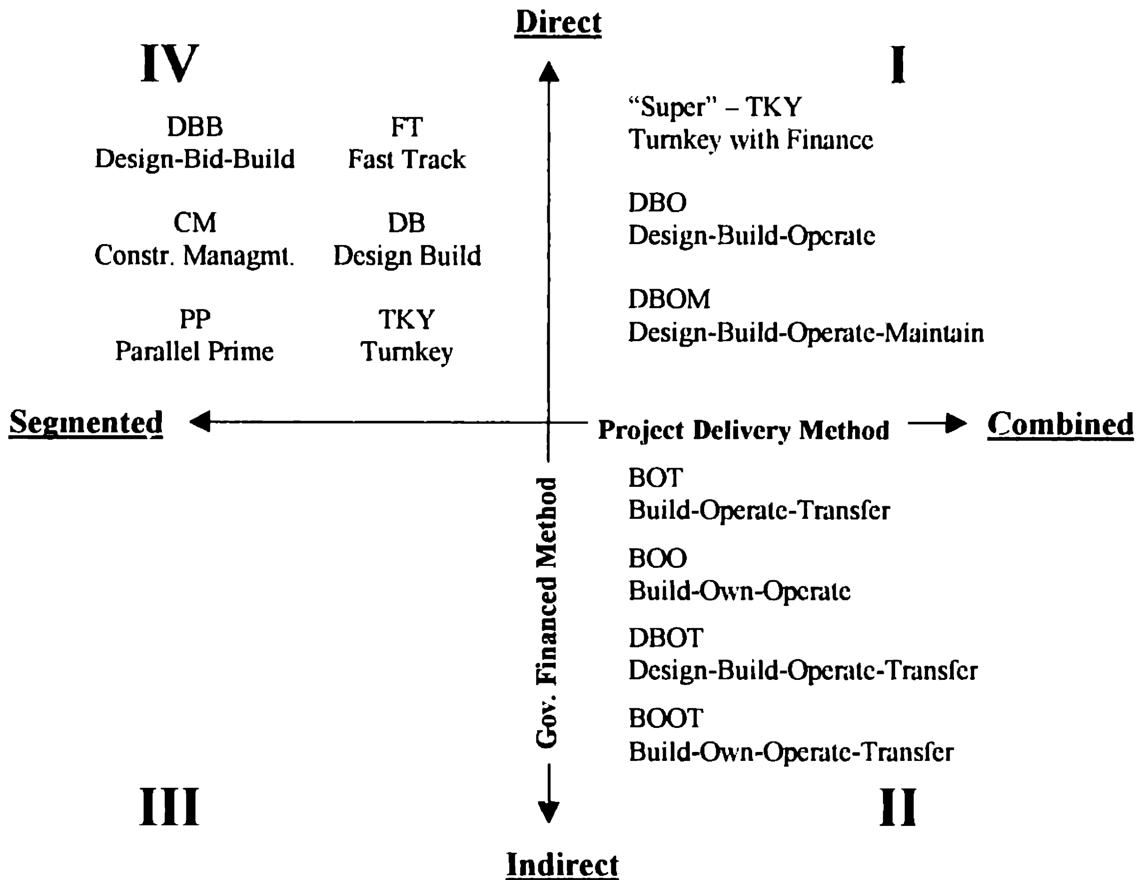

Figure 1.3.1: Infrastructure Projects' Delivery-Finance Strategies Framework

In terms of the delivery method (horizontal axis), the choices consist of a continuum of methodologies between the following two extreme strategies:

- A ***segmented*** process in which the planning, design, construction, finance, operations and maintenance are provided by distinct parties.

[2] John B. Miller, *Aligning Infrastructure Development Strategy to Meet Current Public Needs*, Doctoral Thesis, MIT, 1995, p. 22.

- A ***combined*** approach in which one entity assumes the responsibility for all of the project's elements.

Similarly, from a government financial strategy perspective (vertical axis), the funding of the undertaking can be structured in many forms between:

- A ***direct*** method through government appropriations.
- An ***indirect*** strategy in which the public sector, by means of incentives, mandates, subsidies, etc., encourages a private enterprise to assume the financial risk of the venture.

In synthesis, Miller's framework consists of two perpendicular axes used to represent a continuum of choices relating to project delivery and funding strategies that the government may adopt when promoting the development of an infrastructure facility. Although there can be as many forms of infrastructure delivery-finance strategies as there are projects, there are four general categories: Design-Bid-Build, Design-Build, Design-Build-Operate, and Design-Build-Transfer.

In the ***Design-Bid-Build*** approach, the government separates the design function from the construction process by directly contracting with an architect/consultant firm and with a construction manager/contractor for the engineering and construction of the facility, respectively. Under this arrangement, the public sector finances both the construction and operation stages of the project through appropriations from its general tax fund or any other direct financial scheme.

While ***Design-Build*** integrates the engineering and construction operations into one entity, the ***Design-Build-Operate*** is placed on the far right of Figure 1.3.1 because it shifts the responsibility of the infrastructure facility operation to the contracting private sector entity. Finally, in the ***Build-Operate-Transfer*** strategy for infrastructure development (Refer to quadrant II of Figure 1.3.1), in addition to its being a combined or systems approach, the responsibility for the construction and operations phases financing is transferred to the private sector sponsor.

According to Christopher M. Gordon, the procedure for selecting the appropriate project delivery and finance strategy starts by choosing the most suitable organization or business entity with whom the promoter will hold a contract.[3] Also, in order to select the right organization in connection to an infrastructure facility development, the project, owner, and market drivers have to be analyzed. Gordon breaks down the drivers by specific characteristics, as shown in Table 1.3.1.

Project Drivers	Owner Drivers	Market Drivers
• Time Constraints • Flexibility Needs • Pre-construction Service Needs • Design Process Interaction • Financial Constraints	• Construction Sophistication • Current Capabilities • Risk Aversion • Restriction on Methods • Other External Factors	• Availability of Contractors • Market State • Project's Package Size

Table 1.3.1: Project's Organization Selection Drivers

Although the best delivery-finance strategy for an infrastructure project will be subject to the aforementioned drivers, it is generally agreed that integrated and indirect finance models are best suited for large and complex infrastructure development programs (Refer to Figure 1.3.2). With few exceptions, in small and well defined buildings the benefits of implementing a combined and indirect finance project delivery strategy will not compensate the duplication costs (i.e. various designs, feasibility studies,

[3] Christopher M. Gordon, "Choosing Appropriate Construction Contracting Method," *Journal of Construction Engineering and Management*, American Society of Civil Engineers, Vol. 120 No. 1, March, 1994.

etc.) associated with the procurement process, or the premium charged by the private sector to compensate for the additional assumed risks.

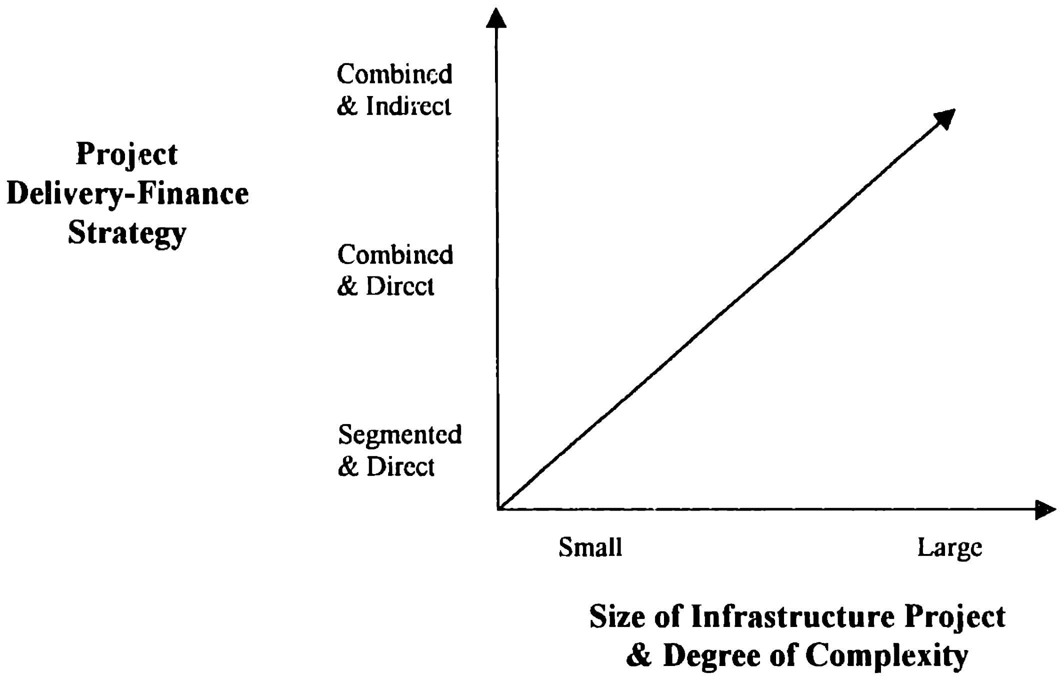

Figure 1.3.2: Suitability of Delivery-Finance Strategies to Infrastructure Projects

From among all the methods possible to develop an infrastructure project, the BOT has been chosen as the focus of this thesis. In reality, this delivery system is one of the most appropriate when the government does not have the funds to finance a particular infrastructure facility, or when seeking to maximize the benefits resulting from the private sector's efficiencies.

1.4 The BOT Project Delivery and Finance Model

The Build-Operate-Transfer (BOT) model for project finance and delivery is one strategy, among several alternatives, for implementing and providing an infrastructure facility. Under a BOT arrangement, a private special purpose company (project company) is responsible for the design, finance, construction, operation and maintenance of the infrastructure facility for a pre-determined period of time (concession, franchise of lease period). During the development and construction phases, the project is funded mostly by private investors and lenders. Once the infrastructure facility is functional, the project company operates it to service the accumulated debt, and to generate a return on the investment before transferring it back to the public authorities.

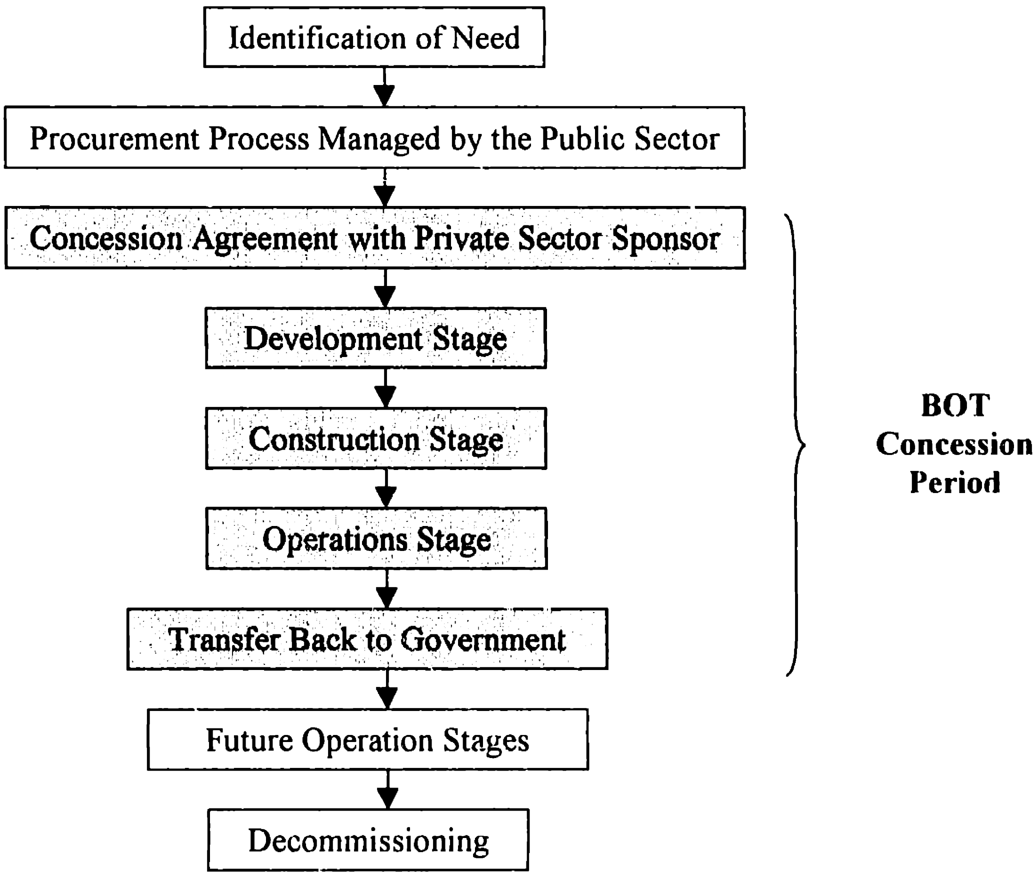

Figure 1.4.1: Infrastructure Facility Lifecycle under a BOT Development Strategy

Figures 1.4.1 and 1.4.2 show the lifecycle of an infrastructure facility developed following the BOT model and the principal stakeholders in a BOT arrangement, respectively.

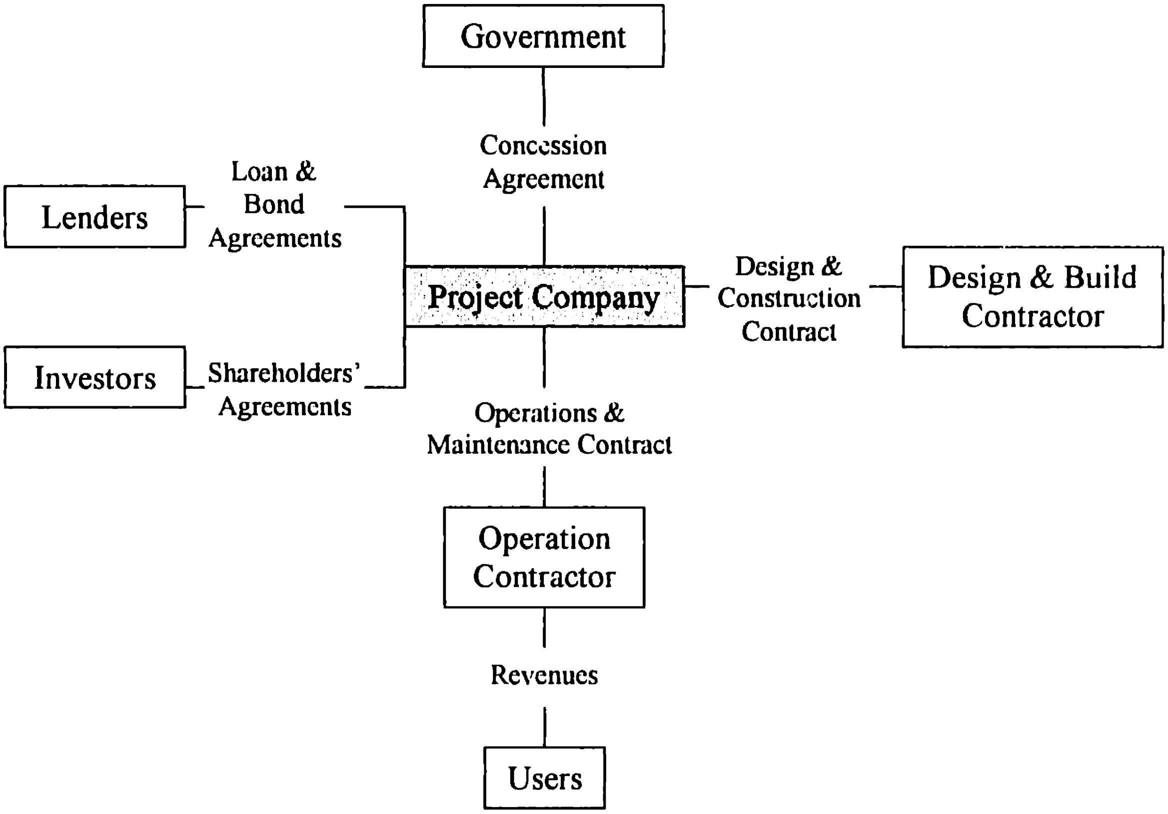

Figure 1.4.2: Principal Stakeholders in a BOT Agreement

The BOT approach for the provision of infrastructure is being used increasingly by governments of industrialized and developing countries to leverage public funds with private capital in order to meet the public need for more and better facilities. In addition to providing new infrastructure at no cost or relatively little cost to the state, the BOT model presents the following benefits:[4]

- ***Credibility***: In general, the private sector is considered to be better able to evaluate the feasibility of the investment, as well as how the project should be built and the facility operated.
- ***Efficiencies***: Since the private sector is subject to the economic forces of the marketplace, it is often more capable than the government in effectively and

efficiently managing the development, construction and operation processes in connection with an infrastructure facility. Although the idea that private initiative can do better than state bureaucracy is somewhat overrated, it is a fact that the private sponsors' control and their continuing economic interest in the design, construction and operation of the project will result in significant cost efficiencies that will ultimately benefit the population in general.

- ***Benchmark***: It is in the best interest of the host country, and of all the stakeholders involved in a BOT venture, to have a private sector project against which the efficiencies of similar public developments can be measured.
- ***Technology Transfer and Training***: The all-encompassing and integrated approach of the BOT model facilitates the transfer of knowledge not only within but across all the management and technical disciplines involved in these complex and massive undertakings. The full consideration of the project's lifecycle costs early in the planning and design phases often produce synergistic results that promote the creation and dissemination of new technologies for the development, construction and operation of infrastructure facilities.
- ***Privatization***: By delegating the provision of infrastructure to the private sector, the government gains by:
  - Relieving itself from most of the financial and administrative burden.
  - Reducing the size of its bureaucracy.
  - Being able to focus, instead, on important social issues.
  - Assuming the role of a master planner rather than an operator.

---

[4] Mark Augenblick and B. Scott Custer, Jr., *The Build, Operate, and Transfer (BOT) Approach to Infrastructure Projects in Developing Countries*, The World Bank, Washington, D.C., 1990, p. 44.

Ralph Stanley, manager of infrastructure development for Bechtel Enterprises, Inc., and former head of the U.S. Urban Mass Transportation Administration, attributes the increase in BOT projects to four factors:[5]

- A worldwide shift away from centrally planned economy to free markets.
- Huge and persistent budget deficits.
- A pressing need for infrastructure.
- The growing acceptance of user fees.

The BOT approach to project implementation has opened an exciting market for the provision of infrastructure facilities that presents new challenges and opportunities to both, the public and private sectors. Furthermore, it has paved the way for government agencies and private consortiums to engage in unprecedented collaborative relationships, with the purpose of creating innovative financing mechanisms that will help bridge the gap between the ever mounting infrastructure needs and the limited public sector's direct funding sources.

Because the BOT model constitutes a paradigm shift from the way infrastructure projects have been "traditionally" funded, a new methodology is needed for deciding what BOT investments to undertake and how to finance them. This will bring about an effective increase in the private sector's participation in these types of ventures.

1.5 Scope and Objectives of this Thesis

One of the great benefits of infrastructure projects delivered following the BOT approach is that they incorporate financial engineering, as a major discipline, into the

---

[5] "Time and Change," *Bechtel Briefs*, McGraw Hill Publishing Company, May, 1993, p. 16-20.

overall planning and implementation stages of these large and complicated capital ventures. In contrast to the segmented design-bid-build process in which the economic feasibility of the investment is not a priority, infrastructure projects developed under the BOT model have to be financially viable in order to be undertaken.

In the context of this thesis, ***financial engineering*** is defined as the procedure for deciding first on what to invest and then designing the most effective and least costly funding structure for the private financing and development of a public infrastructure facility following the Build-Operate-Transfer (BOT) strategy. Once the decision to participate in a BOT infrastructure project concession bid has been made by a private sector consortium, the objective is to implement the optimal funding structure, in terms of its value contribution to the investment, for successfully financing the venture. With all this in mind, the ***financial engineer*** is the consultant responsible for envisioning ingenious and realistic funding structures for the project.

In addition to the need of a sound financial analysis and design for a successful BOT project, expertise in the creative financing of infrastructure development has become a key factor for prospective respondents in winning these projects' bids. From this perspective, financial engineering can be viewed as an essential core competency that differentiates respondents from one another, and one that could provide a specific bidder with a sustainable competitive advantage when all other factors (technical know-how, construction and operations procedures, etc.) are in relative parity among the participants.

Based on the above discussions, the objectives of this thesis can be summarized as follows:

- To introduce financial engineering as a major discipline in BOT infrastructure facilities' development, and as a source of competitive advantage among the private sector consortia pursuing these projects.
- To propose a formal methodology, primarily from the private sector's perspective, for the financial engineering of BOT ventures.
- To apply the proposed financial engineering framework to a case study consisting of the Canada Confederation Bridge Project.
- To identify and discuss, through a literature review and four mini case studies, some of the major issues relating to the financial appraisal of BOT investments.

Chapter 2

Financial Engineering

2.1 Introduction

In order for a BOT infrastructure project to be successful, its financial feasibility must be clearly demonstrable to the project promoters, as well as to potential equity investors and lenders. While investors and lenders want to be "assured" that their risk-reward requirements will be met, the government needs to feel "confident" that the project company has engineered a workable financial plan for the private development of the infrastructure facility under consideration.

In addition to the economic appraisal for a BOT infrastructure investment, issues relating to risks identification and allocation, financial market limitations, project cash flows, lenders-investors' expectations, etc. have to be considered also while designing the optimal capital structure and financing plan for these complicated undertakings.

It is through expertise in the financial engineering of BOT infrastructure projects and through its systematic application that these private sector initiatives can be properly evaluated, structured and implemented. Furthermore, as mentioned at the end of Chapter 1, the adoption of financial engineering as a core competency will provide firms with a significant competitive advantage in the pursuit of these projects.

Before outlining the scope and objectives of the financial engineering of BOT infrastructure projects, it is necessary to define and discuss terms such as project financing, quality of revenue streams and security to lenders. This chapter concludes by presenting the proposal procedure for the financial engineering of BOT infrastructure projects.

2.2 Project Financing

In general, ***project financing*** is the basic private sector funding mechanism that permits the provision of infrastructure facilities through the BOT model. As stated by Peter K. Nevitt, project financing can be formally defined as: "A financing of a particular economic unit in which a lender is satisfied to look initially to the cash flows and earnings of that economic unit as the source of funds from which a loan will be repaid and to the assets of the economic unit as collateral for the loan."[6]

In the case of BOT infrastructure developments, the project financing technique is usually referred to as "non-recourse" because lenders will not have any significant direct debt repayment guarantees from the project sponsors of from the host government. Since ownership of the land where an infrastructure project is being developed is typically retained by the public sector, and because the facility will be transferred to the government at the end of the concession period, the assets of the project are not normally considered as collateral for the loans. In this context, non-recourse lenders fear that, if the project company defaults, there will be no ready market for a partially built toll road or a non-operational infrastructure facility.

From the lenders' perspective, BOT project financing is essentially a combination of standalone deals, where the sole guarantee for repayment emanates from the project cash flows themselves and not from the balance sheet of either the sponsor or the promoter. Due to the off-balance sheet or non-recourse financing configuration associated with most BOT infrastructure projects, the borrower, for all practical purposes, is the project itself and not its sponsors or its promoters. Consequently, BOT projects can be visualized as start-up business ventures that require large amounts of up-front capital, and which can only be guaranteed by the anticipated revenue streams associated with the operation of the facility in a quasi-monopolistic environment.

Although there are significant differences between lenders and borrowers as to what constitutes the optimal project financing scheme, the biggest challenge according to Nevitt is: "The key to a successful project financing is structuring the financing of a project with as little recourse as possible to the sponsor, while at the same time providing sufficient credit support through guarantees or undertakings of a sponsor or a third party, so that lenders will be satisfied with the credit risk."[7]

For the private sector sponsors, the main project finance objectives are: maximizing the amount of funds borrowed and limiting their exposure to the equity invested in the venture. This off-balance sheet financing will only be accomplished if any of the following two situations occur:

- The expected revenue is so solid and predictable that it can be both the repayment source and the loan's collateral.
- The eventuality that the government would become an "indirect" project sponsor by supporting the project with its sovereign credit and guaranteeing a minimum amount of revenues.

This means that in order for the project finance strategy to work, the infrastructure facility must have a clear and reliable source of revenues that will be sufficient to:

---

[6] Peter K. Nevitt, *Project Financing*, Fifth Edition, Euromoney Publications, London, England, 1989, p. 3.
[7] IBID, p. 4.

- service principal and interest payments on the accumulated debt,
- pay for the operations and maintenance expenses of the facility, and
- provide a rate of return on the invested equity that is commensurate with the risks assumed.

Since the revenues must be sufficient to at least service the total project's accumulated debt as well as the operations and maintenance of the facility, the total cost of the project must be accurately predicted. Because lenders and investors must feel confident that the infrastructure facility can be built and operated with the funds being committed, BOT projects are normally developed on a fixed cost, turnkey basis (Refer to Section 1.3). Consequently, in order to avoid the additional risks associated with experimental technology, lenders usually require the use of proven technology. In sum, the less predictable the total costs are, and the riskier the project is perceived to be by the lenders, the more recourse will have to be provided in the form of additional equity by the sponsors or stand-by commitments by the host government.

In general, interest in project finance has augmented as the traditional sources of public financing decrease and the demands for infrastructure improvement increase. Project finance, when properly engineered, constitutes a viable generic financial strategy to meet the mammoth capital commitments needed for infrastructure facilities' developed or renovated following the BOT model.

2.3 Assured Revenue Streams and Security to Lenders

Since the project financing for most BOT infrastructure projects is structured in a non-recourse basis to the promoters, revenues are both, the primary mechanism for repayment and the only "collateral" on the advanced funds.

Referring to the importance of correctly assessing the revenue stream of transportation projects, Mr. Dan Chao, Vice President of Bechtel Financial Services, Inc. has asserted: "Typically, most infrastructure projects are so enormous that their revenue streams, which are finite because there is an upper limit to the amount you can charge someone to use a private road, can not generate sufficient return quickly enough for most investors. Based on user fees alone, a toll road could easily take 40 years to pay back to investors. The trick is to narrow the payback period by augmenting the revenue stream."[8]

In general, the soundness of infrastructure facilities' revenue streams developed following the BOT project delivery approach can be enhanced by the sponsoring government in several ways:

- By adding (discarding) other projects with a high (low) anticipated profitability.
- By offering incentives such as: subsidies, guarantees of minimum revenues, options to extend the concession life, etc. In addition, the host government could provide a standby credit facility in the form of a subordinated loan, which could be used if project revenues fall below a specified level.
- By awarding property grants or development rights for areas of land adjacent to the infrastructure facility (e.g. along the toll road route).

[8] "Time and Change," *Bechtel Briefs*, McGraw Hill Publishing Company, May, 1993, p.18.

- In the specific case of transportation projects, by allowing the application of tariffs to other roads and bridges that compete with the route to be developed.
- By allowing the issuance of tax exempt bonds as senior debt to the project.

The implementation of any of the aforementioned techniques for reducing the uncertainty or inadequacy of a BOT project revenue stream will depend on the type of project (i.e. transportation, power generation, water resources, telecommunications, etc.), and the degree of commitment by the government towards its development. Because of their nature and the characteristics of the market to be serviced, the predictability and soundness of revenue streams among infrastructure projects vary in degree of quality. Unlike power plants, where suppliers' feedstock agreements and buyers' off-take contracts are normally secured, transportation projects are more challenging in terms of finding ways to mitigate the uncertainties associated with their cash flows.

In order for a revenue stream to be predictable and sound, the infrastructure facility to be developed must deliver its service to a captive market or in a near monopoly situation. Again, while water supply/treatment facilities and power generation plants operate for captive consumers, most transportation projects tend to be less monopolistic due to the availability of alternate routes and to the high price elasticity of tolls among commuters. Due to these complications, the economic feasibility of transportation projects rely on accurate traffic flow studies and anticipated demand analyses under different scenarios.

Depending on the nature of the revenue stream, infrastructure projects can be classified into two broad categories: ***market based*** and ***contract based***. The market based group includes transportation projects such as roads, bridges, tunnels, etc., in which the customers are the actual consumers and, therefore, their profitability is subject to the economic forces applicable to the particular market. On the other hand, the revenues of contract based projects, like power or water and sewage treatment plants, are subject to negotiations with the host government who in turn charges the consumer.

Contract based BOT infrastructure projects have less risk (with other things being equal) than market based ventures, since their revenue streams are set in advance with little or no speculation, and because the latter are normally built anticipating an increasing demand in the future. Market based infrastructure project investments typically offer higher rate of returns than contract based ones or, alternatively, require some form of government support to make them attractive to the private sector.

The assured cash flow of a contract based project ensures its economic success, provided that the development and production costs have been accurately predicted. Furthermore, despite the many possible permutations, there are three general types of contracts used for these projects:

- take or pay contracts where the purchaser is obliged to pay even if the product is not delivered,
- take and pay agreements in which the purchaser pays for the product if it is delivered, and
- through-put agreements, which are used when the project provides a service (e.g. transmission through a pipeline) in lieu of a product (e.g. electrical energy). Similar to a take or pay contract, in the basic form of a through-put agreement the obligor pays whether the service is used or not.

In addition to assured revenues and government support to market based ventures, there are other standard mechanisms through which the project company can provide security to the non-recourse lenders within a BOT infrastructure project. These are:[9]

- Collecting revenues in a separate escrow account, independent from the project company and managed by an agent who effectuates payments in accordance to the stipulated priorities (e.g. operations & maintenance, debt service, investor's dividends, etc.).
- Establishing a debt service escrow account with enough reserve balance to pay the senior debt coupons for a minimum agreed period of time (usually six months).
- Assigning any project company contract benefits to a trustee representing the lenders. Possible benefits include proceeds from performance bonds, insurance and supplier warranties.
- The pledge, by the sponsors, of all of their project company's equity as security for the loans. Should the venture encounter financial, management or technical difficulties, the lenders may want to take control of the project well in advance of the bankruptcy stage.
- The flexibility of the project in accessing pre-approved subordinated loan facilities, that will act as emergency cushions in the eventuality of adverse unanticipated situations (e.g. construction and schedule overruns, a shortfall of initial revenue, etc.).

2.4 Financial Engineering – Scope and Objectives

Section 1.5 broadly defined financial engineering as a procedure consisting of two general functions: the investment decision and the selection of the most cost-effective financial structure in connection with a particular BOT infrastructure project. More specifically, the financial engineering of BOT infrastructure projects can be described as a discipline that combines art and science, and a scope that includes such tasks as:

- Comparing (benchmarking) the proposed BOT infrastructure project with similar undertakings in terms of opportunity cost, profitability and risk-reward tradeoffs. The goal of this function is helping the sponsor decide whether the investment should be pursued.
- Determining the financial feasibility of the venture, considering the constraints (availability of adequate financial instruments, etc.) of the financial market. This requires developing financial models (Refer to Chapter 3) for the investment.
- Understanding the attitudes, interests and drivers of investors and lenders in connection to the specific project under consideration. It is important to note that, while lenders tend to concentrate on the risks of not being repaid, investors focus on the opportunity of achieving higher rate of returns than in other ventures with similar uncertainties. Since lenders are not in the venture capital business, they should assume a credit rather than an equity risk. In practice, however, most BOT infrastructure projects are highly leveraged and therefore it may not be totally possible to insulate lenders from equity risks.

---

[9] Mark Augenblick and B. Scott Custer, Jr., *The Build, Operate, and Transfer (BOT) Approach to Infrastructure Projects in Developing Countries*, The World Bank, Washington, D.C., 1990, p. 12-13.

- Being able to correctly identify and allocate risks among the project's stakeholders (Refer to Chapter 5).
- Identifying and sourcing the most innovative and cost-effective financing available for the project. In turn, the availability of financial instruments to fund BOT infrastructure projects will be subject to:
  - The economic attractiveness of the venture, as perceived by the investors.
  - The lenders' willingness to accept limited or non-recourse financing.
  - The level of development of the host country's financial markets, as well as their accessibility to the international financial markets.
  - The risk-reward relationship of these ventures.
- Aiding in the drafting and negotiation of the various financial agreements between the sponsors and government authorities, contractors, suppliers, funding institutions, passive investors, etc.
- Monitoring the actual financial performance of the project throughout its different stages.
- Making the necessary changes to the financial structure of the venture, resulting from the deviations in the expected versus the actual financial performance of the project.

In terms of structuring the funding configuration of infrastructure projects, Carl Beidleman, et. al. have stated: "Formulating the financial package for a complex project is similar to design engineering in that it involves arranging a series of capital market instruments and structures necessary to finance the project successfully. By tailoring the cash flows and credit support (e.g. completion guarantees), managers design innovative financial approaches that meet specific projects needs. Doing this normally involves addressing contractual arrangements, risk allocation, and the arrangement and rearrangement of cash flows, from a pre-launch to post-operational financing. Numerous participants collaborate in the more successful of these efforts."[10]

Relating to the contribution of financial engineering in accomplishing a successful project financing, Peter Nevitt has said: "There is no magic about project financing. Such a financing can be accomplished by financial engineering which combines the undertakings and various kinds of guarantees by parties interested in a project being built in such a way that none of the parties alone has to assume full responsibility for the project, yet when all of the undertakings are combined and reviewed together, the equivalent of a satisfactory credit risk for lenders has resulted."[11]

C. Walker, et. al. have described the objectives of financial engineering as:[12]

- Structuring the various BOT arrangements to:
  - enhance the credit worthiness of the borrower
  - reduce the risk to lenders
  - lower the cost of borrowing to the concession company.
- Developing innovative financial instruments to:
  - improve the viability of a project
  - augment the attractiveness of the undertaking to equity investors and potential project lenders.

BOT infrastructure project lenders comprise organizations such as banks, insurance companies and pension funds. As providers of debenture, their primary

---

[10] Carl R. Beidleman, Donna Fletcher and David Vesbosky, "On Allocating Risk: The Essence of Project Finance," *Sloan Department Review*, Spring 1990.
[11] Peter K. Nevitt, *Project Financing*, Fifth Edition, Euromoney Publications, London, England, 1989, p. 4.

concern is not the potential profitability of the investment, but the guarantee of repayment as demonstrated by the concessionaire's balance sheet and security package. As a result, building up the credibility of the project company is one of the most important objectives of financial engineering.

The financial engineer can accomplish credit enhancement of a BOT project in several ways. As discussed in Section 2.3, through a revenue-sharing scheme, an otherwise non-viable toll road project can become feasible. Complementing the revenues of a proposed infrastructure development with those of an existing facility is one ingenious method of making an infrastructure venture possible. In essence, by improving the adequacy of the revenue stream, the credit worthiness of the project company is enhanced.

Other ways in which financial engineering can augment the credit worthiness of a BOT project is by the creative implementation of property development rights, indirect funding from the host government, tax-exempted debenture, and the correct allocation of risks. It is important to note that, while the financial engineer can suggest innovative mechanisms to increase the feasibility of a BOT infrastructure project, it is essential for them to be well received and implemented by the host government in order to attract the interest of the private sector into these long-term investments. From this perspective, in addition to providing a valuable service to the private sector sponsors, the financial engineer can also advise the host government and assist in designing a workable revenue stream plan as well as the overall financial requirements in connection with the BOT venture. Including a sound preliminary financial plan in the project's request for

---

[12] C. Walker and A.J. Smith, *Privatized Infrastructure: The Build Operate Transfer Approach*, Thomas Telford Publications, London, England, 1995, p. 75.

proposal documents will ultimately result in a win-win situation for both the public and private sectors (Refer to Section 6.3).

In terms of the development of innovative financial instruments, while there is a growing trend to use sophisticated products, commercial bank loans remain the most typical debt funding mechanism. To counteract this historical inertia, it is the responsibility of the financial engineer to package the BOT venture in such a way that institutional investors and the capital markets are attracted to fund these developments.

Having a broader base of financial instruments will benefit the project company by:

- Achieving a better alignment between the project's cash flow profile and the debt repayment schedule.
- Reducing the overall cost of capital for the project through the competition of a bigger pool of investors.
- Hedging any financial risk exposure by diversifying the sources of funds.
- Better accommodating the different return expectations of potential investors.
- Relying on a secondary market for the trading of BOT projects' investment securities.
- Providing an incentive for commercial banks to become more aggressive in the funding of BOT deals.

These benefits will increase the economic attractiveness of a BOT infrastructure project, to potential investors and lenders, because of its improved financial viability through a lower cost of capital and a better funding structure.

2.5 Financial Engineering – Recommended Process

Based on the scope and objectives outlined and discussed in the preceding section, the proposed financial engineering process in connection to a BOT infrastructure project investment is comprised of the following eight steps:

1. ***Evaluating the Clarity, Transparency, Fairness and Financial Requirements Included in the Project's Request for Proposal (RFP).*** Is the project's scope of work well defined? How objective is the evaluation criteria included within the RFP? What is the degree of government commitment to a fair and transparent procurement process as well as to the project itself? Considering the approximate total capital investment, what are the requirements (if any) for the debt to equity ratio, debt coverage ratio, etc. throughout the concession period? What are the restrictions on the user fees to be charged? What are the major risks and which are going to be assumed by the host government?
2. ***Checking the magnitude and reliability of the revenue stream.*** Based on a preliminary cost estimate and capital structure, is the revenue stream adequate to service debt, pay for operations and maintenance, and provide a reasonable rate of return to investors? Are there any guarantees, by the host government, supporting the revenue stream?
3. ***Financial Modeling.*** Does the BOT infrastructure project constitute an attractive investment considering its risk-reward characteristics? Can the undertaking be financed, considering the capital structure requirements included in the RFP and the constraints of the market?

4. ***Formal Risk Assessment***. Can the major risks be correctly identified and allocated to the parties that are best able to control and manage them? Is there any significant uninsurable risk?
5. ***Facilitate Negotiations***. Having performed a formal risk assessment and having developed the financial models for the project, the financial engineer should assume a pro-active role in the negotiations between the host government and the private sponsors, and among the latter with third party investors, contractors, suppliers, etc.
6. ***Final Capital Structure Design***. Based on the financing alternatives available to the project company, this step involves identifying and arranging the most cost-effective funding structure for the BOT development.
7. ***Financial Performance Monitoring***. Establishing effective control mechanisms and implementing contingency plans (debt restructuring, concession agreement re-negotiation, etc.) when needed.
8. ***Financial Feedback***. Analyzing and learning from any deviations that might occur between the actual and the expected financial performance of the undertaking. Building up the body of knowledge in the financial engineering of BOT infrastructure projects. Experience and expertise in financial engineering can become a key core competency that provides an organization with a competitive advantage in pursuing BOT infrastructure projects.

The procedure for financial engineering is, like most design processes, iterative and performed in a systems rather than sequential manner. Moreover, although all of the aforementioned tasks are interdependent and essential, the financial modeling function is the cornerstone of the financial analysis and design of BOT infrastructure project investments. As will be discussed in more detail in Chapter 3, financial modeling comprises the development of the basic analytical tools (models) that will portray the financial situation intended for the venture.

Chapter 3

Financial Modeling – Methodology

3.1 Introduction

Regardless of their individual role in a Build-Operate-Transfer infrastructure project investment, stakeholders want to fund projects which are worth more than they cost or, alternatively, with positive net present values (NPV). In order to assess their investment, investors and creditors need a methodology for calculating the anticipated value of these massive capital undertakings, as well as for estimating the corresponding rate of returns.

This chapter builds on the capital budgeting asset valuation theory and discounted cash flows procedure to propose a framework for evaluating the economic feasibility and financial viability of a BOT infrastructure project investment.

After outlining and describing the evaluation process within the proposed methodology, each of the steps is explained in detail.

3.2 Methodology

The proposed financial modeling process for the financial analysis and design of a BOT project development consists of constructing and analyzing the following models:

1. Economic Feasibility Analysis
2. Economic Sensitivity Analyses
3. Preliminary Capital Structure Assessment

4. Construction Stage Cash Flow Analysis
5. Take Out Stage Financial Analysis
6. Financial Sensitivity Analyses

Although the capital structure of a BOT venture will have an impact in the economic feasibility of the investment, the aforementioned methodology is based on the recommendation by Brealey and Myers that analysis of the investment decision be first separated from the one pertaining to the financing decision.[13] One of the reasons for not accounting for how the project is to be financed in the Economic Feasibility Analysis is to avoid double-counting the capital and financing costs. Once the economic attractiveness of the project has been ascertained, step five (Take Out Stage Financial Analysis) takes into account the interdependency of the investment and financing decisions.

3.3 Economic Feasibility Analysis

For the purpose of this thesis, an Economic Feasibility Analysis is concerned with the project's monetary return to the sponsors, and not with its contribution to the country's infrastructure development program or to the government's objectives for the whole economy. The latter would require, among other tasks, a social and macroeconomic study on the host country to judge the impact of the newly constructed infrastructure facility. Assigning values to intangible benefits (costs) such as increased employment, technology transfer, environmental impact, augmented productivity, income distribution, etc. are not within the scope of the proposed economic feasibility analysis.

---

[13] Richard A. Brealey and Stewart C. Myers, *Principles of Corporate Finance*, Fifth Edition, McGraw Hill Company, New York, 1996, p. 120.

As intended in this thesis, the objective of the Economic Feasibility Analysis is to perform a preliminary assessment of the project's economic attractiveness, without considering how the investment is going to be funded. The economic appraisal of a BOT venture consists of comparing the monetary costs of the project's construction and operation stages with the revenues associated with the facility's operation throughout the concession period. The procedure focuses on discounting the annual net cash flows by an appropriate "hurdle rate" to obtain the project's net present value (NPV). Although a more detailed discussion on discount factors is included in Section 4.6, at this point an appropriate hurdle rate will mean a discount factor that is: either proportional to the rate of return of other investments with similar risk profiles (opportunity cost), or representative of the anticipated weighted average cost of capital (WACC) of the funds financing the project.

The general formula underlying the spreadsheet of our economic feasibility analysis can be expressed as:[14]

$$PV = \sum \frac{C_t}{(1 + h_r)^t} \quad \text{, where}$$

PV = Present Value of the investment

C_t = Cash Flow for the year "t"

h_r = the assumed hurdle rate, and

t = values from zero to the last year of the concession period.

[14] Richard A. Brealey and Stewart C. Myers, *Principles of Corporate Finance*, Fifth Edition, McGraw Hill Company, New York, 1996, p. 35.

From a format perspective, the spreadsheet rows correspond to the years within the concession period, and the columns include each type of cost (uses of funds) and revenue (sources of funds) associated with the project (Refer to Section 8.3) for a sample spreadsheet setup).

3.4 Economic Sensitivity Analyses

The next step within the proposed financial modeling methodology is assessing the vulnerability of the "Base Case Scenario" evaluated in the Economic Feasibility Analysis. In other words, the intention of the Economic Sensitivity Analyses is to determine the "sensitivity" of the project's economic feasibility to changes in the underlying assumptions of the base case scenario.

Through the consideration of "what if" questions in relation to the project's economic variables, the analyst can determine which assumptions are the most critical to the viability of the investment. This not only provides more insight to the overall robustness of the venture, but also focuses the management's attention towards the critical variables during the implementation of the financial plan.

Performing economic sensitivity analyses on a BOT project investment is justified by the fact that each variable within an economic feasibility analysis has a certain degree of uncertainty. Among the most significant uncertainties associated with BOT infrastructure projects are:[15]

- the potential for construction cost and schedule overruns
- the gap between the facility's actual level of service and its design capacity

---

[15] *Guidelines for the Development, Negotiation and Contracting of Build-Operate-Transfer (BOT) Projects*, United Nations Industrial Development Organization, 1995, p. 128.

- forecast variations in the number of users and overall revenues at different levels of user charges
- an increase in the investment's opportunity cost or weighted average cost of capital
- actual operation & maintenance costs
- residual value (if any) at the end of the concession period.

While these risks are shared among the many parties involved in a BOT venture, the economic feasibility of the investment can not be totally insulated from these uncertainties (Refer to Chapter 5 for a detailed discussion on risks).

3.5 Preliminary Capital Structure Assessment

Once the project's economic feasibility and the impact resulting from variations to its base case scenario have been assessed, the next step consists of designing a preliminary capital structure for the funding of the BOT venture. The objective of this task is twofold:

- To determine the maximum amount of debt that the project's net revenues can sustain
- To check whether the preliminary capital structure can be viable to the investors and creditors.

The implementation of a BOT financial plan requires its capital structure to be acceptable for both, the investors and creditors. While a large proportion of equity within the project's capital structure will deter potential sponsors from investing in the project, a 100% debt requirement will in most cases be unacceptable to the creditors. Before deciding on the final combination of debt and equity for the project, it is useful to estimate the maximum amount of debenture that the net revenue flows or earnings can support. The suggested procedure is:

1. Calculate the Present Value (PV) of the annual earnings during the concession period using an anticipated cost of debt as the discount factor.
2. Find an Equivalent Uniform Annuity (EUA) for the Present Value of the net revenue stream.
3. Assume a minimum debt Coverage Ratio (CR); e.g. 30%.
4. Set the expression for Annual Debt Service (ADS) as:

   ADS = (1 + CR) * Debt Amount * (A/P, *i*%, *n*)

   where (A/P, *i*%, *n*) is the present value factor of an annuity

   given the debt amount, its interest (*i*), and life in years (*n*).
5. Equate the net revenue stream's Present Value Equivalent Uniform Annuity to the Annual Debt Service expression and solve for the maximum debt amount:

   (1 + CR) * Debt Amount * (A/P, *i*%, *n*) = EUA

By finding the maximum amount of debt that the annual earnings of the project can theoretically sustain, we obtain an estimate of the minimum amount of capital that has to be raised through subordinate debt, equity or a combination of both. Also, after performing the aforementioned calculations, the analyst can get a good feeling on whether the project's net revenue stream can support a workable capital structure.

Alternatively, as will be discussed in Section 4.5, the maximum amount of debt within the capital structure can be found by selecting the desired bond rating and performing the appropriate "reverse engineering" calculations.

3.6 Construction Stage Cash Flow Analysis

The goals of the Construction Stage Cash Flow Analysis are:

- To assess the cash flow requirements of the BOT investment during the pre-construction and construction stages.
- To determine the escalated cost of the project upon completion of the construction stage.

While many of the expenses incurred prior to the actual construction could be considered as "sunk costs" (Refer to Section 4.4 for more on this subject), most construction cost estimates include an allowance (between 0 and 5% of the total construction cost) for the cash outflows that take place during the four phases of the pre-construction stage. The phases and the associated expenses are:[16]

1. ***Proposal Preparation*** – Performing preliminary feasibility analyses and preparing the conceptual proposal.
2. ***Project Development*** – Refining the project's proposal and financial plan.
3. ***Project Initiation*** – Validation of the revenue projections, environmental and permits clearances, and preliminary negotiations with equity investors and lenders.
4. ***Final Pre-Construction*** – Negotiation of final financial commitments and construction mobilization.

Once all the sources of funds and the expenses associated with the pre-construction and construction stages are identified, the construction stage cash flow analysis can be performed to calculate the project's total escalated cost (PTEC). The project's total escalated cost is equal to the sum of the compounded value of the pre-

[16] O.P. Agarwal and J.B. Miller, "The Santa Ana Viaduct Express (SAVE)", *Infrastructure Development Systems IDS-97-T-011*, Massachusetts Institute of Technology, 1997, p. 8-9.

construction equity, the compounded value of the construction equity, the total construction loan, and the accumulated construction loan interests. Stated as a formula,

$$\text{PTEC} = \begin{array}{c}\text{Compounded}\\ \text{Pre-Const.}\\ \text{Equity}\end{array} + \begin{array}{c}\text{Compounded}\\ \text{Const.}\\ \text{Equity}\end{array} + \begin{array}{c}\text{Total}\\ \text{Const.}\\ \text{Loan}\end{array} + \begin{array}{c}\text{Accumulated}\\ \text{Const. Loan}\\ \text{Interests}\end{array}$$

The project's total escalated cost after construction is one of the most important parameters used in the Take Out Stage Financial Analysis.

3.7 Take Out Stage Financial Analysis

Once the robustness of the BOT project investment has been confirmed through the economic feasibility and sensitivity analyses, a workable capital structure has been determined, and the project's total escalated cost after construction has been calculated, the next step is to assess the viability of the investment, taking into consideration the financial scheme for the take out stage.

While the Economic Feasibility Analysis described in Section 3.3 computed the net present value (NPV) of the investment assuming all-equity financing, the Take Out Stage Financial Analysis adjusts the base case NPV by incorporating the present value of the financing side effects.

Similar to Section 3.3, the general formula underlying the spreadsheet of a Take Out Stage Financial Analysis can be expressed as:[17]

$$ANPV = \sum \frac{C_t}{(1 + C_c)^t} + \text{Present Value of Financing Side Effects} \quad \text{, where}$$

[17] Richard A. Brealey and Stewart C. Myers, *Principles of Corporate Finance*, Fifth Edition, McGraw Hill Company, New York, 1996, p. 517.

$ANPV$ = Adjusted Net Present Value of the investment

C_t = Cash Flow for the year "t"

C_c = the project's cost of capital, and

t = values from zero to the last year of the concession period.

Contrary to the Economic Feasibility Analysis, where the net annual cash flows are discounted at an arbitrary hurdle rate (h_r), in the Take Out Stage Financial Analysis the cash flows are discounted at the actual project's cost of capital (C_c). Brealey and Myers have proposed two definitions for the cost of capital:[18]

- ***Concept 1: The opportunity cost of capital (r).*** This is the expected rate of return offered in capital markets by equivalent-risk assets. This depends on the risk of the project's cash flows. The opportunity cost of capital is the correct discount rate for the project if it is all-equity financed.
- ***Concept 2: The adjusted cost of capital (r^*).*** This is an adjusted opportunity cost or hurdle rate that reflects the financing side effects of an investment project.

Since most BOT deals are funded through some combination of debt and equity, the adjusted cost of capital (*Concept 2*) is the definition of the cost of capital (C_c) that better applies when performing Take Out Stage Financial Analyses.

The procedure for doing a Take Out Stage Financial Analysis can be outlined as follows:

1. Establish the base proposition that equates the Uses of Funds to the Sources of Funds:

PTEC + Cost of Raising Capital + Reserves = D + E, where

[18] Richard A. Brealey and Stewart C. Myers, *Principles of Corporate Finance*, Fifth Edition, McGraw Hill Company, New York, 1996, p. 533.

PTEC = The project's total escalated cost after construction
(Calculated in the Construction Stage Cash Flow Analysis; see Section 3.6)

D = Debt; Senior and Subordinated, and

E = Equity; Common and Preferred

2. Decide on the final capital structure and determine the cost of each financial instrument.

3. Calculate the Weighted Average Cost of Capital (WACC) from the formula:

$$WACC = \left(\frac{D_1}{V} * C_{D1}\right) \ldots + \left(\frac{D_N}{V} * C_{DN}\right) + \left(\frac{E_1}{V} * C_{E1}\right) \ldots + \left(\frac{E_N}{V} * C_{EN}\right), \text{where}$$

V = Total Capital = $D_1 \ldots + D_N + E_1 \ldots + E_N$

D_1 = Type of Debt #1 and C_{D1} is the associated cost of debt capital, and

E_1 = Type of Equity #1 and C_{E1} is the associated cost of equity capital.

4. Set a spreadsheet to discount the annual project's cash flows at the Weighted Average Cost of Capital (WACC).

5. Check the spreadsheet base case scenario to make certain there are no negative cash flows on any year throughout the concession period. If they were present, adjustments would have to be made to the selected capital structure (e.g. increase the amount of equity), reserve fund amount, debt service payment terms, etc.

6. Obtain the project's Net Present Value (NPV).

7. Calculate the investment's Net Present Value from:

Project's Net Present Value	-	Present Value of Contributed Equity	=	Investment's Net Present Value

8. Compare the results with the ones from the Economic Feasibility Analysis.

3.8 Financial Sensitivity Analyses

Analogous to the Economic Sensitivity Analyses (Section 3.4), this step involves testing the investment's financial viability by varying the assumptions included in the Take Out Stage Financial Analysis base case scenario.

This process will not only provide more insight into the attractiveness of the investment, but will also disclose to the project's stakeholders the most critical variables in terms of their influence on the venture's financial success.

3.9 Remarks and Conclusions

Due to the mammoth capital requirements, expensive pre-construction process, political dependency, large number of stakeholders involved, and revenue stream uncertainty, BOT infrastructure project financing is both complicated and difficult.

The main goal of the framework presented in this chapter is to propose a systematic and simple procedure for the financial modeling of BOT project investments. Although the specific calculations and content of spreadsheets will vary among BOT project ventures, the general decision flowchart still applies to all.

Figure 3.9.1 presents the decision flowchart for the Financial Modeling of BOT Project Investments.

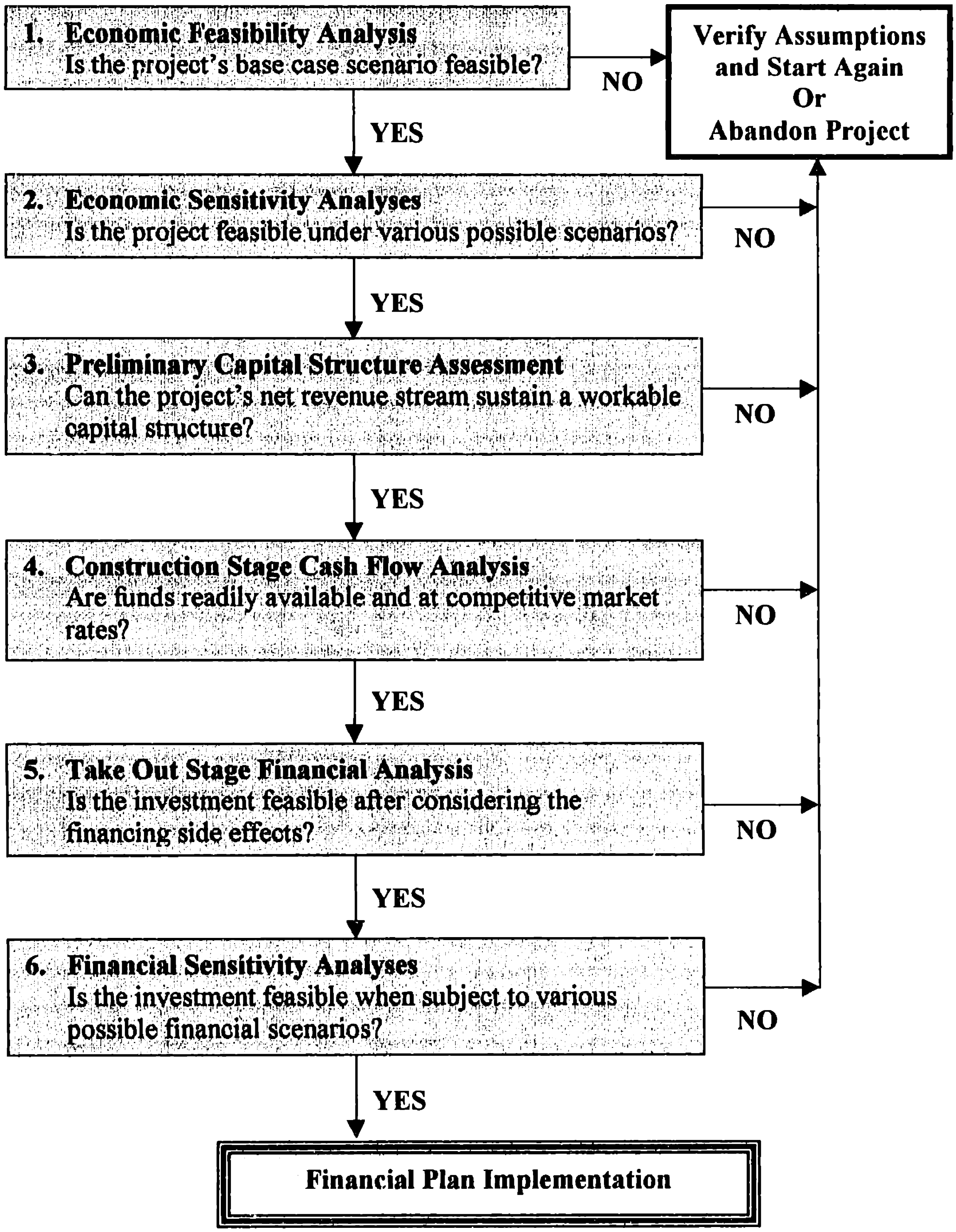

Figure 3.9.1: Financial Modeling Decision Flowchart

Chapter 4

Financial Strategy

4.1 Introduction

Broadly defined, models are simplified representations of reality designed to facilitate the systematic analysis of complex situations. The financial models presented in the previous chapters constitute a valuable set of tools and techniques that assist potential BOT infrastructure project sponsors in assessing the economic attractiveness of these complicated ventures. Nevertheless, more important than the numerical results of the computer spreadsheets representing the financial processes of these undertakings is the thought process in connection with the various models.

Before applying the suggested financial modeling methodology to a case study, it is the overall goal of the next three chapters to discuss key elements within the financial engineering of BOT infrastructure projects. This in turn will provide more insight with respect to the financial concepts and related issues embodied in the proposed framework.

While this chapter focuses on the financial strategy for BOT ventures, Chapters 5 and 6 emphasize on the importance of effective risk management and strong host country support, respectively, for the success of these undertakings. Once the underlying theoretical concepts are presented, the proposed financial modeling process is applied to the Canada Confederation Bridge Project in Chapter 8.

4.2 Financial Instruments – General

Financial instruments can be defined as the mechanisms that enable creditors and investors to fund BOT infrastructure projects, in anticipation of their future cash flows. In return they receive financial security in the form of a stock share, bond certificate, promissory note, etc., that describes the nature of their claim on the project's expected cash flow. So, in the context of this thesis, a financial instrument is an intangible asset that funds a BOT project and represents a legal claim to the future cash payouts of the infrastructure facility.

In terms of attracting the interest of the private sector to fund a BOT infrastructure project investment, the financial engineer must market the "claims" on the project's expected net revenue stream. Once all the potential funding alternatives have been identified, the "claims" must be packaged and sold in the form of the financial instruments that will yield the highest value to the project company. Value maximization will depend on the financial instrument's alignment with the project's anticipated cash flow profile, cost of capital and associated covenants.

The BOT infrastructure project's financial alignment will be subject to the financial engineer's qualifications with respect to his knowledge regarding the spectrum of financial instruments available, the merits and restrictions of each instrument, and the markets in which they are traded. Furthermore, when designing and selecting the instruments to be used, the financial engineer must resolve two fundamental issues: their risk-reward relationship and the right of their holders to participate in company decisions. The risk-reward relationship can be broken down to the determination of the appropriate rate of return (cost of capital), given the investment risk, and to the claim priority on the company's revenue stream or on its tangible assets in the event of liquidation.

According to C. Walker, et. al., among the factors affecting the mix of financial instruments in the funding of BOT infrastructure projects are:[19]

- adequacy and predictability of the project's prospective cash flows
- cost of the various instruments
- legal and tax implications associated with each instrument
- expected capital structure of the project company
- risk-reward needs of the financing institutions involved
- size and purpose of the financing
- drawdown and repayment profiles
- currency mix of the project's costs and revenues
- level of protection required against interest rate movements
- project's risk allocation and distribution
- repayment guarantees (if any) by sponsors and promoters
- off-take and feedstock agreements (where applicable)
- terms and conditions of the concession agreement
- agreements among the various stakeholders.

Regarding the viability of BOT infrastructure projects and the sustainability of the BOT model strategy for infrastructure development, they are to a great extent directly proportional to the size of the menu of cost-effective financing alternatives available to fund these ventures. Although the use of innovative financial instruments and techniques is emerging as the market for BOT infrastructure projects develops, a substantial part of the senior debt employed to date in funding these undertakings has consisted of traditional commercial bank loans. Notwithstanding the past experience, there is a need for the creation and use of more sophisticated financial instruments. These provide adequate funds at affordable costs of capital, and better align the needs and interests of lenders and investors. The use of these instruments will help reduce the schism between the public demand for more and better infrastructure facilities and those provided by the government.

In general, the sophistication level of the financial instruments available to fund a limited non-recourse infrastructure project financing will be subject to:

- the degree of economic feasibility of the proposed BOT infrastructure project investment
- the reputation and credibility of the project promoters and sponsors
- the maturity of the financial markets in the host country
- the accessibility to foreign and international financial markets
- the qualifications, creativity and resourcefulness of the financial engineer.

4.3 Types of Financial Instruments and Sources of Capital

The financial instruments that can be used to fund a BOT infrastructure project can be broadly classified as: ***equity***, ***senior debt*** and ***subordinate debt (mezzanine financing)***.

---

[19] C. Walker and A.J. Smith, *Privatized Infrastructure: The Build Operate Transfer Approach*, Thomas

Equity

Equity, in the form of shares (common stock) of the project company, constitutes a residual income security because stockholders have a claim on any income remaining after all liabilities have been paid. Since equity constitutes ownership claims against the project company's cash flows, it is often referred to as risk capital, in the sense that if the BOT project succeeds stockholders become the chief beneficiaries, but if it fails shareholders loose the most.

Typically, the initial equity investors in a BOT infrastructure project are those parties who directly benefit the most from the development of the facility. They include: engineering and construction firms, purchasers of the project's output, suppliers of raw materials and essential products, operations contractors, financial consultants, etc. The general public and institutional investors tend to fund BOT infrastructure projects, as passive shareholders, after the facility becomes operational and has a demonstrated record of profitability. Institutional and individual shareholders are referred to as passive investors because, contrary to the project sponsors, they are not typically involved in the development or operation of the BOT infrastructure project. Their common stock investment is based solely on the expected profitability of the venture, and is used to complement the sponsor's risk capital in satisfying the overall equity requirements set by the project's senior lenders.

Regardless of the economic strength of the BOT project investment, lenders want to see sponsors and third party investors put equity into these ventures. As Peter Nevitt points out: "Lenders look to equity investment as providing a margin of safety. They

---

Telford Publications, London, England, 1995, Chapter 5.

have two primary motivations for requiring equity investments in projects which they finance:

1. Lenders expect the projected cash flows generated by the project to be sufficient to pay operating expenses, service debt and provide a very comfortable margin of safety to meet any contingencies which might arise. The more burden the debt service puts on the cash flow of the project, the greater the lenders' risk.
2. Lenders do not want the investors to be in a position to walk away easily from the project. They want investors to have enough at stake to motivate them to see the project through to a successful conclusion."[20]

From a payback standpoint, BOT projects' passive stockholders can receive two types of returns on their investment: dividends and stock price appreciation. The shareholders' annual return (AR) can be expressed as:[21]

$$\underbrace{AR}_{\text{Annual Return}} = \underbrace{\frac{d_0}{P_0}}_{\text{Divided Yield}} + \underbrace{\frac{P_1 - P_0}{P_0}}_{\text{Percentage Change in Share Price}}, \text{ where}$$

d_0 = dividends per share
P_0 = beginning-of-year stock price
P_1 = end-of-year stock price

One noteworthy distinction between the dividend policy in standard corporations and in project companies is that the former is, to a great extent, at the discretion of the management, while in BOT projects the dividend payout program is usually agreed upon in advance. Since a BOT project company is a sole purpose special organization, the

---

[20] Peter K. Nevitt, *Project Financing*, Fourth Edition, Euromoney Publications, London, United Kingdom, 1983, p. 29.

venture's free cash flows are distributed to the shareholders, through a pre-accorded dividends policy, and then they decide for themselves how to re-invest them.

The different types of equity are divided into several classes: ***common shares with equal voting rights***, ***common shares with different voting rights***, and ***preferred stock***. Preferred shares can be subdivided further into ***convertible***, ***redeemable*** and ***cumulative***, depending on their provisions to convert to ordinary shares of capital, to obtain repayment of the initial investment, and to their rights for accumulating unpaid dividends, respectively.

Although preferred stock is considered as a special class of equity, it is really a hybrid instrument in that it behaves like debt in some ways and like equity in others. Similarly to debt, preferred stock is a fixed-income security and, like common stock, its dividends are not tax-deductible and unless there is a "call option" they have no maturity. With respect to claims priorities on the project's cash flows, preferred stock is junior to debt but senior to common stock. The usual provision on preferred stock for the accumulation of unpaid dividends and its consideration as "cheap equity" or "debt with a tax disadvantage," together with the cash flow profile of most BOT infrastructure projects, are the reasons why this is not a widely used financial instrument for these types of ventures.

Senior Debt

Senior debt in BOT infrastructure projects can be categorized into two general groups: ***bonds*** and ***commercial bank loans***.

---

[21] Robert C. Higgins, *Analysis for Financial Management*, Fifth Edition, Irwin/McGraw-Hill, USA, 1998, p. 159.

Bonds are fixed-income securities in which the holders receive specific periodic interest income, and repayment of the principal at a pre-determined date. The three major characteristics of bonds are: par value, coupon rate and maturity date. The par value is the amount of money to be received by the holder on the maturity date, and the coupon rate is the percentage of the par value that the project company promises to pay periodically to the bondholder as fixed interest income. Regarding payment priority, bonds, like any other senior debt, have precedence over equity.

Depending on the indenture agreement between the bondholder and the project company, bonds may include call provisions and a plethora of protective covenants. While a call provision gives the project company the option to retire the bonds prior to maturity, the protective covenants are designed to give bondholders some degree of indirect control over the management of the BOT venture. Typical protective covenants include limits on the project company's financial ratios, the requirement for bondholders' prior consent in the acquisition of major assets or for important management decisions, etc. From a BOT project's cash flow perspective, it is important to note that most bond issues require periodic repayments of principal or a sinking fund. Finally, several rating companies like Standard & Poor's and Moody's analyze and evaluate the investment qualities of many publicly traded bonds. By appraising the BOT infrastructure project's financial viability, its risk distribution program and the strength of the various contractual agreements, these companies are able to assess the bond's default risk, thus assigning an investment rating.

Compared to bonds, commercial bank loans adapt better to the initial phases of a BOT project, since commercial banks are more willing to assume some proportion of the project completion risks as well as other non-credit risks. In general, banks can accommodate the loans' repayment patterns to the anticipated cash flow profile of the BOT infrastructure project. Although most commercial loans are usually paid in level amounts over the life of the facility, principal repayments might be delayed or a large final "balloon" payment can be arranged, depending on the financial needs of the project company. Also, in the event of default by the project company, commercial banks are more willing than institutional investors to restructure repayment schedules so that operations may be continued and the loans eventually repaid. Furthermore, the flexibility of commercial bank loans is enhanced by the fact that their terms and conditions are often re-negotiated before maturity. Provided that the project sponsors remain credit-worthy, that the BOT project is proceeding as planned, and that there is a sound business reason for making a modification, banks are usually willing to accommodate the changing needs and interests of the project company.

Depending on the term sheet and subsequently on the loan agreement, the interest rate of commercial loans can be ***fixed*** or ***floating*** or a combination of both, for the life of the instrument. In the case of a variable rate, it is usually linked to a standard borrowing base like the U.S. prime rate, the London Interbank Offered Rate (LIBOR) or the lender's CD rates. Since commercial banks have no interest in equity investments, and given the non-recourse nature of BOT infrastructure projects' financing, their emphasis is centered on the venture's credit worthiness as portrayed by the following inter-related issues:[22]

- Investment and personal commitments by the project sponsors and other major stakeholders.

[22] *Guidelines for the Development, Negotiation and Contracting of Build-Operate-Transfer (BOT) Projects*, Draft, United Nations Industrial Development Organization, Washington, D.C., 1995, p. 178.

- The probability of compliance with the project's budgetary, completion and technical targets.
- The experience and capability of the project's sponsors and management team to successfully implement the undertaking.
- The adequacy of the project's anticipated cash flow profile.
- The strength of government support to the project.
- The degree of commitment to the project by the highest levels of government.

While being more flexible than bondholders, in terms of structuring their loans to the custom needs of a BOT project, commercial banks typically impose stricter and more comprehensive covenants than their counterparts. Among the most restrictive financial covenants included in the security package of the credit agreement between the commercial bank and the project company are:[23]

- The requirement of appropriate insurance coverage.
- A "negative pledge" clause in which the project company commits itself not to pledge any asset without the prior consent of the bank.
- The requirement of the bank's consent for any major capital expenditure.
- The linkage and allowance of dividend payments in compliance with specified financial ratios.
- The requirement for a cash reserve to cover unknown contingencies.
- Restrictions on issuing additional debt.
- The requirement that equity funds be drawn down before loans are disbursed.

---

[23] *Guidelines for the Development, Negotiation and Contracting of Build-Operate-Transfer (BOT) Projects*, Draft, United Nations Industrial Development Organization, Washington, D.C., 1995, p. 179.

Although the specific type of commercial bank loan will vary depending on the particular needs of the BOT venture, the negotiated terms and conditions, and the security package provided by the project company, there are four major bank credit facilities that may be arranged to finance a BOT infrastructure project:[24]

- ***Revolving Credit.*** Typically arranged to provide interim financing during the construction stage or to provide additional working capital during the facility's operation phase. In this scheme, in addition to the principal, all unpaid interest charges are accumulated and compounded. At maturity, the credit facility is re-negotiated or, in case of a construction loan, refinanced by a permanent loan.
- ***Term Loan.*** Sometimes referred to as permanent or take-out financing, term loans have longer duration (usually up to 10 or 12 years) than revolving credit facilities and have an amortization schedule that is aligned with the anticipated cash flow profile of the project.
- ***Stand by Letter of Credit.*** This credit facility is mainly used as a guarantee of payment to the project company's contractors and suppliers.
- ***Bridge Loan.*** Its primary objective is to cover any gap between the timing of expenditure by the project company and the availability of long-term funds. Like construction interim loans, bridge loans are supported by firm take-out commitments from long-term lenders or equity investors.

Table 4.3.1 lists the ten leading providers of commercial project bank loans in 1995.

[24] John D. Finnerty, *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 164.

Rank	*Bank*	*Amount* (in Millions of Dollars)
1	Chase Manhattan	$7,286
2	Bank of America	7,033
3	Citibank	6,102
4	Societe Generale	5,321
5	ABN AMRO	4,900
6	Union Bank of Switzerland	4,499
7	Barclays Bank	3,959
8	Banque Paribas	3,949
9	Deutsche Bank	3,099
10	Industrial Bank of Japan	2,862

Source: Project Finance International (IFR Publishing).

Table 4.3.1: Leading Arrangers of Project Bank Loans in 1995[25]

Subordinated Debt (Mezzanine Financing)

Like preferred shares, subordinated loans are flexible capital instruments and have both, common equity and senior debt characteristics. Because of the "dual personality" of subordinated debt, its financial risk profile is somewhere between senior debt and pure equity capital. Payments to senior debt take precedence over those on subordinated loans and, whenever funds are not available, mezzanine financing is treated like equity and no payments materialize. However, provided that the project's cash flow permits it, subordinated loans' interest payments are made prior to any dividend distribution. Because subordinated debt bears more risk than senior loans or bonds, higher interest rates or a profit participation scheme is usually offered by the project company to the facilitators of these funds. Providing share options, convertible rights and other forms of "equity kickers" are some of the features used to increase the economic attractiveness of mezzanine financing.

In general, subordinated debt offers the following advantages:[26]

[25] John D. Finnerty, *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 167.

- Enables BOT infrastructure projects to be financed with more debt and less equity, while avoiding the full burden of higher debt service in the early years when cash flow is tight.
- Since most senior debt providers consider subordinated debt as equity, sponsors are able to retain a higher shareholding interest in the venture, thus maximizing the returns on their investment (provided the project succeeds).
- From the senior debt providers' standpoint, subordinated debt improves the credit worthiness of the project company by providing an additional equity cushion.
- For the providers of mezzanine financing, it is an opportunity for realizing higher returns than those of senior debt, without taking the fall risk of equity capital.

Sophisticated Financial Instruments and Other Sources of Funds

Sophisticated financial instruments refers to the hybrid issues that, like preferred stock and subordinated debt, can not be categorized as purely debt or common stock. These debt and equity derivatives contain unusual features and their main objective is to reduce the cost of capital, while attracting medium and long-term funds for BOT infrastructure projects' financing. Examples of these instruments are: convertible debentures, zero coupon bonds, dual convertible bonds, indexed rate notes, leveraged preferred stocks, etc.

In addition to sponsors, contractors, suppliers, individual investors and commercial banks, other important sources of funds for BOT infrastructure projects include: export credit agencies, bilateral and multilateral agencies, institutional investors and the capital markets.

---

[26] *Guidelines for the Development, Negotiation and Contracting of Build-Operate-Transfer (BOT) Projects*, Draft, United Nations Industrial Development Organization, Washington, D.C., 1995, p. 176.

Export credit agencies (ECA) are usually state-owned providers of long-term credit, and their primary goal is promoting their own countries' exports. Because ECA's terms are typically more generous than those of commercial banks, due to government subsidies, they are highly suited for the financing of long-term infrastructure projects. On the other hand, capital from bilateral and multilateral aid agencies is normally restricted to developing countries and therefore not available to BOT infrastructure projects in the United States. Funds from these agencies (e.g. The World Bank, The International Finance Corporation, etc.) are provided for very long terms (up to twenty years or more) and are advanced on commercial rather than subsidized terms.

As previously mentioned, institutional investors include insurance companies, pension funds, investment funds and other financial organizations. Due to the long-term nature of their funds, institutional investors are in a better position than commercial banks to provide long-term financing (ten years and longer) to BOT infrastructure projects. Also, because institutional investors concentrate on the down-stream potential of a project, rather than in its short-term liquidity, their risk-reward profiles are better aligned to BOT investments than other traditional sources of capital. The downturns are that institutional investors are not as accommodating as commercial banks, and are not as willing to assume any proportion of the pre-completion risks associated with BOT infrastructure projects. Table 4.3.2 shows the ten largest institutional investors in the United States in 1993.

Rank	*Company*	*Amount* (*in Millions of Dollars*)
1	Prudential Life Insurance	$5,000.0
2	Metropolitan Life Insurance	4,104.1
3	Teachers Insurance and Annuity	4,050.0
4	John Hancock Mutual Life	3,932.0
5	Principal Financial Group	3,462.3
6	CIGNA	3,200.0
7	New York Life	1,800.0
8	Travelers Insurance	1,455.0
9	Mass Mutual	1,300.0
10	Pacific Mutual Life	1,039.0

Source: Private Placement Letter (September 29, 1994), p. 6.

Table 4.3.2: Largest Institutional Investors in the United States in 1993[27]

Although the capital markets, by way of investment in marketable debt and equity securities, are another viable source of capital, their accessibility is usually limited to extremely reputable and creditworthy project participants as well as to BOT ventures with sound financial and security packages. Since a BOT infrastructure project is essentially a start-up venture, it is very difficult to obtain an investment grade credit rating that will attract private sources of funds in the public securities market. In addition, in order to sell securities to the public in the United States, the project company has to register the issue with the Security and Exchange Commission, which typically is an expensive, long-lasting and tedious proposition. Regarding the possibility of a public issue, the financial engineer has to decide whether the merits of the BOT project, together with the benefits of accessing a wider market, warrant the associated complications and additional up-front costs. Table 4.3.3 summarizes and compares the characteristics of bank loans, private placements and the public bond markets.

[27] John D. Finnerty, *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 173.

	Debt Markets		
Characteristic	*Bank Loan*	*Private Placement*	*Public Bond*
Maturity	Short	Medium to long	Long
Interest rate	Floating	Fixed	Fixed
Severity of information problems posed by the average borrower	High	Moderate	Small
Average loan size	Small	Medium to large	Large
Average borrower size	Small	Medium to large	Large
Average observable risk level	High	Moderate	Lowest
Covenants	Many, tight	Fewer, looser	Fewest
Collateral	Frequent	Less frequent	Rare
Renegotiation	Frequent	Less frequent	Infrequent
Lender monitoring	Intense	Significant	Minimal
Liquidity of loan	Low	Low	High
Lenders	Intermediaries	Intermediaries	Various
Principal lender	Banks	Life Insurance companies	Various
Importance of lender reputation	Somewhat important	Most important	

Source: Carey, Prowse, Rea, and Udell (1993b), p.33.

Table 4.3.3: Characteristics of Bank Loans, Private Placements and the Public Bond Markets[28]

4.4 Financial Plan

Broadly stated, the mission of a BOT infrastructure project's financial plan is to structure the optimal mix of debt, equity and mezzanine financing that will add value to the investment while ensuring the financial viability of the undertaking. This is accomplished by selecting the financial instruments that will simultaneously enhance the economic attractiveness of the venture and minimize the project's risk of cash insolvency throughout its different stages.

[28] John D. Finnerty, *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 170.

More specifically, according to John Finnerty, the principal objectives that should guide the financial engineer when designing the most appropriate financing plan for a BOT infrastructure project are:

- "Ensuring the availability of sufficient financial resources to complete the construction of the facility.
- Securing the necessary funds at the lowest practicable cost.
- Minimizing the project sponsors' credit exposure to the project.
- Establishing a dividend policy that maximizes the rate of return on the project sponsors' equity, subject to the constraints imposed by lenders and the cash flow generated by the project.
- Maximizing the value of the tax ownership benefits to which the project will give rise.
- Achieving the most beneficial regulatory treatment."[29]

Since these goals are not always in perfect harmony with one another, conflicts are bound to occur, and it is the responsibility of the financial engineer to decide which compromise better suits the interests of the project company and ultimately those of the sponsors. To implement the financial plan's mission, and in order to attain its objectives, one of the most important tasks involves the selection of the most appropriate financial instruments to fund the BOT infrastructure project. As suggested by Robert Higgins, choosing the right financial instrument is a two-step process consisting of:[30]

---

[29] John D. Finnerty, *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 91.

[30] Higgins, Robert C., *Analysis for Financial Management*, Fifth Edition, Irwin/McGraw-Hill, USA, 1998, p. 191.

- ***Deciding how much external capital is required.*** This calculation entails knowing the amount of money available from the project sponsors, as well as a careful consideration of the financial markets and the terms on which the company can raise the external capital needed.
- ***Designing the financial instrument to be sold.***

As discussed in the previous section, the financial engineer can choose the best mix of funding mechanisms from a tremendous variety of financial instruments. The adequacy of the financial instruments will be subject, among other factors, to the characteristics of the specific phases of the project to be funded. Most financial plans for BOT infrastructure projects are based on the fact that these undertakings are comprised of two distinct phases: first, a high risk development-construction phase and, second, a lower risk public utility operation phase (Refer to Chapter 5 for a thorough discussion on risks).

<u>**Development Phase**</u>

The costs associated with the development phase of a BOT infrastructure project include feasibility studies, financial viability analyses, engineering and design, as well as bid and proposal preparation. These expenditures can be relatively high (up to $5-Million), and are normally borne by the project sponsors through risk capital in the form of common stock. Although these expenditures could be considered as costs of doing business or sunk costs, they normally count towards the sponsors' equity contribution. In some instances, government procurement strategies provide for the partial reimbursement of the development costs to all the project's bid respondents.

Construction Phase

The costs incurred in this stage include the construction of the entire BOT infrastructure project and the purchase and installation of any equipment. Since the facility is not operational and the accumulated costs reach their peak at the end of the construction, it is during this phase that the overall project risk is at its highest level (Refer to Section 5.3). For this reason, traditionally, passive investors have been reluctant to fund this phase, and the construction of the infrastructure facility is normally financed by the sponsors' equity contribution and through commercial bank loans. Deviations from this financing scenario occur when the economic attractiveness of the BOT project venture is so sound, that institutional and other passive investors are willing to assume some proportion of the pre-completion risks and provide long-term funds before the infrastructure facility is constructed.

With respect to the drawdown sequence during the construction stage, it is customary for the equity funds to be used first, followed by periodic drawdowns from the interim construction bank loan. This drawdown sequence assures commercial banks that project sponsors will have a substantial financial interest in the venture from its early stage, as well as remain committed to the successful completion of the construction phase. In addition, if an export credit agency is a source of capital to the project, the agreed upon funds will be withdrawn as required to pay for the purchase of special equipment, etc.

Finally, most commercial banks require the project sponsors to obtain a formal commitment on the permanent funding that is going to take-out the construction loan, prior to providing interim financing. In order to arrange the permanent financing, the financial engineer needs to make an accurate estimate of the total external funds that will be required at the end of the construction stage. This amount will be equal to the sum of:[31]

1. the total cash cost required for the basic completion of the facility during the construction phase, plus
2. the construction loan's capitalized interests, plus
3. any fees and out-of-pocket expenses that are incurred in connection with arranging the project financing, plus
4. the initial investment in working capital, plus
5. the cash to cover salaries and other operating expenses prior to the completion of construction, plus
6. contingencies or margins of safety funds, less
7. any cash revenues that are generated by the partial operation of the infrastructure facility during the construction period.

Operations Phase

Once the infrastructure facility is completed and operational, the overall project risk is substantially reduced. At this point, long-term debt, equity and mezzanine financing can be arranged from passive investors at more favorable terms to refinance the construction loans. However, the maturity of the long-term debt can not exceed the shortest expected useful life of the facility or of the concession period.

[31] John D. Finnerty, *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 92.

In addition, to complement the internally generated funds in meeting the working capital requirement to finance the infrastructure facility's operations, a revolving credit line can be arranged with a commercial bank.

Table 4.4.1 summarizes the typical basic financial plan for BOT infrastructure projects.

BOT Project Stage	Accumulated Costs	Overall Project Risk	Major Capital Provider	Major Financial Instrument
Development	Low	Medium	Sponsors	Equity
Construction	High	High	Commercial Banks	Debt – Const. Loan
Operations	Decreasing	Decreasing	Passive Investors	Debt – Long Term Funds

Table 4.4.1: Financial Plan – Base Case Scenario

4.5 Capital Structure

In this section, unless otherwise noted, ***capital structure*** refers to the project company's proportions of debt and equity, with respect to the total long-term contributed capital, at the beginning of the infrastructure facility's operations stage.

Regardless of the financial instruments used to fund a BOT venture throughout its different phases, the sources of funds employed, and the specific financing plan implemented, the capital structure of most project companies is comprised of debt ranging from 70% to 90% and equity fluctuating from 30% to 10% of the total contributed capital. Despite these unusual proportions of debt and equity, it is conceivable to finance a BOT infrastructure project without any substantial true equity, but rather with various levels of senior and subordinated debt.

In general, the debt to equity ratio within the project company's capital structure will be subject to the following considerations:

- The expected profitability of the BOT venture or, alternatively, the maximum debt service capacity of the project's revenue stream.
- The strength of the security arrangements and the credit worthiness of the entities bound by these arrangements.
- The project's business (operating) risk.
- The financial requirements of the desired credit rating.
- The cost of capital.

The project's expected profitability may be the basis for calculating the maximum amount of debt that the venture can sustain. In theory, the highest level of debt that a project can service is equal to its investment net present value reduced by some arbitrary factor, depending on the security arrangements, business risk, minimum equity amount required by lenders, etc. As implied in Section 3.3, the BOT venture's present worth concept can be visualized as the equivalent value, in today's dollars, of the investment's future net cash flows throughout the concession period. This net value constitutes, for all practical purposes, the collateral against which commercial banks and/or passive investors will be providing their long-term debt to finance the BOT venture. Based on the procedure discussed in Section 3.5, the maximum debt that a BOT project can sustain can be approximated by the following exression:

MD = INPV * RF, where

MD = Maximum Debt amount

INPV = Investment Net Present Value

RF = Reduction Factor; e.g. 75%

So, the more profitable the BOT undertaking, the higher its investment net present value and the greater its capacity for increased levels of debt within its capital structure.

In addition to the revenue volume adequacy, the debt to total capital ratio (or the project company's leverage ratio) will be subject to the quality of the revenues. The stronger the project's security arrangements (e.g. contract based revenue stream, guarantees, etc.), and the higher the credit worthiness of the parties involved, the more stable the revenue stream will be. All other things being equal, increased predictability of the project's revenue stream will augment the venture's capacity to sustain higher leverage ratios.

The project's business risk can be defined as the variability of the annual revenues to be realized during the operation stage of the infrastructure facility. Statistically, the business risk can be quantitatively measured by the standard deviation (spread) between the expected annual revenues and their mean (average) value. So, two BOT projects can have the same expected annual revenues average value, but substantially different business risks as represented by their respective standard deviations. The venture with the least business risk has the higher quality revenue (i.e. predictability and stability) and, as previously mentioned, can sustain a bigger proportion of debt within its capital structure. Figure 4.5.1 shows a graphical representation of two BOT infrastructure investments with equal expected annual revenues mean value, but different business risks with respect to the spread or variability of possible annual revenue values.

Another method for calculating the highest proportion of debt that a BOT project company can sustain is by reverse engineering the capital structure decision based on the desired long-term credit rating. By first selecting the target bond rating, the financial engineer can engage in a reverse engineering process to estimate the maximum amount of debt consistent with the selected rating. The advantages of this methodology are that sponsors know how much debt can be issued before suffering a rating downgrade, and that it reduces the uncertainty relating to the availability of long-term funds.

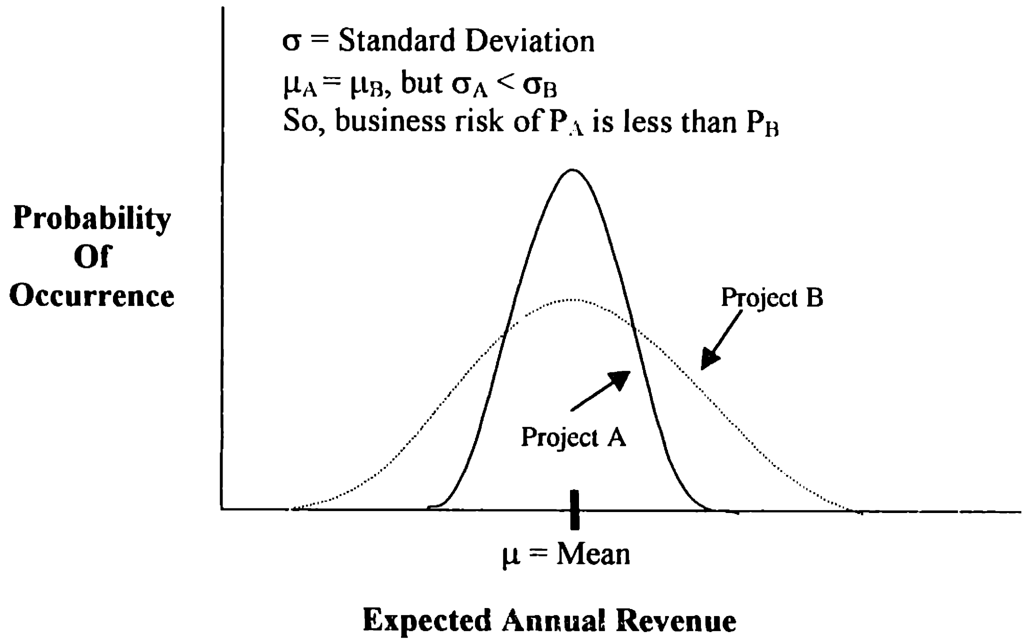

Figure 4.5.1: Expected Annual Revenues Probability Distributions for Two BOT Projects

As a rule, bonds rated Baa or above by Moody's or BBB or above by Standard & Poor's are considered to be "investment grade bonds," because they are regarded as having adequate capacity to pay interests and repay principal. Similarly, bonds with ratings below Baa or BBB are known as "junk bonds," because they are considered as having either speculative characteristics or identifiable vulnerabilities with respect to their capacity to pay interests and repay principal. For these reasons, most infrastructure projects' financings are structured so that the project company's leverage is consistent with a Baa/BBB credit generality. In conclusion, based on the debt service coverage ratios and other financial benchmarks associated with the Baa/BBB target credit rating, reverse engineering calculations can be performed to find the maximum allowable level of debt in connection with the BOT undertaking.

4.6 Cost of Capital

As mentioned in Section 2.4, one of the most important tasks of the financial engineer is to identify and source the most cost-effective financing for the BOT infrastructure project. Because the risk profiles and capital structures of BOT ventures are substantially different from those of their sponsors, it is the project's cost of capital that should be used as the discount factor in all net present value calculations. Both the project's preliminary economic feasibility and its financial viability will be highly dependent on the short and long-term funds' cost of capital committed to the undertaking. In turn, the project's capital structure will also be influenced by the potential financial instruments to be incorporated into its funding scheme.

Once the final capital structure of a BOT project has been designed, its overall cost of capital is calculated by the weighted average cost of all the financial instruments funding the undertaking. The following cost of capital analysis will be simplified by assuming that senior debt and common equity are the only two components within a BOT venture capital structure. In addition, the main objective of this section is not to pursue a theoretical discussion of the Weighted Average Cost of Capital (WACC) equation or of the Capital Asset Pricing Model (CAPM), but to suggest how these tools may me applied in estimating the cost of capital of BOT infrastructure projects.[32]

[32] For a detailed discussion on WACC and CAPM refer to: Richard .A. Brealey and Stewart C. Myers, *Principles of Corporate Finance*, Fifth Edition, McGraw Hill Company, New York, 1996, Chapters 7 & 8.

In general, the cost of capital of a BOT infrastructure project will be the weighted average cost of equity and the after-tax debt rate of return, or

$$\text{WACC} = \left(\frac{E}{V}\right) * r_e + \left(\frac{D}{V}\right) * r_d * (1 - t), \text{where}$$

E = market value of stockholders' equity

D = market value of total debt

V = total value of the project = E + D

r_e = rate of return on equity

r_d = rate of return on debt, and

t = the applicable marginal income tax rate.

The weighted average cost of capital (WACC) serves as the hurdle rate or discount factor to be used in the financial viability analyses of the BOT project investment.

Because debt interest payments are typically tax deductible, and due to the higher risk assumed by the stockholders, the cost of equity is higher than that of debt. While the cost of debt *(r_d) * (1 – t)* for BOT projects can be approximated by the contractual interest rate required by the lenders and the marginal income tax rate applicable to the project company, the rate of return on equity *(r_e)* can be estimated by the Capital Asset Pricing Model (CAPM). The basic postulate of CAPM is that the expected return on any risky asset is the sum of the appropriate risk-free rate and a risk premium. or

$$\overbrace{r_e}^{\text{Return on Equity}} = \overbrace{r_f}^{\text{Risk-Free Rate}} + \overbrace{\beta * (r_m - r_f)}^{\text{Risk Premium}}, \quad \text{where}$$

r_f = *The appropriate risk-free rate.* For BOT projects in the United States, this rate can be approximated by the long-term U.S. Government Bonds' rate at the time the venture is to be undertaken (e.g. 5%).

r_m = *The average return on the market portfolio of common stocks.* This could be represented by the Standar & Poor's Composite 500 Index (e.g. 12%).

$(r_m - r_f)$ = *The difference between the return on the market and the risk-free rate.* This term is referred as the market risk premium (e.g. 12% - 5% = 7%).

β = A factor based on the relative risk of the BOT project with respect to the market risk premium. Intuitively, it is a measure of how sensitive the returns of the BOT venture are to the overall market movements. Statistically, it is the covariance of the fluctuation in the project company's stock price and market return divided by the variance of the market return. Table 4.6.1 lists Beta (β) values for various companies.

Stock	Beta (β)
AT&T	0.92
Biogen	2.20
Bristol-Myers Squibb	0.97
Coca-Cola	1.12
Compaq	1.18
Exxon	0.51
Ford Motor	1.12
General Electric	1.22
McDonald's	1.07
Microsoft	1.23

Table 4.6.1: Sample Beta (β) Values for Various U.S. Companies[33]

The risk-free rate (r_f) and the market average return (r_m) are values that can be readily obtained at any given point in time. Table 4.6.2 shows the average rate of return for various portfolios calculated between 1926 and 1994.

Portfolio	Nominal Average Annual Rate of Return (%)
Treasury Bills	3.7
Government Bonds	5.2
Corporate Bonds	5.7
Common Stocks (S&P500)	12.2
Small-firm Common Stocks	17.4
Source: Ibbotson Associates, Inc., 1995 Yearbook	

Table 4.6.2: Average Rate of Return, 1926-1994[34]

[33] Brealey, Richard A. and Stewart C. Myers, *Principles of Corporate Finance*, Fifth Edition, McGraw Hill Company, New York, 1996, p. 181.

Estimating Beta (β) for BOT projects is, to a great extent, an art rather than a science. Among the reasons making this process a subjective appreciation of the financial engineer rather than one based on hard data are:

- ***The one-of-a-kind nature of most BOT infrastructure projects.*** No two projects are alike in terms of their security packages, revenue stream adequacy, risk-sharing program, contractual agreements, etc.
- ***Lack of historical data.*** BOT ventures are a "recent" development in project delivery and finance strategies (Refer to Section 1.1).
- ***No diversification of assets.*** From the project company's perspective, "all their eggs are in one basket," namely, the BOT infrastructure project. Contrary to most firms, BOT project companies do not reduce the project's unique (unsystematic) risk by diversifying their operations and engaging in various ventures simultaneously.
- ***Significant differences between government-run utility companies and other possible comparables.***

Assuming that a true comparable company could be found, the procedure for calculating the BOT project's Beta would be:

1. Calculate the Asset Beta (β_A)

   β_A = (β of comparable) * (equity to total capital ratio of comparable)

2. Calculate project's Beta (β_P)

   β_P = (β_A) / (equity to total capital ratio of BOT project)

---

[34] Brealey, Richard A. and Stewart C. Myers, *Principles of Corporate Finance*, Fifth Edition, McGraw Hill Company, New York, 1996, p. 146.

Based on the fact that BOT project companies are more highly leveraged than most ordinary firms, it is very likely that the above calculations will yield a project Beta (β_P) that is substantially greater than that of its comparable (β_C).

As an example, let us take the Standard & Poor's Composite 500 Index as the comparable and assume that the equity to total capital ratio of this "market company" is 40% and 20% for a typical BOT project company. Given this information, the project's Beta (β_P) will be calculated as follows:

1. $\beta_A = 1 * 40\% = 0.40$

2. $\beta_P = 0.40 / 20\% = 2.00$

Using the data in Table 4.6.2,

r_f= Return on Government Bonds = 5.2%

r_m = Return on S&P 500 Common Stocks = 12.2%

so that,

$r_e = 5.2\% + 2 * (12.2\% - 5.2\%)$, or

$r_e = 19.2\%$

and assuming a senior debt interest rate (r_d) of 12% and a marginal tax rate of 34%, the weighted average cost of capital (WACC) for the sample BOT infrastructure project will be:

$WACC = (20\% * 19.2\%) + 80\% * 12\% * (1 - 34\%)$

$WACC = 10.18\%$

So, even though the return on equity required by BOT infrastructure investors can be relatively high, the fact that most BOT ventures are so highly leveraged will minimize its contribution to the total project's cost of capital.

4.7 Remarks and Conclusions

The objective of the BOT infrastructure project 's financial strategy is to design the venture's financial plan. This in turn involves implementing the most suitable capital structure, which will enhance the economic attractiveness of the investment while, at the same time, assuring the project's cash solvency throughout both, its development and operational stages.

The optimal financial plan for a BOT undertaking will be greatly dependent upon the availability of cost-effective financial instruments to fund the project. Furthermore, the alternatives regarding financial instruments will be determined by the maturity of the capital markets where the BOT venture is being promoted, its accessibility to the international capital markets, the project's economic attractiveness and the creativity of the financial engineer.

Finally, the weighted average cost of capital for a BOT project is determined by the relative proportions of debt and equity and specifically by the types of financial instruments employed. It is the venture's weighted average cost of capital that ultimately should be compared to the expected project's rate of return to determine its economic feasibility.

Chapter 5

Risk Considerations

5.1 Introduction

One of the most important tasks within the financial engineering of a BOT infrastructure project is the correct identification, allocation and management of risks among the venture's stakeholders.

According to Carl R. Beidleman, et. al., "Only around 20 percent of the projects that are seriously considered are successfully completed. Some of the causes for this high failure rate are delays in adoption and completion (with consequent delays in the contemplated revenue flow), technical failure, poor management, and legislative or regulatory changes. The key to accurate forecasting and successful project finance, then, is to identify and manage these risks."[35]

Addressing the risk issues in BOT projects is specially complicated, when compared to other project finance and delivery systems, due to the wider scope of work and contractual responsibilities assumed by the private sponsors. While the host government wants to transfer most of the BOT infrastructure project's risks to the sponsor, the latter tries to minimize its exposure by shifting as many of the risks as possible to third and external parties. Nevertheless, despite this instinctive tendency "to keep the honey and pass the hot potatoes," the overall objective should be to conscientiously allocate the risks to the parties best able to control and manage them.

---

[35] Carl Beidleman, Donna Fletcher and David Vesbosky, "On Allocating Risk: The Essence of Project Finance," *Sloan Management Review*, Spring 1990.

This policy of efficiently and effectively allocating risks will minimize the cost of the undertaking, as well as motivate each party to perform its contractual duties. In the words of R. E. Levitt, et al.: "A balancing of the risk should be sought between the owner and his contractor or designer in order to utilize the incentive value of bearing risk while minimizing a contingency charge for accepting the risk."[36]

Although the specific risks inherent to a BOT infrastructure development will vary among industries and from project to project, there are several ways in which the most typical ones can be classified. The grouping of risks in meaningful categories will aid the financial engineer in the investment analysis as well as in their accurate identification, correct allocation, and optimal management.

5.2 Risk Classifications

From a strictly financial management perspective, the risks of a BOT infrastructure project can be grouped into two broad categories: ***investor's risk*** and ***lender's risk***.[37] With respect to these two classifications, C. Emerson has stated: "Investors are at risk when they decide to support a project with their participation in the equity and their legally binding agreement to provide any additional finance necessary to satisfy the lenders to the project. The degree to which investors can minimize these risks depends on the degree to which they can reduce their equity participation to the project by introducing other equity and loan finance to the project or transfer the identified risks to third parties… lenders are usually prepared to accept only those (risks) which apply

---

[36] R.E. Levitt, D.B. Ashley and R.D. Logcher, "Allocation of Risk and Incentive in Construction," *Construction Division Journal*, ASCE, September, 1980.
[37] C. Walker and A.J. Smith, *Privatized Infrastructure, The Build Operate Transfer Approach*, Thomas Telford Publications, London, England, 1995, p. 78

once production has begun, leaving pre-completion risks with the investors in the project."[38]

Referring to the attitude of lenders towards feasible project financing and the associated risks, P. Nevitt has affirmed: "Lenders, on the other hand, are not in the venture capital business. They are not equity risk takers. Lenders want to feel secure that they are going to be repaid either by the project, the sponsor or an interested third party."[39]

Although the previous quotes are theoretically correct, in practice the reality is that lenders are not always so well covered against pre-completion and equity risks. Furthermore, since these risks are going to be ultimately shared in some proportion by all the project's stakeholders, it is in the best interest of every party involved in a BOT venture to properly identify and classify them in a fashion that will facilitate their evaluation.

In general, the most significant and common risks associated with a BOT infrastructure project investment can be broadly grouped into two categories: ***general or country risks*** and ***specific project risks***.[40]

General or Country Risks

According to the United Nations Industrial Development Organization (UNIDO), these are risks that are generally out of the project sponsors' control. Specifically, general or country risks refer to macro-economic factors like political situation, economic

[38] C. Emerson, *Project Financing*, The Financial Times Business Enterprise Ltd., United Kingdom, 1983.
[39] Peter K. Nevitt, *Project Financing*, Fifth Edition, Euromoney Publications, London, England, 1989, p. 3
[40] *Guidelines for the Development, Negotiation and Contracting of Build-Operate-Transfer (BOT) projects*, Draft, United Nations Industrial Development Organization, 1995, p. 148-149.

growth, taxation, legislation, government fiscal and monetary policies, currency exchange rate fluctuations, etc.

The general or country risks can be subdivided into: ***political***, ***commercial*** and ***legal*** risks.[41] While political risks relate to the internal and external political situation of the host country, commercial risks have to do with the economic environment surrounding the project. Legal risks refer to the contractual and legal framework supporting the project's financing arrangement, as well as to the uncertainty emanating from the possibility of the host country's enactment of new legislation that may affect the BOT venture.

Specific Project Risks

Whereas general or country risks apply to any type of investment, specific project risks can be effectively mitigated by the project participants and therefore are within their control. Although the general or country risks need to be considered by the financial engineer when analyzing the feasibility of a BOT project investment, it is the specific project risks that are within his control and, therefore, more relevant to the scope of this thesis.

The specific project risks are best identified and analyzed when grouped following the stages of a typical BOT infrastructure project. In general, the life cycle of an infrastructure project consists of four phases: ***development***, ***construction***, ***operation*** and ***decommissioning*** (Refer to Figure 5.2.1). Since it is assumed that the facility is transferred to the public sector after all the debt has been repaid and before its useful life

[41] *Guidelines for the Development, Negotiation and Contracting of Build-Operate-Transfer (BOT) projects*, Draft, United Nations Industrial Development Organization, 1995.

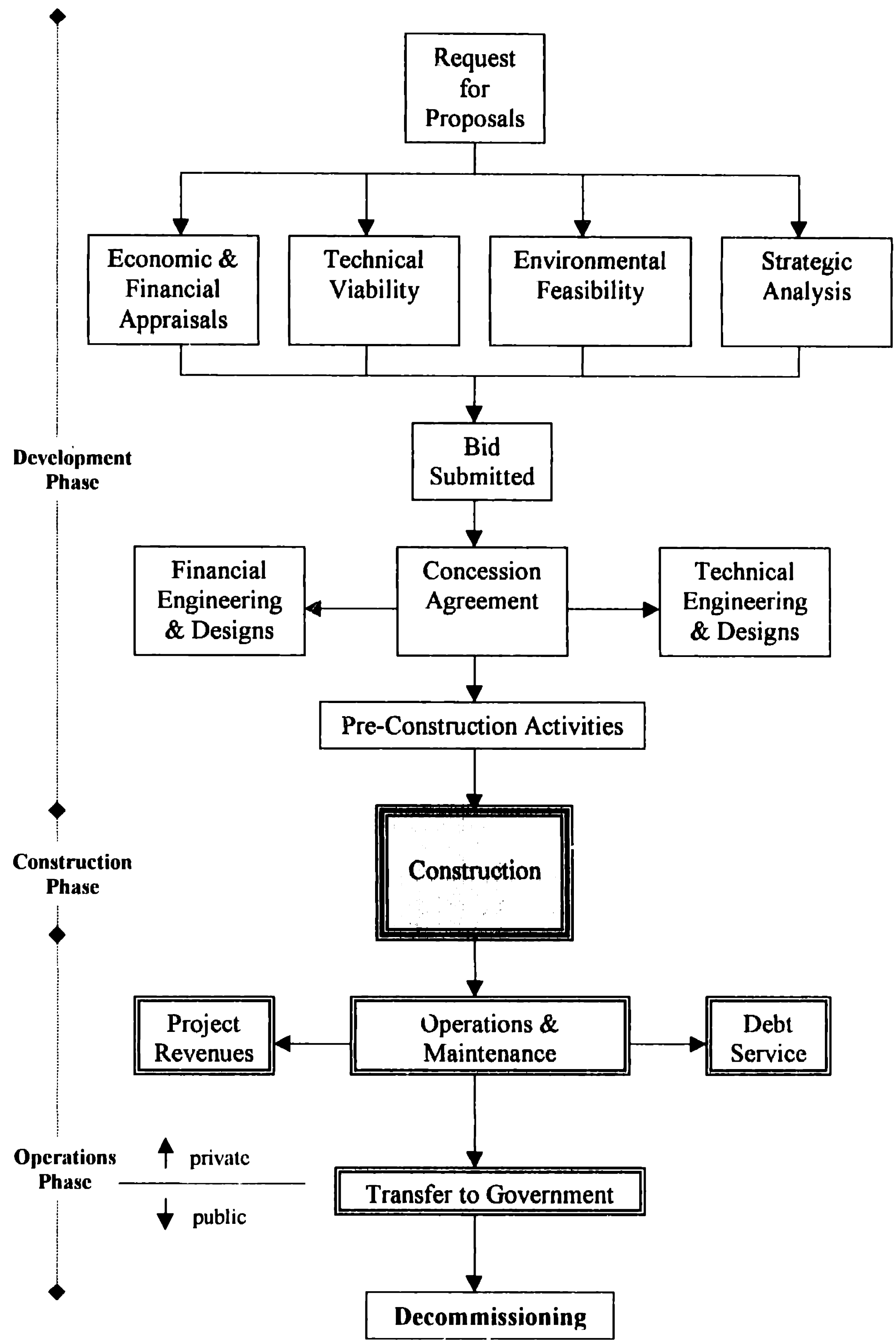

Figure 5.2.1: Phases in a BOT Infrastructure Project

expires, the risk associated with the decommissioning stage will not be considered in the following discussion.

5.3 Development Phase Risks

The development phase risks refer to the most significant uncertainties associated with the initial stage of the undertaking. These include: exposure to defects in the Request for Proposal (RFP), the possibility of errors in the economic appraisal of the investment, the probability of loosing the bid, design errors, pre-construction delays, credit risks, and technological and environmental risks.

In order to discuss the allocation and management of risks among the major participants in a BOT infrastructure facility development, it is necessary to construct a simplified model of the most important contractual relationships that take part in these ventures (Refer to Figure 5.3.1).

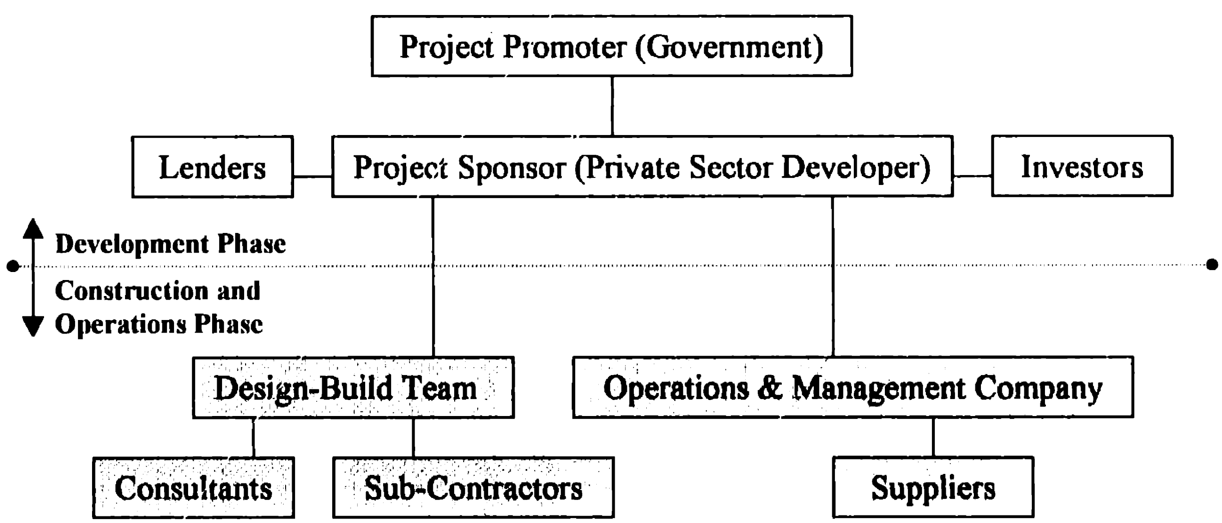

Figure 5.3.1: Simplified BOT Project Organizational Diagram

As shown in Figure 5.3.1, it is during the Development Phase that the project agreement (between the government and the private sector developer), the shareholders agreement (among the project's investors), and the various credit agreements with the project lenders are negotiated and formalized. These three types of contracts will delineate the distribution of risks mentioned at the beginning of this section, and will serve as the basis for the allocation of risks in the construction and operation phases.

Although the steps for distributing risks in a BOT venture are not completely sequential or discrete, and can vary greatly from project to project, Figure 5.3.2 presents a flowchart of the contractual development process.

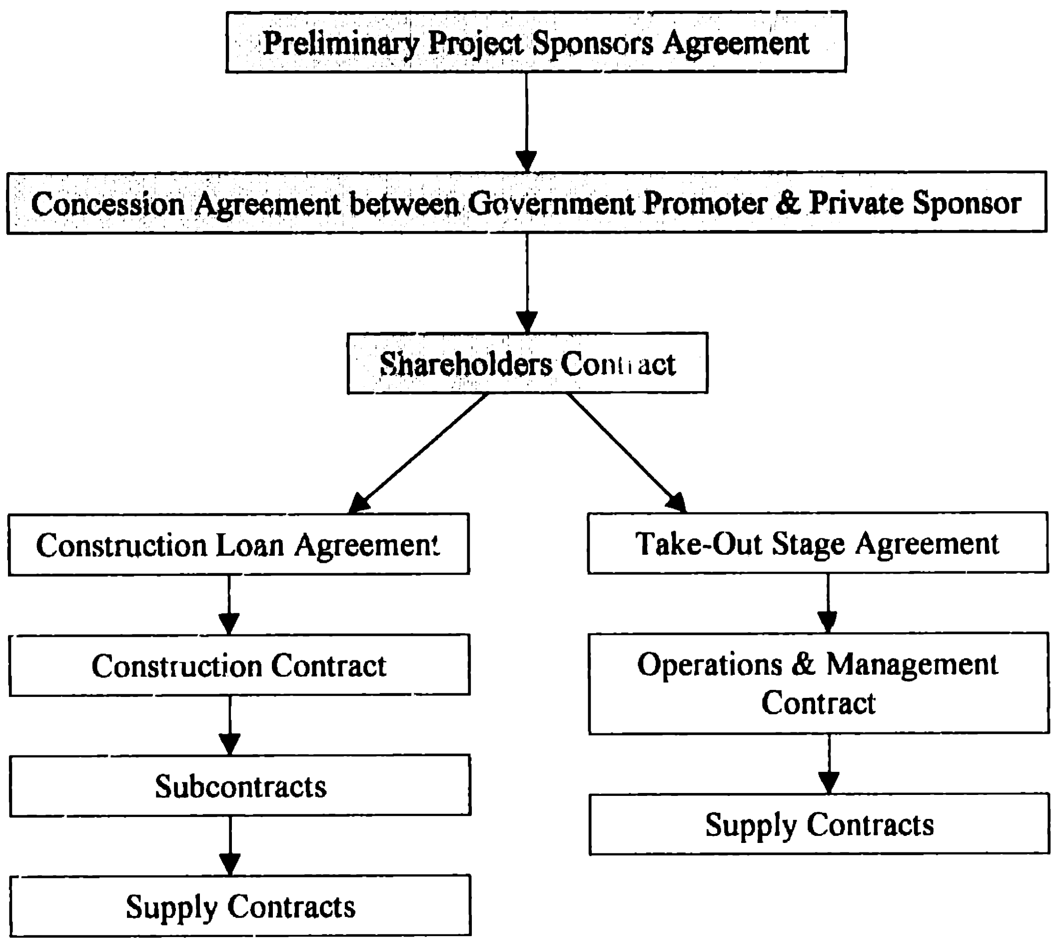

Figure 5.3.2: BOT Project Sponsors Agreement

Because the development phase is the first stage of the project, the risks associated with the economic, environmental and technological feasibility of the undertaking are mostly assumed by the private sector sponsors. Table 5.3.1 summarizes the typical risks present in the Development Phase, their allocation, and ways to manage them.

Identification	Allocation	Management / Comments
RFP Defect	Promoter	Compensation to Sponsor
Loosing the Bid	Sponsor – Investors	Cost of Doing Business
Pre-Construction Delays	Sponsor – Investors, Promoter	Liquidated Damages / Compensation
Design Errors	Sponsor – Investors	Standby Equity Funds Independent Checking Engineer
Environmental Compliance	Sponsor – Investors, Promoter	Shared Responsibility
Technological Feasibility	Sponsor – Investors, Supplier	Insurance, Guarantees
Credit Risk	Sponsor – Lenders	Contract Covenants

Table 5.3.1: Development Phase Risks

With the exception of defects in the government's Request for Proposal (RFP), the private project sponsor should assume most of the risks associated with the development phase. It should also be noted that exposure to risks for actions (or the lack of them) outside the control of the private sector should not be assumed by the project sponsor. Specific examples of these situations could be pre-construction delays resulting from the negligence of public agencies in issuing building permits, or lack of compliance to the project's preliminary environmental impact statement conducted by the government.

Regardless of the project's particularities, the development phase risks should be carefully identified and allocated to the party best able to control and manage them.

5.4 Construction Phase Risks

During the construction of the infrastructure facility massive amounts of cash are consumed without any revenue being generated. For this reason, at the end of this phase the project's overall risk is at its maximum.

The main risks inherent to the construction phase are: ***completion***, ***cost overrun***, ***performance*** and ***liability*** risks.

Completion delays can be very expensive, since the interest burden during the construction stage is augmented and the revenue period within the overall concession is decreased. Shifts in schedule can be caused by many factors such as: lack of coordination of subcontractors and critical suppliers, design errors and omissions, changes in the scope of the construction contract, unforeseen site conditions, etc. While construction delays can be attributed to the project promoter on certain occasions, most of the time they are within the control of the private sector team.

Cost Overruns can be caused by schedule delays, inflation, changes in the legal system or government regulations, changes in the scope of work, lack of quality control, and miscalculations. The performance risk is associated with the sponsor's failure to comply with its commitments with respect to the contractor, and liability risks refer to "Acts of God" (floods, earthquakes, fires, strikes, etc.) as well as to legal exposures like injury of workers or third party representatives.

The risk that involves completing the construction of the infrastructure facility on time and in accordance to the stated price is normally managed by employing a fixed price firm schedule, design-build construction contract with stipulated liquidated damages, and payment performance bonds. While the cost overruns risk can be effectively passed to the design-build contractor[42] and its insurance company, the risk associated with schedule delays is secondarily assumed by the project's investors and lenders, to the extent that the revenue period is shortened by the construction delay.

Performance risks are best managed through a clear and unambiguous construction contract that includes an effective and well stipulated dispute resolution procedure. Finally, liability risks could be covered by transferring them to third parties through the purchase of insurance.

Table 5.4.1 synthesizes the usual risks encountered in the construction phase of a BOT infrastructure project.

Identification	Allocation	Management / Comments
Completion Risk	Contractors, Sponsor	Firm Schedule Contract, Liquidated Damages, Performance Bond
Cost Overrun	Contractors, Sponsor	Fixed Price Contract, Escalation Clauses, Contingency Funds
Performance	Sponsor	Clear Contract, Dispute Resolution Clause
Liability	Third Parties, Sponsor	Insurance Coverage

Table 5.4.1: Construction Phase Risks

5.5 Operation Phase Risks

The risks associated with the operation phase of a BOT infrastructure project can be identified as: ***revenue or off-take risks***, ***operational cost overrun***, ***sponsor's performance risks***, ***supply risks***, ***equity resale risks***, and ***liability risks***.

Without any doubt, the most important risk of this stage and of the entire undertaking is the off-take or revenue projection risk. The off-take risk is defined as the difference between the projected revenue and the actual revenue from operations. Other parameters being equal, if the revenues from operations are below the anticipated ones, the venture's return on investment will be reduced and, depending on the revenues' shortfall, they may not be sufficient to serve the project's debt to lenders.

[42] Note: An exception to this would be the provision of escalation clauses in the contract, in which the design-build team would qualify for additional compensation under certain situations (e.g. changes in the

Among the different methods to mitigate the off-take risks are assured revenues from the host government, the provision of escrow accounts, and commercial insurance. Assured revenues from the government can take the form of "take or pay" contracts typical of power plant projects, or minimum revenue guarantees which are often used in transportation projects. Escrow accounts guaranteeing the debt service whenever revenues are insufficient can be funded through equity contributions, subordinated loans, and standby lines of credit from the host government or third party investors. Although commercial insurance is available in the London market to cover cash flow risks in BOT type projects, the associated cost is very high, so usually this is not the most cost-effective method of managing these risks. Depending on the mechanism to manage the off-take risk, it will be allocated to the sponsor, lenders or host government.

Similar to the construction phase, operational cost overruns may be caused by inflation, higher costs of materials, changes in labor regulations, miscalculations, etc. This risk is normally shared between the project sponsor and its operations and management contractor.

Supply risks refer to the uncertainty regarding the availability of basic inputs that are critical to the infrastructure facility's operation. Sponsors and operations & management contractors usually shift these risks to vendors by negotiating contracts requiring the steady supply of raw materials, fuel and spare parts at stable prices for a pre-determined period of time.

For lack of an established secondary market for BOT project investments, the equity resale risk is associated with the inability of the project's sponsors to sell their equity share at the expected value at any point in time during the concession period.

---

minimum wage, increases in cost due to inflation, etc.).

Table 5.5.1 outlines the most common and important risks present in the operation phase of a BOT infrastructure project.

Identification	Allocation	Management / Comments
Off-Take Risks	Sponsor, Lenders	Government Guarantees, Standby Lines of Credit, Insurance
Operational Cost Overruns	Sponsor, Operations Contractor	Escalation Clauses, Future Contracts
Sponsor's Performance	Operations Contractor	Clear Contract with Operations Contractor
Supply Risks	Operations Contractor	Firm Price Long Term Contracts with Vendors
Equity Resale Risks	Sponsor – Investors	Diversify Portfolio
Liability Risks	Third Parties, Sponsor	Insurance Coverage

Table 5.5.1: Operation Phase Risks

5.6 Ongoing Risk

In addition to the risks to which the private sponsors are exposed during the development, construction and operational phases of a BOT infrastructure project, there are two major risks that are present during the whole lifecycle of the venture: ***financial (interest rate) risk*** and ***exchange rate fluctuations***. The proportion of these two ongoing risks to be assumed by the project lenders and investors will depend on the financial agreements (e.g. fixed v. floating interest rates, etc.) corresponding to the construction and take-out stages of the undertaking.

Regardless of which party within the private sector is allocated the ongoing risks, there is a wide range of capital market instruments that can be employed to mitigate and manage the currency and interest rate risks. The most common ones are the use of forward market, futures market, options market, money market hedge and SWAPS.[43]

[43] Massood V. Samii; MIT Visiting Professor, "Construction Finance Lecture Notes," MIT Course 1.145, September, 1997.

In both the forward and futures market, there is an agreement between the market participants to exchange a particular amount of currency at a determined time and at a specified rate. In contrast, in the options market one buys the right, without any commitment to exercise it, to buy (or to sell) a foreign currency in the future at a set exchange rate. When the forward, futures and options markets do not exist for any pair of currencies, or when countries implement exchange rate controls, SWAPS can be used to manage the risks against currency fluctuations. Through a SWAP a firm makes an agreement with another to exchange currencies directly. The idea is that by swapping their exposure, each company will end up with liabilities that match their revenues, therefore mitigating their respective exchange rate risks. In a similar fashion, the money markets can be used to align the currency of the project's revenues with that of a liability by borrowing funds in the currency of the former, and then exchanging the loaned amount for funds in the currency of the latter. This way the loan will be repaid from the project revenues, while the liability (e.g. a foreign equipment supplier) will be paid with the exchanged borrowed funds. Finally, in addition to the capital market instruments aforementioned, project sponsors can protect themselves against interest rate fluctuations by issuing senior debt with fixed rather than variable interest rates.

Together, SWAPS, options, forward and future markets, and fixed interest rate debt offer the stakeholders a BOT project investment the means of removing uncertainty from currency and interest rate variations. By doing this, these capital market instruments provide project participants with the ability to adjust their risk/reward profiles to ones that are better aligned with their respective investment attitudes and absorption capabilities.

Table 5.6.1 integrates the identification, allocation and management of a BOT infrastructure project's on-going risks.

Identification	Allocation	Management / Comments
Interest Rate Risk	Sponsor, Lenders	Fixed Interest Rate Loans
Exchange Rate Fluctuations	Sponsor, Market Participants	Capital Market Instruments

Table 5.6.1: Ongoing Risks

5.7 Remarks and Conclusions

The risk profile of a BOT infrastructure development varies greatly from those of other project delivery systems. This is because, in addition to the usual construction risks encountered in any major construction endeavor, the BOT project sponsors assume the responsibility for the takeout stage financing, while being subject to the uncertainties of the revenue stream. In terms of their risk pattern, it is generally agreed that BOT infrastructure undertakings consist of two distinct projects: a high-risk construction program and a low-risk government utility operation.

When the development phase commences, the project risk (PR), as measured by the accumulated funds committed to the venture, is relatively low. However, the risk of the private sponsor not pursuing the investment is high, because no substantial financial commitment has taken place. As the construction of the facility progresses, the PR increases as the funds are advanced and interest charges accumulate. In contrast, due to the financial backing to the project, a fixed-price firm-schedule design-build contract and insurance coverage, the risk of the sponsors abandoning the project typically decreases as construction unfolds. While the risk of abandonment (RA) reaches its peak at the end of the development phase, the PR maximum level occurs just prior to the beginning of the operation stage. Since the RA disappears at the end of the construction phase and the PR decreases once the facility is running and revenues are collected, the overall project risk (OPR = RA + PR) starts to decrease at the commencement of the operations phase. Figures 5.7.1 and 5.7.2 show a general graphical representation of the risk pattern in typical BOT infrastructure projects.

	Project Risk: High	Project Risk: Low
Risk of Abandonment (RA): High		***Development Stage***
Risk of Abandonment (RA): Low	***Construction Phase***	***Operations Stage***

Figure 5.7.1: Risk of Abandonment – Project Risk Matrix

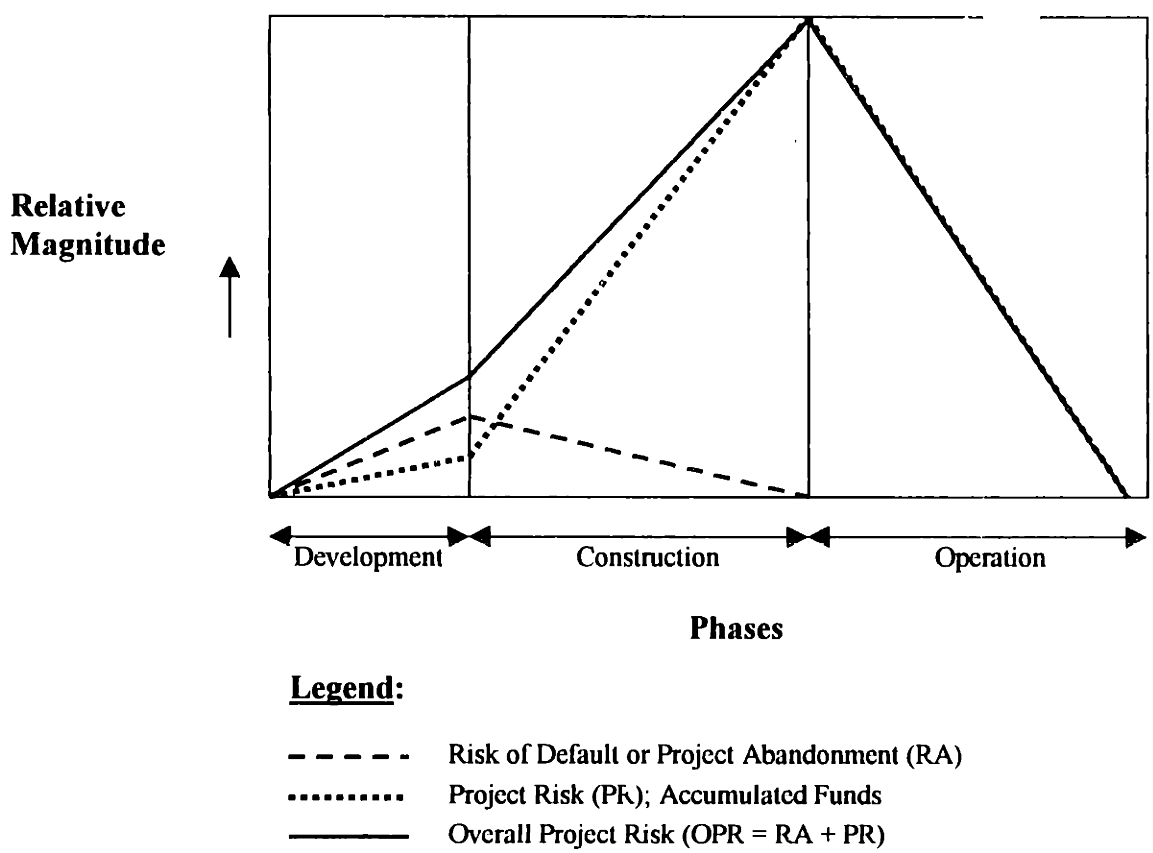

Figure 5.7.2: Project Risk Patterns

Based on the greater risk and long duration of the investment, project sponsors expect a higher rate of return on BOT infrastructure projects. Because the project sponsors' returns will be linked to the long-term success of the undertaking, host governments and financial institutions will want sponsors to bear a substantial part of the risks. The sponsors in turn should retain or shift each identifiable risk to either the party best able to assess, control and manage it, or to the one with better access to hedging instruments, greatest ability to diversify, or with the lowest cost for bearing the risk.[44]

In practice, however, it is difficult for the financial engineer to design the optimum risk-sharing arrangement in a BOT infrastructure project for the following reasons:[45]

- There are many parties in a BOT venture and it is not always evident which one is in a better position to control a specific risk or implement appropriate mitigation measures.
- In addition to control over a certain risk and accessibility to mitigation measures, each party's level of risk aversion should be taken into account when distributing risks among the various stakeholders.
- Risks are prone to be distributed based on the negotiation power of each participant.
- Transaction costs may make the tailoring of risk-sharing arrangements to specific projects extremely expensive.
- A party's capacity to control and assume a particular risk may change over time.

Despite these obstacles, it is the responsibility of the financial engineer to identify the varied risks that apply to a particular BOT infrastructure project. Also, he must

---

[44] Michael Kerf, et.al., *Concessions for Infrastructure, A Guide to their Design and Award*, The World

measure the degree of exposure introduced by the identified risks, and design the best risk sharing structure that will ultimately contribute the most to the viability of the BOT project investment.

Bank and The Inter-American Development Bank, Washington, D.C., 1998, p. 23.
[45] IBID, p. 25, 100.

Chapter 6

Host Country Environment

6.1 Introduction

As has been discussed in previous chapters, expertise in financial engineering is both, an important source of competitive advantage among the private sector participants, and essential for the success of a BOT venture. The implementation of innovative financial techniques for the private funding and development of infrastructure projects is, to a great extent, constrained by the degree of the host government's support to BOT undertakings. In essence, a strong government commitment to a BOT project not only attracts the participation of the private sector, but serves as a working platform for the development of viable and creative financial schemes.

In general, once the need for an infrastructure facility has been established, a host government justifies supporting a BOT model in its funding and delivery by its need to supplement insufficient public economic resources, as well as by additional benefits to be obtained from the private sector efficiencies. In contrast, the main incentive motivating private sponsors to committing resources into these type of ventures is the possibility of realizing higher rates of returns than in other investments of comparable risk. By assisting the private sponsors in the mitigation of risks, principally during the facility's development phase and in connection with its revenue stream, the host government promoting the BOT project can layout a solid foundation for a sound financial structure.

The discussions within this chapter are based on the following three assumptions:

- A strong host government support is a necessary prerequisite for the financial engineering of a BOT infrastructure project.
- The host government is the most important stakeholder within a BOT venture.
- All BOT infrastructure projects must be, in one form or another, a partnership between the public and private sectors.

After discussing specific mechanisms through which the host government can actively support a BOT venture, this chapter focuses on the importance of the public procurement strategy and the underlying legal structure, as facilitators for the financial engineering process.

6.2 Host Country Support Mechanisms

The financial engineering of a BOT infrastructure project starts by considering and analyzing the investment decision. For a BOT venture to be attractive to the private sector, and a sound investment, the host government promoting the venture must really want the facility under consideration to be developed. Although the specific methods through which a host government can and should commit to a BOT infrastructure venture will vary depending on the particularities of every project, the case studies included in this thesis reveal that the public sector support is most effective when aimed at the following four areas:

- The elimination or significant reduction of the political risk associated with the venture
- Actively participating as a creditor or investor to the project
- Enhancing the quality of the project's revenue stream

- Helping in expediting and shortening the project's development phase.

The Elimination or Reduction of Political Risk

Irrespective of the projected rate of return, private lenders and investors will not fund a project without an acceptable guarantee against the possibility of adverse government intervention, at any point in time, throughout the concession period. The efforts to mitigate the risks associated with unanticipated unilateral and negative actions, by any of the levels of government, should commence when enacting the special legislation that all the states require to legalize the provision of infrastructure facilities through the BOT delivery and financing approach.

First of all, a BOT infrastructure project should be explicitly supported and authorized by the State Legislature. Once a bill has been passed, the authority for its implementation should be delegated to an agency, or someone within the executive branch with the capacity and resources to manage and facilitate these complex capital undertakings. The selected government entity or person should then retain competent outside technical, financial and legal advisors with proven knowledge and expertise in the procurement, negotiation and implementations of these complicated public-private partnerships. By legitimizing the process and putting in place a capable organization structure, the government credibility, with respect to its commitment to the BOT venture, is greatly enhanced.

In terms of its contents, the special legislation should enable the government's participation in the BOT project without restriction, eliminate the possibility of future ad hoc regulation, establish clear procurement guidelines and require performance guarantees of the various public agencies to be involved in the project. By properly addressing these issues, the private sector will receive a positive signal regarding the low probability of any breach of contract by the host government. The elimination or substantial reduction of political risk will enable the BOT project to be considered as a possible investment by the private sector, and will validate the BOT model as a viable alternative for the provision of infrastructure facilities in the future.

Financial Participation by the Host Government

In general, by actively participating as a creditor or investor to the BOT venture, the host government supports the project in three ways:

- reduces the political risk
- decreases the overall cost of capital
- bridges the financial gap between private debt and equity funds.

Holding a direct financial claim on the project is clear and tangible evidence to the private sector of the host government's strong commitment (i.e. low political risk) to the BOT undertaking. As a provider of equity or debt funds, it is in the government's best interests for the project to be successful and for its revenue stream to be adequate for servicing all of its operational and financial obligations.

In terms of cost of capital, since the financial instruments issued by the various levels of government are tax exempt and usually backed by solid collaterals, public agencies can be prime providers of cheap debt. By facilitating its low cost debt to the project company, the host government will decrease the interest burden on the venture, while augmenting its internal rate of return.

From a financial structure standpoint, by providing the private sponsors with standby credit facilities and subordinated loans, the government not only provides a safety cushion for the operational and debt servicing obligation of the venture, but also fills a critical gap between lenders and investors. This in turn increases the robustness of the project's capital structure, as well as the sponsor's ability to deal successfully with adverse market scenarios.

Enhancing the Project's Revenue Stream Quality

Since most BOT infrastructure projects are financially engineered on a non-recourse basis, senior lenders are not covered by physical assets or other forms of tangible collaterals. Consequently, due to the dual role of the project's revenue stream as source of repayment and only collateral on the borrowed funds, it is extremely important that its quality, in terms of adequacy and stability, is high. There are several mechanisms through which the government can augment the quality of a BOT project's revenue stream:

- By reducing the economic risk of the venture through the mediation of a quasi-monopolistic market environment in which to offer the products or services of the infrastructure facility.
- By allowing commercial development along the project site.
- By giving preferential tax treatment to the project.
- By partially or totally funding pre-construction tasks like environmental studies, land use analyses, revenue projection assessments, etc.
- By providing the right-of-way of the project for free, or at a very low cost.
- By guaranteeing a minimum level of revenues or providing direct subsidies.

As discussed in Section 2.3, the importance of a quasi monopolistic market environment is critical for the financial success of BOT infrastructure facilities that sell their products or services directly to the public, rather than to the host government. For example, senior lenders and equity investors will be reluctant to fund a transportation project, unless traffic projections are more than adequate to service the venture's operational and financial obligations. Traffic studies, in turn, are very often based on the assumption that there will not be a competing route, private or public, for the life of the concession period.

The rationale for allowing a preferential tax treatment to the BOT project emanates from the fact that taxes increase the overall cost of the project, which in turn will have to be paid by the government through a direct contract with the sponsors or indirectly through longer concession periods, higher user fees, etc. Furthermore, the long-term economic growth of a region, upon the completion of a new and state-of-the-art infrastructure facility, very often justifies total or partial exemption for the project company or the deferral of its obligations with respect to property, income, sales and other types of taxes.

In general, all of the methods in which the government can support and enhance the quality of the BOT project are aimed at, either reducing the costs incurred during the life of the project, or increasing the volume and cash flow predictability of the revenue stream. Due to the time value of money and to the unwillingness of senior lenders to assume pre-completion risks, the government's support is most effective when funding a portion of the expenses incurred during the development phase of the project. In terms of direct economic contributions, there are many creative mechanisms through which the host government can solidify the revenue stream of a BOT infrastructure project. One way is to assign to the project company an existing asset (e.g. a toll bridge) capable of producing earnings which can be used in the payment of capital costs, debt service and operating expenses of the new facility.

Shortening the Project's Development Stage

Decreasing the length of the BOT infrastructure project development phase, increases the venture's operation stage within the concession period (i.e. larger revenue period), and minimizes the non-productive transaction costs (e.g. interest expenses, temporary facilities' rent fees, etc.) associated with the undertaking.

Among the major factors causing the lengthy schedule and high cost associated with the development phase of BOT infrastructure projects are:

1. "The complex contractual structure of BOT projects and the many parties involved in the development process.
2. Relative inexperience of some parties and government officials in negotiating and packaging BOT projects.
3. Lack of adequate legislation for private sector participation in public infrastructure projects and inability of the government to provide necessary regulatory and administrative support.
4. Lack of a clearly defined project framework, including lack of a clear definition of government objectives, technical framework, financial framework, standardized documentation and proposed risk allocation arrangements.
5. Lack of clear criteria for selection of sponsors.
6. Lack of independently commissioned feasibility studies to confirm that the project is viable and to help government solicit realistic project proposals.

7. Lack of standardized contracts for project agreements and a number of other agreements that have to be put in place.
8. Lack of established methods to pre-qualify bidders, limit the number of bidders and reduce the high bidding risk.
9. Lack of predictability in procurement procedures and clearly established procurement schedule.
10. Prolonged and uncertain negotiations with preferred bidder(s) before final acceptance (closing) of a tender."[46]

As in the case of improving the quality of the revenue stream, the host government can help the private sponsors in shortening the project's development phase by:

- Obtaining formal legislative approval of the BOT venture prior to its procurement.
- Assuming responsibility for efficiently expediting environmental impact statements, land use analyses, permits and right-of-way negotiations.
- Reducing the level of bureaucratic requirements and minimizing intergovernmental and interagency disputes.
- Exempting the private sponsors from abiding by the government procurement methods.

Since the BOT model is not in accordance with the traditional government approach for project delivery and finance, and since infrastructure facilities often involve the monopolistic provision of production services, public BOT ventures must be authorized through special legislation. The time and effort required in obtaining the

---

[46] Guidelines for the Development, Negotiation and Contracting of Build-Operate-Transfer (BOT) Projects, Draft, United Nations Industrial Development Organization, Washington, D.C., 1995, p. 97.

legislative consent for a BOT infrastructure project should not be underestimated. Legislative authority should be in place before engaging in the project's procurement and, under no circumstances should the lobbying for a BOT Bill be left to the private sector sponsors.

Once the Legislature has approved a BOT concession, the power for its implementation should be delegated to a specific department or agency within the host government's executive branch, which would then serve as mentor to the project company.[47] The BOT venture's public sector mentor should help the private sponsors in overriding the bureaucratic obstacles that are usually presented by the government utility company which would otherwise build-operate the project and by other interest groups that oppose the private development of traditionally public undertakings.

Shortening the time between the signature of the concession agreement and the commencement of construction requires a BOT projects proactive government policy and a credible and efficient administrative framework emanating from the host government. Complicated bureaucratic procedures and a lack of a sense of urgency within the public sector result in unnecessary delays in the expedition of licenses, permits and approvals. Since a long development phase can be detrimental to the economic feasibility of the undertaking, lenders and equity investors have to carefully evaluate the host government's organization, experience and procurement procedures before committing their funds to the venture.

---

[47] Mark Augenblick and B. Scott Custer, Jr., The Build, Operate, and Transfer (BOT) Approach to Infrastructure Projects in Developing Countries, The World Bank, Washington, D.C., 1990, p. 15.

6.3 Public Procurement Strategy

A host government seeking to apply the BOT model to the development of an infrastructure project, and to enable the value creation resulting from the associated financial engineering process, must first establish an adequate procurement strategy. A clear, objective and transparent procurement strategy, by the host government promoting the BOT venture, will permit an accurate assessment of the investment and the creative design of innovative financial schemes by prospective sponsors, investors and lenders. In addition, the quality of the private sector entities participating in a BOT infrastructure project tendering process will be subject to the overall integrity and adequacy of the procurement strategy.

The importance of the procurement strategy within the overall success in the implementation of a BOT concession has been acknowledged by many recognized worldwide authorities in infrastructure development systems. In his research relating to sustainable policies for infrastructure development, John B. Miller has identified ten fundamental elements that have served as principles for the emerging infrastructure strategy in the United States. Several items on Miller's list of underlying principles are directly related to BOT infrastructure projects' procurement strategies. These are:

- "Government defined scope
- Competition
- Fair treatment of actual competitors
- Transparency
- An independent engineering check on the efficiency of the design
- Openness to technological change

- Sound financial analyses over the project's life cycle."[48]

Government Defined Scope

This principle is based on the fact that an infrastructure project's scope of work is the platform upon which the contractual relationship between host government and private sector sponsors is formed. In addition to identifying the public infrastructure need and selecting the model through which to provide the facility, the host government, and not any of the potential private sector proponents, should be the entity defining the project's scope of work. This presupposes that, before inviting the private sector to submit proposals, the government should clearly describe the BOT project's objectives as well as the performance criteria to be fulfilled.

Contrary to the traditional design-bid-build project delivery approach, where the government provides comprehensive design specifications, in the BOT model the scope of work is usually based on the more general performance specifications. While the private sponsors decide the design, financial, construction and operational details of the BOT venture, the government should provide a basic description of the infrastructure facility to be built and of its desired performance results. The overall goal of the BOT project's government supplied scope of work is twofold: to provide a solid common basis upon which the private sector proposals can be objectively evaluated, and to allow enough flexibility to encourage innovative solutions from the prospective bidders.

Since potential bidders are required to present their own concepts for design, construction, financing and operation, participating in the procurement process of a BOT infrastructure project can be a very expensive proposition. A clearly defined scope of

[48] Miller, John B., *America's Emerging Public/Private Infrastructure Strategy: The End of Privatization*, Draft, Massachusetts Institute of Technology, 1997, p. 481.

work, based on the particularities and objectives for the infrastructure facility under consideration, will help prospective private sector proponents to justify the high capital cost involved in the preparation of BOT project proposals.

Competition

In essence, competition is the process through which the host government guarantees the receipt of cost-effective BOT proposals based on the efficiencies of the private sector. To promote the participation of qualified private sector entities in the BOT infrastructure project procurement process, the government should conduct the competition on an objective non-discriminating evaluation criteria made known to potential proponents in advance. To the extent that is possible, and without compromising its objectivity, the evaluation criteria should be based on a formula that includes price, compliance with the performance requirements, feasibility of the financial package, economic strength and qualifications of the private sponsors (both individually and as a group), soundness of operating plans, sensitivity to the environment, technology transfer, etc.

Participation from various proponents in a BOT procurement process is in the best interests of both the government and private sector. Not only does competition encourage innovative and cost effective proposals, but it provides checks on the technical and financial feasibilities of complex infrastructure development programs. The submittal of more than one BOT proposal will assist the government and selected respondent in the final negotiation and implementation of the concession agreement.

Although promoting competition is desirable, the main objective of the BOT tendering process should not be to maximize the number of proponents, but to ensure the participation of several qualified and capable respondents. In order to comply with this requirement, the competitive bid for a BOT concession is usually preceded by a strict pre-qualification process.

<u>Fair Treatment of Actual Competitors</u>

Fair treatment of actual competitors refers to the concept of laying out a "level playing field" in which to conduct the BOT infrastructure project procurement process. In order for private sector entities to engage in the lengthy and expensive BOT bidding process, they must be confident that they will receive impartial and unbiased treatment in the evaluation and award of franchises. From this perspective, the perception of fair consideration is an essential pre-requisite for healthy competition in a BOT project procurement process.

<u>Transparency</u>

John B. Miller defines transparency as: "the notion that potential competitors in the acquisition system can see and understand the acquisition process prior to making a commitment to participate, and can rely upon government to impartially implement this process to its conclusion."[49] In essence, transparency of the procurement strategy alludes to the degree of predictability and reliability of the bidding process.

As with the requirement of fairness, potential private sector bidders will not spend their time and resources on a BOT project procurement, if they can not anticipate how their bids will be considered within the context of the "Request for Proposals" and of the evaluation criteria. Similarly, they will be reluctant to participate in the bidding process

---

[49] Miller, John B., *America's Emerging Public/Private Infrastructure Strategy: The End of Privatization*, Draft, Massachusetts Institute of Technology, 1997, p. 247.

if they perceive that the host government is not capable of properly conducting and implementing the published BOT procurement strategy.

An Independent Check on the Efficacy of Design

Independent engineering for checking the technical feasibility and long-term public safety of the infrastructure facility to be built must be an essential element of the BOT procurement strategy.

In the traditional segmented and government funded infrastructure delivery system, design professional services are procured first, based on qualifications and then on price. Furthermore, the designers' contractual relationship is with the government, and detailed drawings and specifications are prepared prior to procuring the construction work. Under the BOT approach, not only is the design performed by the private sector respondents based upon a general performance criteria supplied by the government, but also the fiduciary responsibility of the design professional is to the project sponsor and not to the public sector.

Based on the integration of functions under the BOT model and in the importance of assuring public safety, it is recommended that BOT procurement strategies include the requirement of an independent checking engineer, whose professional obligation is to the government, but whose fees are paid directly by the private sponsor.[50] This "CPA" approach to auditing the technical feasibility of a BOT infrastructure project is to the benefit of all the stakeholders involved in the venture, and an investment that can pay for itself many times over.

---

[50] Miller, John B., *America's Emerging Public/Private Infrastructure Strategy: The End of Privatization*, Draft, Massachusetts Institute of Technology, 1997, p. 255.

Openness to Technological Change

One of the most important reasons for selecting the BOT approach for the provision of infrastructure facilities is to reap the benefits resulting from the private sector's capability for creativity in design, technology, management and operational processes, and in financing schemes.

The BOT procurement strategy should include incentives and flexibility to motivate the private sector into submitting proposals based on innovative technical, financial and management solutions. The overall objectives should be to encourage cost reductions, schedule acceleration and the introduction of efficiencies that would not be achieved under the traditional design-bid-build procurement process.

In order to support the implementation of innovative solutions, BOT procurement strategies should seek to protect the intellectual property developed by the private sector respondents. Qualified and experienced sponsors will not participate in BOT project bids where their innovations are not adequately protected.

Sound Financial Analyses over the Project's Life Cycle

Instead of focusing on the initial design and construction costs, the government should perform sound economic and financial analyses of public infrastructure facilities over their life cycle.

From a BOT infrastructure project's procurement strategy perspective, performing financial analyses over the planned concession period will aid the government in assessing the economic feasibility of the venture and in identifying the critical success factors associated with the undertaking. By going through the thought process that accompanies preliminary, but sound, financial exercises, the host government can design a more effective procurement strategy based on the key economic drivers of a specific BOT infrastructure project.

The ability to design and arrange an attractive financial package has been the decisive factor in winning most BOT project bids. Consequently, the financial considerations, and not the technical challenges, are the issues that normally drive the BOT procurement process. It is therefore essential for the procuring government entity to understand the concerns of potential investors and lenders, and to design a BOT procurement strategy that makes the undertaking financially feasible.

By performing financial life cycle analyses over the proposed concession period, the government will be in a better position to communicate and negotiate the franchise agreement with the selected bidder. Complex financial issues, like the allocation of risks, can not be totally understood and visualized until adequate economic and financial analyses have been carried out.

Complementing John B. Miller's guidelines for a sustainable infrastructure development strategy, the United Nations Industrial Development Organization (UNIDO) has recommended the following additional objectives for a sound BOT infrastructure project procurement process:

- "Giving priority to the needs of the particular BOT project in issue.
- Providing assurance to investors, lenders, suppliers and other parties that the government has selected "the right" BOT proposal.
- Strengthening public confidence in the BOT approach for infrastructure development.
- Promoting an early award of the project.

- Minimizing the project development costs."[51]

As suggested by UNIDO, a BOT project procurement strategy should be tailored to the government's specific economic and social goals and to the needs of the particular infrastructure facility to be developed. As previously mentioned, in addition to aligning the procurement process with the development plans of the state or local region, customizing the procurement strategy to the specific project drivers involves, among other exercises, sound financial analyses over the facility's life cycle on behalf of the government.

The financeability of a BOT project will be subject, in some way, to how investors and lenders perceive the procurement strategy adopted by the government. In this regard, the host government should send positive signals in connection to the transparency, fairness and overall integrity of the procurement process. By providing a strong assurance to prospective private sector participants, the host government not only maximizes the level of competition, but also assists every respondent in structuring their most cost-effective proposal.

Due to the large capital amounts and mammoth construction programs involved in most BOT infrastructure projects, these ventures usually suffer from high public exposure. In addition to resistance to change and to the opposition emanating from various interest groups, the public confidence on the BOT approach for project delivery is very vulnerable. As a result, it is the responsibility of the government to institute the BOT model's advantages and validity by making available to the general public as much information as possible regarding its procurement strategy, tenders and key decisions.

---

[51] *Guidelines for the Development, Negotiation and Contracting of Build-Operate-Transfer (BOT) Projects*, Draft, United Nations Industrial Development Organization, Washington, D.C., 1995, p. 93.

An open communication policy will help the procurement strategy in adhering to the principles of fairness and transparency as well as to strengthen the public confidence in the BOT project delivery and financing methodology.

Knowledge on the host government's commitment to an expeditious procurement process and to an early concession award will help the project sponsors in arranging firm commitments from lenders, investors and suppliers. The shorter the time span between the proposals' submission and the BOT project's award, the less probability for changes in the economic conditions and revenue projections in connection with the products or services to be offered by the infrastructure facility.

Finally, the procurement strategy for a BOT infrastructure project should be designed to minimize the venture's bidding and development costs. The lengthy duration and the potential high costs of the BOT project development stage can transform a financially feasible venture into a non-viable investment. Inasmuch as the procurement strategy serves as framework for the government's role after the award of the BOT concession, the procurement process should include procedures that allow the public sector to assist the project sponsor in reducing the project development's costs and duration.

6.4 Legal Environment

A legal environment that enables the implementation of the BOT model for the provision of new and better infrastructure facilities is a necessary condition for the financial feasibility of these complicated ventures. Not only must temporary private ownership, through a franchise, be allowed by local law, but also the legal system and regulations under which the BOT project is expected to operate have to be predictable as well as compatible with the private sponsors' interests. In general, the host country's legal system assures sponsors and lenders that the contractual agreements to the BOT project, by the host government and by other stakeholders to the venture, will be respected and enforced.

According to C. Walker and A.J. Smith, the functions of a legal framework, within a BOT project, include:[52]

- The definition of the overall concept and structure of the project including project finance and taxation issues.
- Establishment of enabling legislation and the regulatory systems on environmental protection, planning and user charges.
- Controlling undue competition.
- Facilitating the negotiation of the respective rights and obligations and the preparation of the associated documentation, allocating risks and identifying insurance requirements.
- Establishing procedures for the resolution of disputes.

In addition to a conducive legal structure, for a BOT project to succeed, the relationships between the various participants must be clearly defined to permit an efficient and fair allocation of risks. The interrelationships between the stakeholders of the project and the effectiveness of the risk distribution program implemented will depend, to a great extent, on the choice of legal structure for the project company. From a financial engineering perspective, the type of organization form selected for the project company can have important tax implications, as well as affect the availability of funds and the overall cost of capital for the undertaking.

Project Company's Legal Form of Organization

According to John D. Finnerty, the most suitable legal structure for a project is subject to a plethora of business, accounting, tax and regulatory considerations. These include:[53]

- The number of participants and the business objectives of each
- The project's capital cost and its anticipated earnings pattern
- The requirements of regulatory bodies
- The existing debt instruments and the tax positions of the participants
- The political jurisdictions in which the project will operate.

Strictly speaking, depending on the aforementioned factors, the private sponsors of a BOT infrastructure project will choose the project company's legal organization to be an undivided joint interest, a corporation or a partnership. However, due to the non-recourse nature of their financial schemes, to their high capital costs and risks, to tax savings and to their finite lives, most BOT infrastructure projects in the United States are legally structured following the partnership form of organization. Also, the fact that the project company's only business concern and real asset is the infrastructure facility to be developed, BOT ventures are better aligned with either the partnership or limited liability

---

[52] Walker, C. and A.J. Smith, *Privatized Infrastructure: The Build Operate Transfer Approach*, Thomas Telford Publications, London, England, 1995, p.172.
[53] Finnerty, John D., *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 70.

company (LLC) form of organization, rather than with an undivided joint interest or other type of corporation.[54]

In its most basic definition, a partnership is a legal joint venture between two or more persons or entities that combines their resources for the purpose of engaging in a business enterprise. One of the most important advantages of partnerships is that they are not subject to corporate income tax, and that profits or losses are passed directly to the partners' tax returns. The benefit of avoiding a "double taxation" is offset by the partners' exposure to unlimited liability.

Although in theory each of the partners' potential liability is unlimited, the experience to date in the United States indicates that BOT infrastructure project sponsors have been able to contain their exposure to the partnership assets by implementing any of the following mechanisms:

- incorporation of limited partners
- by creating "buffer subsidiaries"[55]
- by legally limiting the recourse of loans and contracts to the partnership's assets
- by implementing an adequate risk allocation and insurance program.

A partnership can have any number of "limited" partners, as long as there is at least one "general" partner who is exposed (theoretically) to unlimited liability. In turn, the exposure of the general partner can be reduced by transferring the role of general partner to a wholly owned corporate subsidiary, which can then act as shield to the parent sponsor. In order for this scheme to be effective, the subsidiary must have a valid

[54] In addition to the fact that owners may participate actively in the management of the company without risking loss of their limited liability, LLCs offer private sector sponsors the same advantages that limited partnerships provide.

business purpose (e.g. operational or construction responsibilities). In addition, the sponsors can take the necessary legal precautions, whenever possible, to assure the non-recourse basis of all debt agreements, as well as to implement a strong contractual arrangement and insurance program with the various project stakeholders to efficiently allocate the risks and minimize their exposure.

Partnerships, as a legal vehicle for BOT project companies, offer the best of two worlds: preferential tax treatment and a limited or manageable liability. When applying the partnership form of organization, the project sponsors must design the venture's contractual and financial relationships to avoid being categorized as an association or corporation by the Internal Revenue Code. For the project company to qualify as a partnership, and remain that way throughout the concession period, it must comply with at least two of the following characteristics:[56]

- the partnership has a limited life
- the general partner must act independently of any limited partners, who may not participate actively in the management of the partnership
- the partnership interests are not freely transferable, and
- at least one general partner has unlimited liability for the obligations of the partnership, and the general partners are adequately capitalized.

As would be expected, in order to enhance the liquidity of its equity and protect project sponsors, most BOT infrastructure projects' limited partnerships are structured to comply with the first two requirements only.

---

[55] Finnerty, John D., *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 83.
[56] IBID, p. 86.

In addition to Limited Liability Partnerships (LLP), another noteworthy variant of the partnership form of organization that could be employed in BOT ventures is the Master Limited Partnership (MLP). In essence, MLP are publicly traded limited partnerships that, except for ventures engaged in certain qualifying activities relating to minerals or natural resources, are taxed as corporations.

Within the context of BOT infrastructure projects in the United States, the usual practice is for each private sector sponsor to become a partner (either limited or general) of the project company (legally organized as a limited partnership), which is in charge of the financing, construction and operation activities throughout the concession period. Then the project company issues, usually through a corporate financing vehicle, equity and debt securities to fund the undertaking's construction and operational costs. Since the ability of major institutional lenders to fund BOT infrastructure projects partnerships is constrained by investment laws and regulations, a special-purpose corporate financing vehicle is normally employed to enable their often crucial financial contribution into these ventures. When this borrowing mechanism is implemented, the financial obligations of the special-purpose company are secured by the BOT project company or partnership to the extent of its limited or non recourse financial structure.

Based on the complex contractual arrangements of most BOT infrastructure projects, the associated high risks and capital expenditures, and the need to encourage the private sector to engage in these ventures through preferential tax treatment and other incentives, the limited partnership form of organization seems to be at present the most suitable legal vehicle for undertaking these ventures in the United States.

6.5 Remarks and Conclusions

Through support mechanisms, a fair and transparent procurement strategy and an enabling legal environment, the overall government commitment towards a BOT infrastructure project constitutes a necessary pre-requisite for maximizing the value that financial engineering can contribute to the venture. A strong support by the host government promoting the BOT project, not only has a direct positive effect on the investment and financing decisions by the private sector, but is also an important factor in instituting the BOT model as a viable alternative for the provision of infrastructure facilities in the United States.

BOT infrastructure projects are extremely complicated undertakings from a legal, financial and construction point of view. For this reason, they require extensive host government support aimed at reducing the costs and period of time associated with their development phase. In addition, since the project's revenue stream is usually the only collateral and source of repayment for the venture's financial and operational obligations, the public sector should assist the private sponsors in minimizing its economic risk.

Although all BOT infrastructure projects are a joint venture between the public and private sectors, the host government promoting the venture is the most important stakeholder. Not only must the host government want the BOT project to succeed, but must also be able to materialize its good intentions through evident and tangible mechanisms. This in turn will enable the financial engineer to design the optimal financial structure for the BOT infrastructure project, based on the lowest cost of capital and the most efficient allocation of risks.

Chapter 7

The Canada Confederation Bridge Project – Part I

7.1 Introduction

The Canada Confederation Bridge Project case study presented in this chapter is a world class engineering and construction endeavor and a prototype of a solid BOT investment. It is also an example of an effective integration of the fundamental elements involving a modern public infrastructure procurement.[57] As was noted in Chapter 6, a robust BOT infrastructure project investment is almost always backed by a fair and transparent procurement process, as well as by considerable support from the government agency promoting the project.

After providing a historical background and describing the project's most significant features, this chapter concludes with a discussion on the financial engineering performed on this BOT project investment.

7.2 Project Overview

The Canada Confederation Bridge Project consists of 66 sections totaling 12.9 km, and connects the province of Prince Edward Island (PEI) to the mainland province of New Brunswick. Even though the bridge spans through the narrowest part of the Northumberland Strait, it is the world's longest highway bridge over ice-forming waters.

---

[57] J.B. Miller, *America's Emerging Public/Private Infrastructure Strategy: The End of Privatization*, Draft, Massachusetts Institute of Technology, 1997, p. 345.

The design life of the reinforced, post tensioned concrete structure is 100 years, and is capable of servicing traffic of approximately 2,000 vehicle crossings per hour. The bridge superstructure consists of concrete hollow-box sections ranging from 4.5 m to 14 m deep supported over concrete octagonal hollow shaft piers. The bridge was intentionally designed with as few piers as possible to minimize the obstruction to the channel, to provide sufficient clearance for crossing ships, and to reduce construction costs. The bridge sections have a typical vertical clearance of 40 meters with a navigation channel of 60 meters high by 172 meters wide.

From a construction standpoint, over ninety percent of the bridge components were built on land in fabrication yards in Borden, Prince Edward Island and Bayfield, New Brunswick. With the aid of two hydraulic sleds, eight tower cranes, four gantry cranes and a self propelled floating crane, the bridge components were then transported over water and assembled on site. The construction of the bridge required 3 million tons of aggregates and stone, 340,000 cubic meters of concrete, 53,000 tons of reinforced steel, 13,500 tons of post tension cable, 8,000 tons of miscellaneous metal fabrication, and 139,000 tons of asphalt paving. Construction activities started early in 1993 and were completed by May of 1997, and the total construction cost was $840 million.

7.3 Historical Background

In 1876 Prince Edward Island joined the Canadian Confederation. The Terms of the Union specified for the federal government to provide an efficient means of communication between Prince Edward Island and the mainland. The requirements to provide a continuous and efficient year round transportation facility for goods, services.

and people between PEI and the mainland was initially met by sailing vessels and steam ship services. Prior to the completion of the fixed link, this responsibility was discharged by government subsidized ferry services between PEI and two points on the mainland: a year round service from PEI to Cape Tormentine in New Brunswick and a May to December service from PEI to Caribou in Nova Scotia.

In addition to schedule delays and inadequacy in serving the passenger volume during the summer months, the ferry operations represented an escalating expensive proposition for the Canadian Government. In 1992, the government spent approximately C$42-Million subsidizing the ferry operations, and expected the magnitude of these subsidies to grow at a rate 15 to 20% higher than the Consumer Price Index (CPI).

Although the idea of constructing a fixed link between PEI and the mainland had been mentioned before, it was not until 1985-86 that the Canadian Government seriously engaged in the preparation of feasibility studies and public consultation. This came after receiving three private unsolicited proposals for the construction of the fixed crossing. Following a plebiscite to assess the public acceptance of the project, issuing a request for proposals, and performing extensive environmental impact and financial studies, the project was authorized for construction by the Canadian Government in 1992.

7.4 The Contract Agreement

Under the agreement, Strait Crossing Development, Inc. (SCDI), a Canadian private consortium, was to finance, design, build, operate and maintain the bridge for a lease period of 35 years, commencing in June of 1997. In return, SCDI was to receive an annual subsidy of C$41.9-Million (in 1992 dollars), and was allowed to keep all the tolls collected on the bridge during the concession period.

For the first year of operation, the bridge tolls were set at an amount equivalent to what would have been charged by the ferry system. Thereafter, the annual increases of the toll rates were not to exceed 75% of the Consumer Price Index (CPI). SCDI was to receive the annual government subsidy starting on May of 1997, whether the bridge was completed in time or not. If the bridge was not operational by June of 1997, SCDI was to fund the ferry system until the completion of the fixed link.

At the expiration of the 35 year lease period, ownership of the bridge would be transferred to the Government of Canada for the nominal sum of C$1.

7.5 Principal Stakeholders

Relating to the private side, the developer was Strait Crossing Development, Inc. (SCDI), a consortium of three Canadian companies that pooled their resources, technical expertise, and worldwide experience to finance, design, build, operate and maintain for 35 years the Canada Confederation Bridge Project. SCDI is a joint venture of Strait Crossing, Inc., GTMI (Canada), Inc., and Ballast Nedam Canada Limited (Refer to Figure 7.5.1).

Strait Crossing, Inc., a 100% Canadian-owned corporation, was established in 1988 to participate in the bid for the Confederation Bridge Project. SCI provided design and construction expertise as well as experience with the domestic market.

GTMI (Canada), Inc. is a wholly owned subsidiary of GTM Entrepose (GTM), a major global engineering construction group with headquarters in Nanterre, France.

GTMI (Canada), Inc. provided experience and expertise in the design, construction, project financing and operations of large projects, particularly long-span bridges.

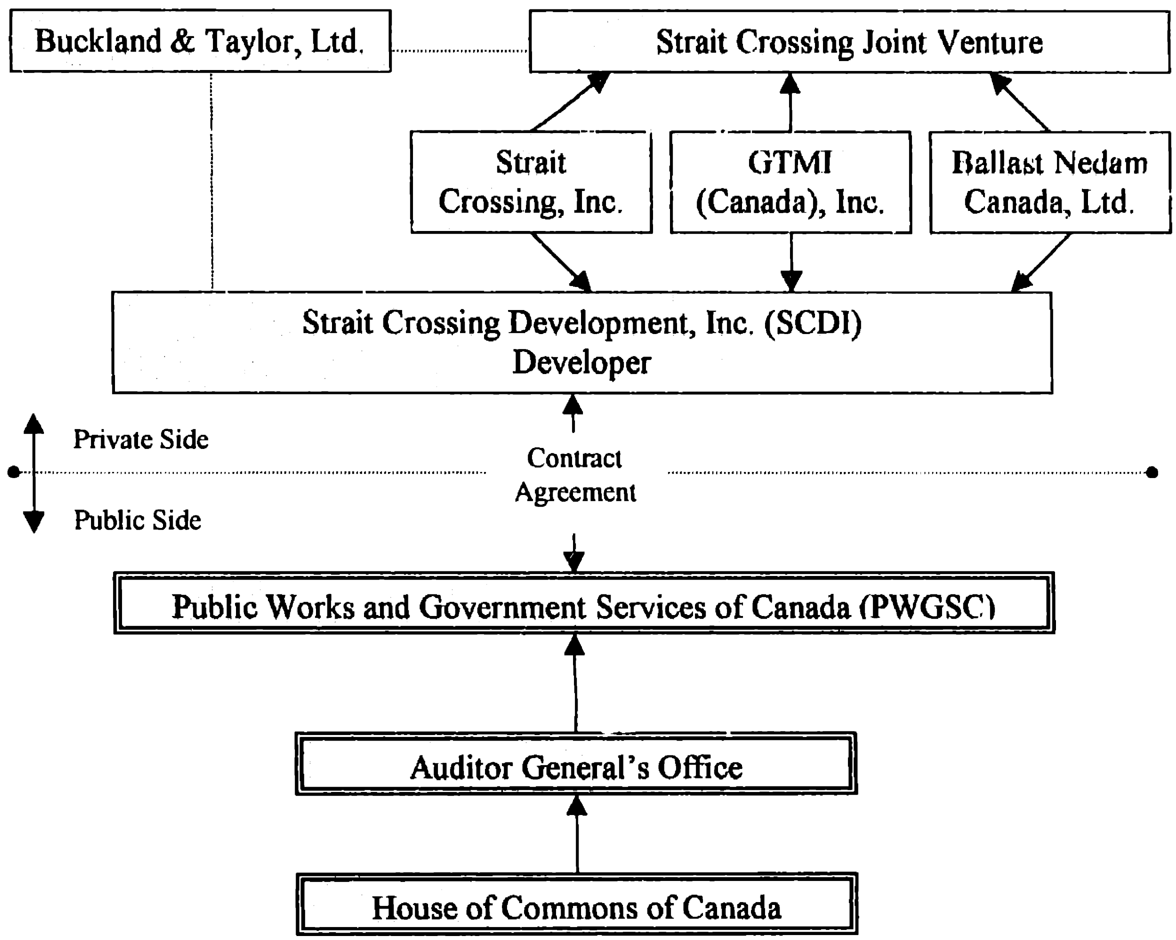

Figure 7.5.1: Organizational Structure Diagram

Ballast Nedam Canada Limited is the Canadian subsidiary of Ballast Nedam, one of the world's major construction groups. Ballast Nedam has a long track record in many construction industry sectors, and specially in dredging where it occupies a prominent worldwide position. Ballast Nedam Canada Limited's recognized qualifications equipped the private consortium with additional expertise in the development, financing, operations and maintenance of infrastructure facilities.

The bridge contractor was Strait Crossing Joint Venture, a 100% Canadian joint venture owned by Strait Crossing, Inc., GTMI (Canada), Inc., and Ballast Nedam Canada Limited.

The independent engineer for the project was Buckland & Taylor Ltd. Although the independent engineer was contracted by SCDI, the feduciary relationship was with the Government of Canada. Among the responsibilities of the independent engineer were: checking the bridge design and construction conformance to agreed-upon specifications, and certifying the draw-downs from the project trust accounts.

From the public side, the major stakeholders were the Federal Government of Canada, and the provincial governments of Prince Edward Island and New Brunswick. The Federal Government was represented by the Public Works and Government Services of Canada (PWGSC). In addition to having experience in the engineering and construction of public projects, PWGSC had access to many other areas of expertise through other federal agencies like the departments of Transportation, Justice, Finance, Environment, etc. PWGSC's role was to represent the interests of the country and to monitor the project's delivery according to the project agreements' terms. PWGSC was supervised and monitored by the Auditor General's Office, who in turn reported to the House of Commons of Canada.

7.6 Financial Strategy

The off-balance-sheet financing for the Canada Confederation Bridge Project was accomplished through the issuance of C$661-Million inflation-indexed, fully-amortizing bonds by a special financing provincial (New Brunswick) Crown Corporation (Refer to

Figure 7.6.1). The bonds were designed to yield a minimum real return of 4.5% per annum, and were secured by a federal commitment to pay an annual subsidy of C$41-Million (1992 dollars) to a trustee representing the interests of the bond holders. In addition, the bonds were to accrue interest for the first five years corresponding to the construction and ramp-up period of the project.

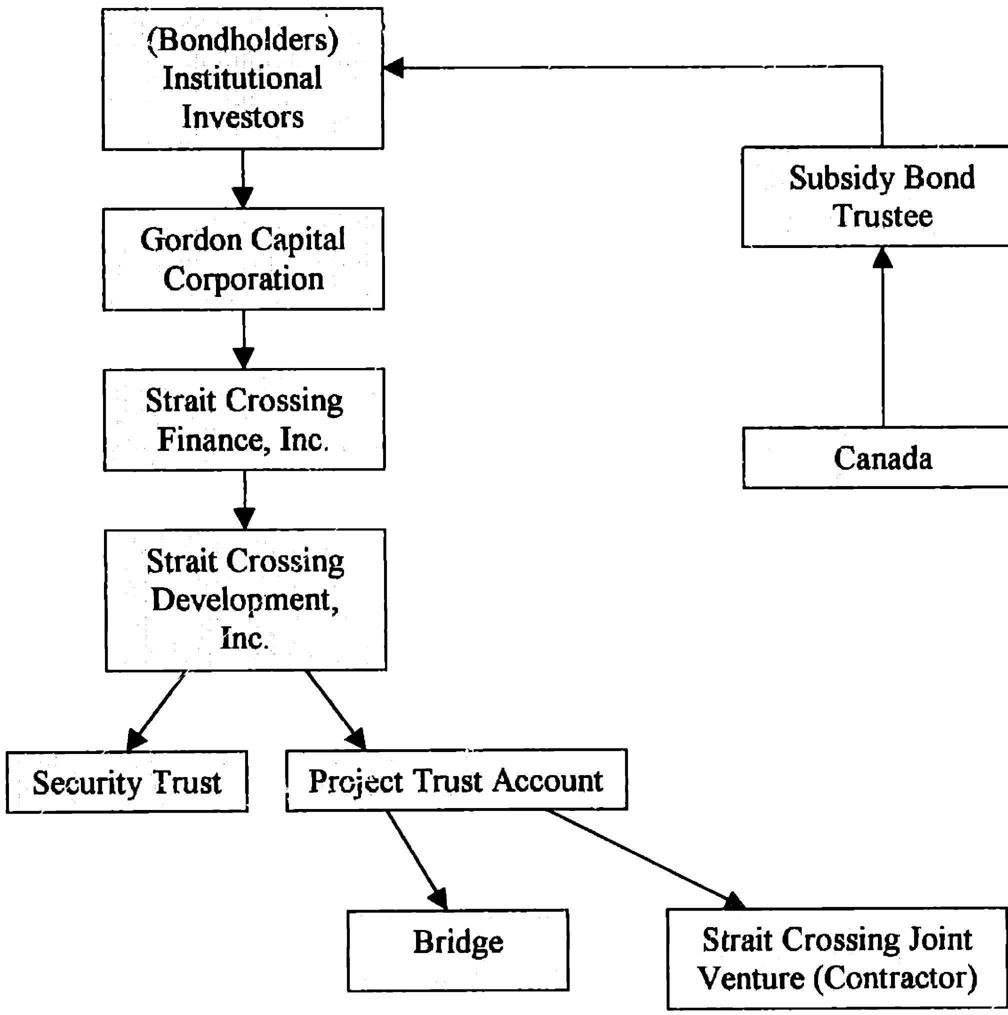

Figure 7.6.1: Financial Structure Diagram

The C$661-Million bond issue was underwritten by the Toronto investment bankers Gordon Capital Corp. and Wood Gandy, Inc., and purchased in a private placement by five major Canadian non-taxable institutional investors and about 20 other smaller groups. According to Gordon Capital and Wood Gandy, this deal represented the largest risk transaction ever accomplished in the Canadian capital markets.[58] Except for a 10% contingency fund (during the construction stage) provided by a letter of credit, there was no bank financing or subordinated debt in the capital structure of this transaction.

Strait Crossing Finance, Inc., the single-purpose crown corporation that issued the bonds, was granted a tax exemption for the annual subsidy by the federal government. In addition to the tax benefits, routing the funds through Strait Crossing Finance, Inc. insulated the subsidy income from third party claims on the private builders. The federal and provincial governments and the project sponsors were not liable for any amounts owing on the bonds. The only recourse on the bonds was limited to the security comprised by the federal government's annual subsidy agreement. Nevertheless, as a result of being backed by the unconditional federal government's commitment to pay the agreed annual subsidies for a trustee, both Moody's and Standard & Poor's gave the bonds their highest ratings.

In return for the commitment of unconditional annual subsidy payments, and to secure the performance of the developer's construction and contract obligations, the government required the following security package from Strait Crossing Development, Inc.:

- A trust fund for an amount equal to the fixed price of the construction contract to complete the bridge.
- A 10% contingency fund provided by an irrevocable letter of credit for the duration of the construction period.

[58] William G. Reinhardt, "P.E.I. Bridge Project Essentials", *Public Works Financing*, November, 1993.

- A C$200-Million performance bond.
- A C$35-Million compliance bond.
- A C$20-Million labor and material bond.
- Extensive prepaid insurance coverage and parent company guarantees.
- SCDI's commitment that in the case the bridge was not substantially completed by the starting date on the subsidy payment (May 31, 1997), SCDI would fund the ferry system until the bridge became operational.

7.7 Remarks and Conclusions

The Canada Confederation Bridge Project is an example of a well planned procurement process, in which the synergism resulting from a strong government support and a very qualified private sector sponsoring consortium provided a world class infrastructure facility.

Due to the innovative and clever way in which the procurement was structured, the private sector sponsors had every incentive to maximize the efficiency and effectiveness of the means and methods pertaining to the design, financing, construction and operation of the project. These means and methods included a fast track schedule, a state-of-the-art on-site bridge components' production facility, a cost effective funding structure, and a careful planning of every activity concerning the engineering, construction and operation of the bridge.

By guaranteeing a C$42-Million annual payment to the project company, even if the bridge was not completed in time, the Government of Canada was able to shift the financial responsibility associated with the operations of the ferry service after May, 1997 to the private developing group. While the government exchanged an increasing cash outflow for a fixed annuity of C$42-Million (in 1992 C$) for a period of 35 years, the private consortium was guaranteed a minimum fixed revenue irrespective of the bridge completion date. Through this creative approach, the government stabilized an escalating budget deficit, and the private developers were empowered with a higher quality project revenue stream. This in turn enabled SCDI to realize a very low cost of capital on the long-term debt funding their project.

Contrary to many BOT concession contracts, the Confederation Bridge franchise period began running on the date of the agreement and not when construction was completed. This proved to be another clever procurement tactic, because the sooner SCDI completed the project, the earlier it would start collecting tolls, and the longer the operations period within the franchise life. If SCDI completed the project one year ahead of schedule, it would have an additional year to collect tolls. From the government standpoint, this meant stabilizing the escalating ferry costs one year earlier than anticipated. On the other hand, if the project had not been completed within the planned schedule, SCDI would have been responsible for funding the operation of the ferry service until the bridge was opened for traffic. The allocation of this risk to SCDI was fundamentally correct, since it was the private developer who had total control over the means and methods regarding the construction of the fixed link between PEI and New Brunswick.

The procurement strategy implemented by the Government of Canada in connection to the development of the Confederation Bridge should be a model to emulate in future similar infrastructure undertakings. The transparency of the procurement process, the clarity of the scope of work, the assured revenue stream guaranteed by the government and the fair allocation of risks made a significant contribution to the overall success of this BOT venture. Finally, the Confederation Bridge Project attests to the fact that the public sector has the capability to successfully implement innovative infrastructure delivery systems, provided that proper planning and needs identification are performed in advance.

Chapter 8

The Canada Confederation Bridge – Part II

8.1 Introduction

As stated in Section 4.1, although a model is a simplified illustration of a real situation, the computerized financial models of a BOT project investment comprise the financial engineer's set of blueprints for the financial condition intended for the undertaking.

More important than accurately representing a real investment opportunity, the main objective of the models should be to provide the financial engineer with valuable insight, understanding, and control of the financial underpinnings of a BOT project venture. By developing the models within the proposed framework and reworking scenarios based on different assumptions, the financial engineer will be better equipped to design creative and innovative financing schemes, as well as to better manage the financial affairs of the relatively recent massive capital investments.

After describing the proposed financial modeling methodology (Chapter 3) and providing background information on the Canada Confederation Bridge Project (Chapter 7), this chapter presents a case study demonstrating an application of the suggested framework.

The data presented in this case study has been altered to preserve confidentiality.

8.2 Base Case Scenario

Unless otherwise noted, the base case scenario for the economic and financial analyses of the Canada Confederation Bridge Project is comprised of the following assumptions and figures:[59]

- Construction Period: Four (4) years, from June of 1993 to May of 1997
- Concession Period: Thirty Five (35) years, from June of 1997 to May of 2032
- Schedule of Construction Costs:

Year	Approx. %tage	Amount (C$000's)	Cumulative (C$000's)
1993	5%	40,000	40,000
1994	24%	200,000	240,000
1995	33%	280,000	520,000
1996	36%	300,000	820,000
1997	2%	20,000	840,000

- Annual Bridge Operations and Maintenance Costs: C$1,000,000 escalating annually at the Consumer Price Index (CPI) rate
- Average Prince Edward Island CPI: 3% per year
- Annual Government Subsidy: C$42-Million in 1992 constant dollars

Equivalent 1997 subsidy = 1992 subsidy * $(1 + \text{CPI rate})^n$; where n is number of years
= $42 * (1 + 0.03)^5$
= C$48,690-Million

- Annual Traffic Volume and Growth Rates:

	Commercial	Other	Passenger
1994 Volume	215,664	876,222	2,404,519
Annual Growth (AG)	5%	3%	4%
3 yrs Escalating Factor $(1+AG)^3$	1.1576	1.0927	1.1249
1997 Volume	249,653	957,448	2,704,843
1 yr Increase (AG * Vol)	12,483	28,723	108,194
20% "one time increase"	52,427	197,235	562,607
1998 Volume	314,563	1,183,406	3,375,644

[59] O.P. Agarwall and J.B. Miller, "Confederation Bridge over the Northumberland Strait," *Infrastructure Development Systems IDS-97-T-010*, Massachusetts Institute of Technology, 1997.

Notes:

1. In addition to the expected annual growth in traffic, the fixed crossing is expected to generate additional economic activity as well as boost tourist inflows. Hence, a one time increase of 20% on all forms of traffic was assumed for 1998.
2. Above volume figures are for traffic leaving Prince Edward Island.

- Annual Vehicle Tolls and Growth Rates:

	Commercial	Other	Passenger
Toll (C$)	30.00	19.50	6.00
Growth Rate	2.25%	2.25%	2.25%

Note:

As per contract agreement, toll increases may not exceed 75% of Prince Edward Island CPI.

8.3 Economic Feasibility Analysis

As discussed in Section 3.3, Table 8.3.1 includes a spreadsheet model of the base case scenario economic feasibility analysis for the Canada Confederation Bridge Project. As stated in the referenced section, in this first step of the modeling process the objective is to get a feeling for the profitability of the project, without considering how the investment is going to be financed. Because the costs of financing the project are not explicitly taken into account in this first analysis, the hurdle rate used to discount the net annual cash flows should be set at a discretionary high number. In our case study, the selected discount rate is 10%.

In the sample spreadsheet, as we proceed from left to right within a given year, the annual costs are subtracted from the corresponding revenues to obtain the total net revenues. These in turn are discounted by the present value factor and added to the previous year's cumulative net present value to obtain the investment's worth at a certain point in time.

Table 8.3.1: Economic Feasibility Analysis

THE CANADA CONFEDERATION BRIDGE PROJECT

Economic Feasibility Analysis - Base Case Scenario

Discount Rate: 10%

Year	Index	Const. Costs	O & M	Annual Traffic Commerc.	Annual Traffic Other	Annual Traffic Passeng.	Toll Rates Com.	Toll Rates Other	Toll Rates Pass.
1993	0	40,000							
1994	1	200,000							
1995	2	280,000							
1996	3	300,000							
1997	4	20,000	1,000	249,653	957,448	2,704,843	30.00	19.50	6.00
1998	5		1,030	314,563	1,183,406	3,375,644	30.68	19.94	6.14
1999	6		1,061	330,291	1,218,908	3,510,670	31.37	20.39	6.27
2000	7		1,093	346,805	1,255,475	3,651,097	32.07	20.85	6.41
2001	8		1,126	364,146	1,293,139	3,797,140	32.79	21.32	6.56
2002	9		1,159	382,353	1,331,934	3,949,026	33.53	21.79	6.71
2003	10		1,194	401,471	1,371,892	4,106,987	34.28	22.29	6.86
2004	11		1,230	421,544	1,413,048	4,271,267	35.06	22.79	7.01
2005	12		1,267	442,621	1,455,440	4,442,117	35.84	23.30	7.17
2006	13		1,305	464,752	1,499,103	4,619,802	36.65	23.82	7.33
2007	14		1,344	487,990	1,544,076	4,804,594	37.48	24.36	7.50
2008	15		1,384	512,390	1,590,398	4,996,778	38.32	24.91	7.66
2009	16		1,426	538,009	1,638,110	5,196,649	39.18	25.47	7.84
2010	17		1,469	564,910	1,687,254	5,404,515	40.06	26.04	8.01
2011	18		1,513	593,155	1,737,871	5,620,696	40.96	26.63	8.19
2012	19		1,558	622,813	1,790,007	5,845,523	41.89	27.23	8.38
2013	20		1,605	653,953	1,843,708	6,079,344	42.83	27.84	8.57
2014	21		1,653	686,651	1,899,019	6,322,518	43.79	28.46	8.76
2015	22		1,702	720,984	1,955,989	6,575,419	44.78	29.11	8.96
2016	23		1,754	757,033	2,014,669	6,838,435	45.79	29.76	9.16
2017	24		1,806	794,884	2,075,109	7,111,973	46.82	30.43	9.36
2018	25		1,860	834,629	2,137,362	7,396,452	47.87	31.11	9.57
2019	26		1,916	876,360	2,201,483	7,692,310	48.95	31.81	9.79
2020	27		1,974	920,178	2,267,528	8,000,002	50.05	32.53	10.01
2021	28		2,033	966,187	2,335,554	8,320,002	51.17	33.26	10.23
2022	29		2,094	1,014,496	2,405,620	8,652,802	52.32	34.01	10.46
2023	30		2,157	1,065,221	2,477,789	8,998,915	53.50	34.78	10.70
2024	31		2,221	1,118,482	2,552,122	9,358,871	54.71	35.56	10.94
2025	32		2,288	1,174,406	2,628,686	9,733,226	55.94	36.36	11.19
2026	33		2,357	1,233,127	2,707,547	10,122,555	57.19	37.18	11.44
2027	34		2,427	1,294,783	2,788,773	10,527,457	58.48	38.01	11.70
2028	35		2,500	1,359,522	2,872,436	10,948,556	59.80	38.87	11.96
2029	36		2,575	1,427,498	2,958,609	11,386,498	61.14	39.74	12.23
2030	37		2,652	1,498,873	3,047,368	11,841,958	62.52	40.64	12.50
2031	38		2,732	1,573,817	3,138,789	12,315,636	63.93	41.55	12.79
2032	39		2,814	1,652,508	3,232,952	12,808,261	65.36	42.49	13.07

cont.

THE CANADA CONFEDERATION BRIDGE PROJECT

Economic Feasibility Analysis - Base Case Scenario

Year	Index	Toll Revenues C$ (000's)	Governm. Subsidy C$ (000's)	Total Net Revenues C$ (000's)	P.V. Cash F. C$ (000's)	Cumulative N.P.V. C$ (000's)
1993	0			-40,000	-40,000	-40,000
1994	1			-200,000	-181,818	-221,818
1995	2			-280,000	-231,405	-453,223
1996	3			-300,000	-225,394	-678,618
1997	4	42,389	48,690	70,079	47,865	-630,753
1998	5	53,954	50,151	103,075	64,002	-566,751
1999	6	57,233	51,655	107,827	60,865	-505,886
2000	7	60,713	53,205	112,825	57,897	-447,989
2001	8	64,408	54,801	118,084	55,087	-392,902
2002	9	68,332	56,445	123,618	52,426	-340,476
2003	10	72,498	58,138	129,443	49,906	-290,570
2004	11	76,923	59,883	135,576	47,518	-243,051
2005	12	81,622	61,679	142,034	45,256	-197,795
2006	13	86,612	63,529	148,837	43,113	-154,682
2007	14	91,912	65,435	156,004	41,081	-113,602
2008	15	97,542	67,398	163,556	39,154	-74,448
2009	16	103,522	69,420	171,516	37,327	-37,121
2010	17	109,874	71,503	179,908	35,594	**-1,527**
2011	18	116,622	73,648	188,758	33,950	**32,423**
2012	19	123,791	75,857	198,091	32,389	64,812
2013	20	131,408	78,133	207,937	30,908	95,721
2014	21	139,501	80,477	218,325	29,502	125,223
2015	22	148,100	82,891	229,289	28,167	153,391
2016	23	157,238	85,378	240,862	26,899	180,290
2017	24	166,948	87,940	253,081	25,694	205,984
2018	25	177,267	90,578	265,985	24,549	230,533
2019	26	188,235	93,295	279,614	23,461	253,994
2020	27	199,891	96,094	294,011	22,427	276,421
2021	28	212,281	98,977	309,225	21,443	297,863
2022	29	225,451	101,946	325,303	20,507	318,370
2023	30	239,450	105,004	342,298	19,617	337,987
2024	31	254,333	108,155	360,266	18,769	356,756
2025	32	270,156	111,399	379,267	17,963	374,719
2026	33	286,978	114,741	399,363	17,195	391,915
2027	34	304,864	118,183	420,620	16,464	408,379
2028	35	323,883	121,729	443,112	15,768	424,147
2029	36	344,107	125,381	466,913	15,104	439,251
2030	37	365,613	129,142	492,103	14,472	453,723
2031	38	388,485	133,016	518,770	13,869	467,592
2032	39	412,810	0	409,996	9,965	477,557

This first model shows that the investment's net present value turns positive between the 14th and 15th year of operation, and that the project's present worth is C$478-Million.

It is important to note that, although this simple model provides us with an initial idea on the economic attractiveness of the undertaking, it does not convey any information regarding the project's cash flow needs throughout its different stages.

8.4 Economic Sensitivity Analyses

Following the financial modeling decision flowchart included in Section 3.9, the next step in our Confederation Bridge Project's case study is to probe the sensitivity of the project's economic feasibility by changing the values of the most critical variables within the base case scenario.

As with the previous model, the purpose of this step is to assess the venture's economic attractiveness under different but nevertheless possible scenarios, and not to investigate the project's cash flow requirements.

By incorporating minor changes to the spreadsheet model of the economic feasibility analysis, the financial engineer can rapidly perform an economic sensitivity analysis. Following herewith is the summary of the results of our case study sensitivity analyses:

1. Discount Rates

Discount Rate:	5%	7.5%	10%	12.5%	14.42%	15%
NPV (C$000's):	2,041	1,016	478 base case	150	0 IRR	-35,386

Note: The Internal Rate of Return (IRR), the discount rate at which the investment's Net Present Value (NPV) equals zero, is 14.42%

2. Increase in Construction Costs

%tage Increase:	0%	10%	20%	30%	67%	100%
NPV (C$000's):	478 base case	395	325	256	0 threshold	-228

3. Increase in Initial Operation and Maintenance Costs

%tage Increase:	0%	50%	100%	1,000%	4,769%
NPV (C$000's):	478 base case	459	454	367	0 threshold

4. Increase in Operation and Maintenance Escalation Costs

%tage Increase:	0%	3%	6%	20%	100%
NPV (C$000's):	464	478 base case	464	462	455

5. Decrease in Initial Annual Traffic

%tage Decrease:	0%	5%	10%	50%	65.40%
NPV (C$000's):	478 base case	428	393	109	0 threshold

6. Changes in Annual Traffic Escalation Factors

Value:	-2%	-1%	0%	1%	2%
NPV (C$000's):	125	163	206	258	320

7. Changes in "One Time" Second Year Traffic Increase

Value:	-20%	-10%	0%	10%	20%
NPV (C$000's):	257	294	350	407	478 base case

8. Decrease in Initial Toll Rates

%tage Decrease:	50%	40%	30%	20%	10%	0%
NPV (C$000's):	109	180	251	322	393	478 base case

9. Changes in Annual Toll Rates Escalation Factor

Value:	-2%	-1%	0%	1%	2%	2.25%
NPV (C$000's):	182	230	288	357	440	478 base case

10. Decrease in Government Subsidy

%tage Decrease:	100%	75%	50%	25%	0%
NPV (C$000's):	7	121	236	350	478 base case

11. Changes in Annual Government Subsidy Escalation Factor

Value:	-3%	-2%	-1%	0%	3%
NPV (C$000's):	277	298	322	350	478 base case

12. Application of Income Taxes

Tax Rate:	10%	20%	30%	40%	50%
NPV (C$000's):	417	371	325	278	232

Note: Refer to Table 8.4.1

13. Construction Schedule Delays with no Costs Overrun

Delay:	0	1 year	2 years	3 years
NPV (C$000's):	478 base case	384	302	287

14. Construction Schedule Delays with Costs Overrun

Scenario:	10% - 1 year	20% - 2 years	30% - 3 years
NPV (C$000's):	318	175	105

Note: Refer to Table 8.4.2

15. Construction Schedule Acceleration of One (1) Year

NPV (C$000's):	562

Tables 8.4.1 and 8.4.2 present the economic sensitivity analyses relating to the application of income taxes and construction schedule delays with cost overruns, respectively.

From the results included above, it is noticeable that the most critical variables are: the discount rate, construction cost, initial traffic volume, government subsidy, application of income taxes, and construction schedule delays.

Table 8.4.1: Economic Sensitivity Analysis 1

THE CANADA CONFEDERATION BRIDGE PROJECT

Sensitivity Analysis - Income Taxes Consideration

Discount Rate: 10%

Note: Items highlighted are changes to the Base Case Scenario

Year	Index	Const. Costs	O & M	Annual Traffic			Toll Rates		
				Commerc.	Other	Passeng.	Com.	Other	Pass.
1993	0	40,000							
1994	1	200,000							
1995	2	280,000							
1996	3	300,000							
1997	4	20,000	1,000	249,653	957,448	2,704,843	30.00	19.50	6.00
1998	5		1,030	314,563	1,183,406	3,375,644	30.68	19.94	6.14
1999	6		1,061	330,291	1,218,908	3,510,670	31.37	20.39	6.27
2000	7		1,093	346,805	1,255,475	3,651,097	32.07	20.85	6.41
2001	8		1,126	364,146	1,293,139	3,797,140	32.79	21.32	6.56
2002	9		1,159	382,353	1,331,934	3,949,026	33.53	21.79	6.71
2003	10		1,194	401,471	1,371,892	4,106,987	34.28	22.29	6.86
2004	11		1,230	421,544	1,413,048	4,271,267	35.06	22.79	7.01
2005	12		1,267	442,621	1,455,440	4,442,117	35.84	23.30	7.17
2006	13		1,305	464,752	1,499,103	4,619,802	36.65	23.82	7.33
2007	14		1,344	487,990	1,544,076	4,804,594	37.48	24.36	7.50
2008	15		1,384	512,390	1,590,398	4,996,778	38.32	24.91	7.66
2009	16		1,426	538,009	1,638,110	5,196,649	39.18	25.47	7.84
2010	17		1,469	564,910	1,687,254	5,404,515	40.06	26.04	8.01
2011	18		1,513	593,155	1,737,871	5,620,696	40.96	26.63	8.19
2012	19		1,558	622,813	1,790,007	5,845,523	41.89	27.23	8.38
2013	20		1,605	653,953	1,843,708	6,079,344	42.83	27.84	8.57
2014	21		1,653	686,651	1,899,019	6,322,518	43.79	28.46	8.76
2015	22		1,702	720,984	1,955,989	6,575,419	44.78	29.11	8.96
2016	23		1,754	757,033	2,014,669	6,838,435	45.79	29.76	9.16
2017	24		1,806	794,884	2,075,109	7,111,973	46.82	30.43	9.36
2018	25		1,860	834,629	2,137,362	7,396,452	47.87	31.11	9.57
2019	26		1,916	876,360	2,201,483	7,692,310	48.95	31.81	9.79
2020	27		1,974	920,178	2,267,528	8,000,002	50.05	32.53	10.01
2021	28		2,033	966,187	2,335,554	8,320,002	51.17	33.26	10.23
2022	29		2,094	1,014,496	2,405,620	8,652,802	52.32	34.01	10.46
2023	30		2,157	1,065,221	2,477,789	8,998,915	53.50	34.78	10.70
2024	31		2,221	1,118,482	2,552,122	9,358,871	54.71	35.56	10.94
2025	32		2,288	1,174,406	2,628,686	9,733,226	55.94	36.36	11.19
2026	33		2,357	1,233,127	2,707,547	10,122,555	57.19	37.18	11.44
2027	34		2,427	1,294,783	2,788,773	10,527,457	58.48	38.01	11.70
2028	35		2,500	1,359,522	2,872,436	10,948,556	59.80	38.87	11.96
2029	36		2,575	1,427,498	2,958,609	11,386,498	61.14	39.74	12.23
2030	37		2,652	1,498,873	3,047,368	11,841,958	62.52	40.64	12.50
2031	38		2,732	1,573,817	3,138,789	12,315,636	63.93	41.55	12.79
2032	39		2,814	1,652,508	3,232,952	12,808,261	65.36	42.49	13.07

cont.

THE CANADA CONFEDERATION BRIDGE PROJECT

Sensitivity Analysis - Income Taxes Consideration

Year	Index	Toll Revenues C$ (000's)	Governm. Subsidy C$ (000's)	Total Net Revenues C$ (000's)	Income Taxes 30%	P.V. Cash F. C$ (000's)	Cumulative N.P.V. C$ (000's)
1993	0			-40,000	-12,000	-28,000	-28,000
1994	1			-200,000	-60,000	-127,273	-155,273
1995	2			-280,000	-84,000	-161,983	-317,256
1996	3			-300,000	-90,000	-157,776	-475,032
1997	4	42,389	47,271	68,660	20,598	32,829	-442,204
1998	5	53,954	48,689	101,614	30,484	44,167	-398,036
1999	6	57,233	50,150	106,321	31,896	42,012	-356,024
2000	7	60,713	51,654	111,274	33,382	39,972	-316,052
2001	8	64,408	53,204	116,487	34,946	38,040	-278,011
2002	9	68,332	54,800	121,973	36,592	36,211	-241,800
2003	10	72,498	56,444	127,748	38,325	34,478	-207,322
2004	11	76,923	58,137	133,831	40,149	32,836	-174,487
2005	12	81,622	59,881	140,237	42,071	31,279	-143,207
2006	13	86,612	61,678	146,985	44,096	29,804	-113,403
2007	14	91,912	63,528	154,097	46,229	28,406	-84,998
2008	15	97,542	65,434	161,592	48,478	27,079	-57,918
2009	16	103,522	67,397	169,493	50,848	25,821	-32,097
2010	17	109,874	69,419	177,825	53,347	24,628	-7,469
2011	18	116,622	71,502	186,611	55,983	23,495	16,026
2012	19	123,791	73,647	195,880	58,764	22,420	38,446
2013	20	131,408	75,856	205,660	61,698	21,399	59,845
2014	21	139,501	78,132	215,980	64,794	20,430	80,275
2015	22	148,100	80,476	226,873	68,062	19,510	99,785
2016	23	157,238	82,890	238,374	71,512	18,635	118,420
2017	24	166,948	85,377	250,519	75,156	17,804	136,224
2018	25	177,267	87,938	263,345	79,003	17,014	153,238
2019	26	188,235	90,576	276,895	83,068	16,263	169,501
2020	27	199,891	93,293	291,211	87,363	15,549	185,051
2021	28	212,281	96,092	306,340	91,902	14,870	199,921
2022	29	225,451	98,975	322,332	96,700	14,224	214,145
2023	30	239,450	101,944	339,238	101,771	13,609	227,754
2024	31	254,333	105,003	357,114	107,134	13,024	240,777
2025	32	270,156	108,153	376,020	112,806	12,467	253,244
2026	33	286,978	111,397	396,019	118,806	11,936	265,180
2027	34	304,864	114,739	417,176	125,153	11,431	276,611
2028	35	323,883	118,181	439,564	131,869	10,949	287,560
2029	36	344,107	121,727	463,258	138,978	10,490	298,050
2030	37	365,613	125,379	488,340	146,502	10,053	308,103
2031	38	388,485	129,140	514,893	154,468	9,636	317,739
2032	39	412,810	0	409,996	122,999	6,975	324,714

Table 8.4.2: Economic Sensitivity Analysis 2

THE CANADA CONFEDERATION BRIDGE PROJECT

Sensitivity Analysis - 3 Yrs. Construction Delay & 30% Construction Costs Overrun

Discount Rate: 10%

Notes: 1. The 1997 Net Government Subsidy = Annual Subsidy - Cost of Ferry Operations
2. Items highlited are changes to the Base Case Scenario

Year	Index	Const. Costs	O & M	Annual Traffic Commerc.	Annual Traffic Other	Annual Traffic Passeng.	Toll Rates Com.	Toll Rates Other	Toll Rates Pass.
1993	0	52,000							
1994	1	97,500							
1995	2	169,000							
1996	3	195,000							
1997	4	195,000							
1998	5	195,000							
1999	6	162,500							
2000	7	26,000	1,093	289,005	1,046,229	3,042,581	32.07	20.85	6.41
2001	8		1,126	318,628	1,131,497	3,322,498	32.79	21.32	6.55
2002	9		1,160	334,559	1,165,442	3,455,398	33.53	21.80	6.70
2003	10		1,194	351,287	1,200,405	3,593,614	34.28	22.29	6.85
2004	11		1,230	368,852	1,236,417	3,737,359	35.06	22.79	7.01
2005	12		1,267	387,294	1,273,509	3,886,853	35.84	23.30	7.16
2006	13		1,305	406,659	1,311,715	4,042,327	36.65	23.83	7.33
2007	14		1,344	426,992	1,351,066	4,204,020	37.48	24.36	7.49
2008	15		1,385	448,342	1,391,598	4,372,181	38.32	24.91	7.66
2009	16		1,426	470,759	1,433,346	4,547,069	39.18	25.47	7.83
2010	17		1,469	494,297	1,476,347	4,728,951	40.06	26.05	8.01
2011	18		1,513	519,011	1,520,637	4,918,109	40.96	26.63	8.19
2012	19		1,558	544,962	1,566,256	5,114,834	41.89	27.23	8.37
2013	20		1,605	572,210	1,613,244	5,319,427	42.83	27.84	8.56
2014	21		1,653	600,821	1,661,641	5,532,204	43.79	28.47	8.75
2015	22		1,703	630,862	1,711,490	5,753,492	44.78	29.11	8.95
2016	23		1,754	662,405	1,762,835	5,983,632	45.78	29.77	9.15
2017	24		1,807	695,525	1,815,720	6,222,977	46.81	30.44	9.36
2018	25		1,861	730,301	1,870,192	6,471,896	47.87	31.12	9.57
2019	26		1,917	766,816	1,926,297	6,730,772	48.94	31.82	9.78
2020	27		1,974	805,157	1,984,086	7,000,003	50.05	32.54	10.00
2021	28		2,033	845,415	2,043,609	7,280,003	51.17	33.27	10.23
2022	29		2,094	887,686	2,104,917	7,571,203	52.32	34.02	10.46
2023	30		2,157	932,070	2,168,065	7,874,052	53.50	34.78	10.69
2024	31		2,222	978,674	2,233,107	8,189,014	54.70	35.57	10.93
2025	32		2,288	1,027,607	2,300,100	8,516,574	55.93	36.37	11.18
2026	33		2,357	1,078,988	2,369,103	8,857,237	57.19	37.18	11.43
2027	34		2,428	1,132,937	2,440,176	9,211,527	58.48	38.02	11.69
2028	35		2,501	1,189,584	2,513,381	9,579,988	59.80	38.88	11.95
2029	36		2,576	1,249,063	2,588,783	9,963,187	61.14	39.75	12.22
2030	37		2,653	1,311,516	2,666,446	10,361,715	62.52	40.64	12.50
2031	38		2,733	1,377,092	2,746,439	10,776,183	63.92	41.56	12.78
2032	39		2,815	1,445,947	2,828,833	11,207,231	65.36	42.49	13.06

THE CANADA CONFEDERATION BRIDGE PROJECT

Sensitivity Analysis - 3 Yrs. Construction Delay & 30% Construction Costs Overrun

Year	Index	Toll Revenues C$ (000's)	Governm. Subsidy C$ (000's)	Total Net Revenues C$ (000's)	P.V. Cash F. C$ (000's)	Cumulative N.P.V. C$ (000's)
1993	0			-52,000	-52,000	-52,000
1994	1			-97,500	-88,636	-140,636
1995	2			-169,000	-139,669	-280,306
1996	3			-195,000	-146,506	-426,812
1997	4		-2,853	-197,853	-135,136	-561,948
1998	5		-3,240	-198,240	-123,091	-685,040
1999	6		-3,648	-166,148	-93,786	-778,826
2000	7	50,585	51,654	75,147	38,562	-740,264
2001	8	56,347	53,204	108,425	50,581	-689,683
2002	9	59,780	54,800	113,420	48,101	-641,582
2003	10	63,425	56,444	118,674	45,754	-595,827
2004	11	67,295	58,137	124,203	43,532	-552,295
2005	12	71,406	59,881	130,021	41,429	-510,867
2006	13	75,772	61,678	136,145	39,436	-471,430
2007	14	80,408	63,528	142,593	37,549	-433,881
2008	15	85,333	65,434	149,383	35,761	-398,120
2009	16	90,565	67,397	156,536	34,067	-364,053
2010	17	96,122	69,419	164,072	32,461	-331,593
2011	18	102,025	71,502	172,014	30,938	-300,654
2012	19	108,297	73,647	180,385	29,494	-271,160
2013	20	114,960	75,856	189,211	28,125	-243,035
2014	21	122,040	78,132	198,519	26,826	-216,209
2015	22	129,563	80,476	208,336	25,593	-190,616
2016	23	137,556	82,890	218,692	24,423	-166,193
2017	24	146,051	85,377	229,621	23,312	-142,880
2018	25	155,078	87,938	241,156	22,258	-120,623
2019	26	164,673	90,576	253,332	21,256	-99,367
2020	27	174,870	93,293	266,189	20,304	-79,062
2021	28	185,709	96,092	279,768	19,400	-59,662
2022	29	197,230	98,975	294,111	18,541	-41,122
2023	30	209,477	101,944	309,264	17,723	-23,398
2024	31	222,497	105,003	325,277	16,947	-6,452
2025	32	236,338	108,153	342,202	16,208	9,756
2026	33	251,055	111,397	360,095	15,505	25,260
2027	34	266,702	114,739	379,013	14,836	40,096
2028	35	283,339	118,181	399,020	14,199	54,295
2029	36	301,031	121,727	420,182	13,593	67,887
2030	37	319,845	125,379	442,571	13,015	80,902
2031	38	339,854	129,140	466,261	12,465	93,368
2032	39	361,134	133,014	491,333	11,942	105,309

In terms of hurdle rates, it was found that for discount rates higher than 14.42% (the investment's internal rate of return), the project would yield a negative net present value. The same would happen if construction cost overruns amounted to more than 67% of the original cost, or if the initial traffic volume was approximately 65% lower than expected. Nevertheless, while large construction cost overruns are not uncommon in complicated infrastructure projects, an actual initial traffic volume of 35% of the expected value is not very probable, considering that the traffic volume under the ferry system was approximately 5% lower.

On the other hand, even with the outright elimination of the government subsidy or the application of income taxes, the project still yields a positive net present value. While most developers exempt themselves from large tax liabilities, by offsetting the profits of one project with the losses of another and through the use of tax shields (e.g. fixed assets' depreciation, tax credits resulting from years with losses, etc.), the effect of taxes was introduced in this sensitivity analysis to demonstrate the robustness of the investment.

Usually, construction schedule delays and cost overruns come together in complicated construction programs typical of large infrastructure projects. They can be the result of scope changes, errors and omissions in the design documents, unavailability of a critical supplier, drastic changes in the design documents, construction team mismanagement or negligence, etc. Acknowledging the possibility of this double effect, scenario 14 of the case study sensitivity analysis results presents the variation on the investment's net present value, when the project is subject to various construction cost and schedule overrun scenarios. As we can see, the combination of a three year construction schedule delay and a 30% increase in construction cost will reduce the project's net present value by approximately 78%. While the investment's net present value is still positive, such a pessimistic scenario can be catastrophic on the project's capacity to service its short-term debt (liquidity). The venture's cash flow analysis throughout its construction and takeout (operation) stages is undertaken during the last three steps in the proposed BOT project's Financial Modeling Methodology.

Whereas a sensitivity study involves assessing the investment's net present value by changing one variable at a time (e.g. construction cost), scenario analysis is based upon the modification of several of the uncertain assumptions in a mutually consistent way (e.g. construction cost and schedule) to evaluate the project's economic attractiveness.

A third technique that helps the financial engineer to think systematically about the sources of risk and their effect on the project's return is a simulation. A simulation is an extension of the sensitivity and scenario analysis, in which a probability distribution and correlation with other factors is assigned to each uncertain variable. A computer then repeatedly selects values in a random fashion for each of the variables according to their occurrence probability.

Regardless of the technique employed to subjectively measure the investment risk of a BOT venture, the most important benefits of this step for the financial engineer are the following: they provide ways to determine the most critical variables, learn the sensitiveness of the investment to the identified variables, and decide, considering the range of possible returns, if the project is worth pursuing.

8.5 Preliminary Capital Structure Assessment

Once satisfied with the investment's economic attractiveness and its associated risk, the next step is to design a preliminary capital structure that can be sustained by the project's revenue stream, and that would be viable to the potential investors and creditors.

- Revenue Projections:

	Commercial	Other	Passenger
1998 Traffic Volume*	314,563	1,183,406	3,375,644
Average Toll (C$)**	30.68	19.94	6.14
Toll Revenues (C$000's)	9,651	23,597	20,726

* From Section 8.2

** 1998 Toll Rate = 1997 Toll Rate * (1 + 75% of CPI)

Note: 1998 was taken as the base year due to the one time 20% traffic increase

Total 1998 Toll Revenues = 9,651 + 23,597 + 20,726 = C$53,974-K
Less Assumed O & M Expenses C$ 1,030-K
Net Revenues from Operations or Earnings C$52,944-K

Government 1998 Subsidy = 42,000 * $(1 + \text{CPI})^6$ C$ 50,151-K
Total 1998 Earnings C$103,095-K

- Annual Earnings Present Value:

  - Assume annual earnings (AR) to grow at a 4% rate (g); Refer to the "Total Net Revenues" spreadsheet column of the "Economic Feasibility Analysis – Base Case Scenario" on Section 8.3.

  - The present value (PV) of the net revenue stream for 35 years assuming a 10% discount rate is:

$$(\text{PV} / g = 4\%,\ i = 10\%,\ n = 35) = \text{AR} * \left[\frac{(1+i-g)^n - 1}{(i-g)(1+i-g)^n} \right]$$

PV = 103,095 * 14.4982 = C$1,494,697-K

- Equivalent Uniform Annuity (EUA):

EUA = PV (A/PV, i = 10%, n = 35); from Present Value Tables
EUA = 1,494,697 * (0.1037) = C$155,000-K

- Assume a minimum Debt Coverage Ratio (CR) of 1.30

- Set the Annual Debt Service (ADS) Expression:

  ADS = CR * Senior Debt * (A/P, i = 10%, n = 35)
  ADS = 1.30 * Senior Debt * 0.1037

- Equate the net Revenue Stream EUA to the Annual Debt Service

  155,000 = 1.30 * Senior Debt * 0.1037
  Senior Debt = C$1,149,766-K

So theoretically, assuming a discount rate of 10% and a reserve fund of 30% of the total project's debt, the maximum amount of debt that the venture's net revenue stream can service is C$1,149,766-K or approximately 37% more than the project's construction cost.

If we carry the same calculations based solely on the government subsidy and disregarding any toll revenue, we would get:

- (PV/g = 3%, i = 10%, n = 35) = 48,690 * 12.9477
  PV = C$630,424-K

- EUA = 630,424 * (0.1037) = C$65,375-K

- 65,375 = 1.30 * Senior Debt * 0.1037
  Senior Debt = C$484,942-K

So, in addition to being an almost 100% reliable revenue stream, the government subsidy alone could finance approximately 57% of the total construction cost.

Although the project lenders will normally require some proportion of equity from the project's sponsors, these preliminary calculations demonstrate the robustness of the revenue stream and its capacity to support a viable capital structure.

8.6 Construction Stage Cash Flow Analysis

The procedure for performing the Construction Stage Cash Flow Analysis is comprised of four steps:

1. ***Funds Drawdown Schedule***; Refer to Item I of Table 8.6.1

   This step involves determining a capital structure for this stage of the project, and establishing the proportion in which the funds will be used throughout the construction period.

2. ***Escalated Construction Cost Calculation***; Refer to Item II of Table 8.6.1

   Once the uses of funds schedule is known, the compounded value of the equity and of the loan's accumulated interests at the end of the construction stage can be determined. The escalating construction cost (ECC) at the end of the construction period can be calculated from the following equation.

   $$ECC = \text{Compounded Value of Equity} + \text{Construction Loan Amount} + \text{Accumulated Loan Interests}$$

   ECC = 364,746 + 769,400 + 254,223 = C$1,388,369-K

3. ***Pre-Construction Equity Escalated Cost Calculation***; Refer to Item III, Table 8.6.1

   The expenses incurred in the proposal preparation, project development, project initiation, and final pre-construction of a BOT infrastructure project can be substantial (often as high as 5 to 10% of the total project construction cost). Because of the high risk associated with the pre-construction stage, funds are usually provided, in the form of equity, by either the project sponsors or third party investors with a vested interest in the project. Due to the project's high uncertainty during this period, the

Table 8.6.1: Construction Stage Cash Flow Analysis

THE CANADA CONFEDERATION BRIDGE PROJECT

Cash Flow Analysis - Construction Stage

Year:			1993	1994	1995	1996	1997
Index:			0	1	2	3	4
I. FUNDS DRAWDOWN SCHEDULE							
USES OF FUNDS:							
Construction	840,000		40,000	200,000	280,000	300,000	20,000
Bank Costs	21,000		21,000	0	0	0	0
Finacial Advisor Fee	8,400		8,400	0	0	0	0
Uses Subtotal	869,400		69,400	200,000	280,000	300,000	20,000
SOURCES OF FUNDS:							
Equity	100,000		69,400	30600	0	0	0
Construction Loan	769,400		0	169,400	280,000	300,000	20,000
Sources Subtotal	869,400		69,400	200,000	280,000	300,000	20,000
End of Year Cash Flow			0	0	0	0	0
II. ESCALATED CONSTRUCTION COST							
Current Equity			69,400	30,600			
Accumulated Equity			69,400	100,000			
Compounded Equity			69,400	186,750	233,438	291,797	364,746
Current Construc. Loan			0	169,400	280,000	300,000	20,000
Accum. Construc. Loan			0	169,400	449,400	749,400	769,400
Const. Loan Interest			0	0	53,928	96,399	103,896
Accum. Loan Interests			0	0	53,928	150,327	254,223
Escalated Const. Cost			69,400	356,150	736,766	1,191,524	1,388,369

Year:	1991	1992	1993	1994	1995	1996	1997
Index:	0	1	2	3	4	5	6
III. PRE-CONSTRUCTION EQUITY ESCALATED COST							
Project Sponsors	5,000	10,000	5,000				
Other	0	8,000	7,000				
Total	5,000	18,000	12,000				
Compounded Value	5,000	24,500	43,850	57,005	74,107	96,338	125,240

IV. PROJECT'S TOTAL ESCALATED COST (C$ 000's) **1,513,609**

Notes:
1. Pre-Construction Equity Opportunity Cost: 30%
2. Construction Equity Opportunity Cost: 25%
3. Construction Loan Interest: 12%

expected rate of return on pre-construction equity (e.g. 25%) is higher than that of the construction stage (e.g. 20%).

In the Canada Confederation Bridge Project case study, the compounded value of the pre-construction equity has been calculated to be C$125,240-K at the end of the construction period.

4. ***Project's Total Escalated Cost (PTEC)***; Refer to Item IV of Table 8.6.1

   PTEC = ECC + Compounded Value of Pre-Construction Equity

   PTEC = C$1,388,369 + C$125,240-K = C$1,513,609-K

8.7 Take Out Stage Financial Analysis

As stated in Section 3.7, the objective of this model is to evaluate the viability of the investment, taking into consideration the funding structure for the project during its operation stage. Not only do we want to make certain that the venture's rate of return is higher than the contributed equity's expected rate of return, but also that the project will be liquid (i.e. no negative annual cash flows) throughout the concession period.

- Base Proposition: Uses of Funds = Sources of Funds

PTEC + Cost of Raising Capital + Revenues = Debt + Equity, where

- PTEC = C$1,513,609-K
- Cost of Raising Capital = Assume approximately 2% of PTEC, or = C$30,000-K
- Reserves = Assume approximately 10% of PTEC, or = C$150,000-K

Based on the above assumptions, the total uses of funds can be calculated as:

C$1,514-M + C$30-M + C$150-M = C$1,694-Million.

- Final Capital Structure and Sources of Capital Cost Determination:

From the Preliminary Capital Structure Assessment we know that the project revenue stream is very reliable and that it can support a high proportion of debt. Based on this, we will assume the following final capital structure for the Confederation Bridge Project:

> ➢ Senior debt of C$1,500-Million to be comprised of bonds with a 7% coupon rate. The bonds will mature on ten (10) equal installments starting on the year 20 after the operation of the facility starts.
>
> ➢ Subordinated debt of C$150-Million to be amortized over a period of 15 years at an interest rate of 12%.
>
> ➢ Equity contribution of C$44-Million with an expected rate of return of 20%.

Uses of Funds						**Sources of Funds**				
PTEC	+	Cost of Raising Capital	+	Reserves	=	Bonds	+	Subordinated Debt	+	Equity
1,514		30		150		1,500		150		44

- Weighted Average Cost of Capital (WACC) Calculation:

$$WACC = \frac{1,500}{1,694}(7\%) + \frac{150}{1,694}(12\%) + \frac{44}{1,694}(20\%)$$

WACC = 7.78%

- Spreadsheet Scenario; Refer to Table 8.7.1

Table 8.7.1 Take Out Stage Financial Analysis - Base Case Scenario

THE CANADA CONFEDERATION BRIDGE PROJECT

Discount Rate (WACC): 7.78%
NPV (C$): 1,073,823
Interest on Bonds: 7.00%
Interest on Subordinated Debt: 12.00%
Equity Opportunity Cost: 20.00%

Year	Index	Res. Fund Balance	Revenues	Res. Fund Interests	Total Revenues	Finance Charges	Bonds Interests	Bonds Repay.	Sub. Debt Repay.
1997	1	150,000	89,660	9,000	98,660	30,000	105,000	0	22,020
1998	2	90,640	102,643	5,438	108,081	0	105,000	0	22,020
1999	3	70,671	107,775	4,240	112,015	0	105,000	0	22,020
2000	4	54,606	113,164	3,276	116,440	0	105,000	0	22,020
2001	5	42,933	118,822	2,576	121,398	0	105,000	0	22,020
2002	6	36,186	124,763	2,171	126,934	0	105,000	0	22,020
2003	7	34,941	131,001	2,096	133,098	0	105,000	0	22,020
2004	8	39,825	137,551	2,389	139,941	0	105,000	0	22,020
2005	9	51,516	144,429	3,091	147,520	0	105,000	0	22,020
2006	10	70,749	151,650	4,245	155,895	0	105,000	0	22,020
2007	11	98,320	159,233	5,899	165,132	0	105,000	0	22,020
2008	12	135,088	167,195	8,105	175,300	0	105,000	0	22,020
2009	13	181,984	175,554	10,919	186,473	0	105,000	0	22,020
2010	14	240,011	184,332	14,401	198,733	0	105,000	0	22,020
2011	15	310,256	193,549	18,615	212,164	0	105,000	0	22,020
2012	16	393,887	203,226	23,633	226,859	0	105,000	0	0
2013	17	514,188	213,387	30,851	244,239	0	105,000	0	0
2014	18	651,822	224,057	39,109	263,166	0	105,000	0	0
2015	19	808,336	235,260	48,500	283,760	0	105,000	0	0
2016	20	985,393	247,023	59,124	306,146	0	105,000	150,000	0
2017	21	1,034,786	259,374	62,087	321,461	0	94,500	150,000	0
2018	22	1,109,941	272,342	66,596	338,939	0	84,000	150,000	0
2019	23	1,213,019	285,960	72,781	358,741	0	73,500	150,000	0
2020	24	1,346,344	300,258	80,781	381,038	0	63,000	150,000	0
2021	25	1,512,408	315,270	90,745	406,015	0	52,500	150,000	0
2022	26	1,713,891	331,034	102,833	433,867	0	42,000	150,000	0
2023	27	1,953,664	347,586	117,220	464,805	0	31,500	150,000	0
2024	28	2,234,813	364,965	134,089	499,054	0	21,000	150,000	0
2025	29	2,560,645	383,213	153,639	536,852	0	10,500	150,000	0
2026	30	2,934,709	402,374	176,083	578,456	0	0	0	0
2027	31	3,510,809	422,493	210,649	633,141	0	0	0	0
2028	32	4,141,523	443,617	248,491	692,109	0	0	0	0
2029	33	4,831,131	465,798	289,868	755,666	0	0	0	0
2030	34	5,584,222	489,088	335,053	824,141	0	0	0	0
2031	35	6,405,711	513,542	384,343	897,885	0	0	0	0

cont.

THE CANADA CONFEDERATION BRIDGE PROJECT

Take Out Stage Financial Analysis - Base Case Scenario

Year	Index	Debt Service	O&M	Cash For Debt Serv.	Cover. Ratio	Net Revenues	N.P.V. Cash Flow	Cumulative N.P.V.
1997	1	127,020	1,000	217,660	1.71	-59,360	201,948	201,948
1998	2	127,020	1,030	197,691	1.56	-19,969	-17,190	184,758
1999	3	127,020	1,061	181,626	1.43	-16,065	-12,831	171,927
2000	4	127,020	1,093	169,953	1.34	-11,672	-8,650	163,277
2001	5	127,020	1,126	163,206	1.28	-6,747	-4,639	158,638
2002	6	127,020	1,159	161,961	1.28	-1,245	-794	157,844
2003	7	127,020	1,194	166,845	1.31	4,884	2,891	160,734
2004	8	127,020	1,230	178,536	1.41	11,691	6,420	167,154
2005	9	127,020	1,267	197,769	1.56	19,233	9,799	176,953
2006	10	127,020	1,305	225,340	1.77	27,571	13,033	189,986
2007	11	127,020	1,344	262,108	2.06	36,768	16,126	206,113
2008	12	127,020	1,384	309,004	2.43	46,896	19,083	225,196
2009	13	127,020	1,426	367,031	2.89	58,028	21,909	247,105
2010	14	127,020	1,469	437,276	3.44	70,244	24,607	271,712
2011	15	127,020	1,513	520,907	4.10	83,631	27,181	298,893
2012	16	105,000	1,558	619,188	5.90	120,301	36,277	335,170
2013	17	105,000	1,605	756,822	7.21	137,634	38,508	373,678
2014	18	105,000	1,653	913,336	8.70	156,513	40,629	414,307
2015	19	105,000	1,702	1,090,393	10.38	177,057	42,644	456,951
2016	20	255,000	1,754	1,289,786	5.06	49,393	11,037	467,988
2017	21	244,500	1,806	1,354,441	5.54	75,155	15,582	483,570
2018	22	234,000	1,860	1,447,019	6.18	103,079	19,829	503,399
2019	23	223,500	1,916	1,569,844	7.02	133,325	23,796	527,194
2020	24	213,000	1,974	1,725,408	8.10	166,065	27,499	554,694
2021	25	202,500	2,033	1,916,391	9.46	201,482	30,956	585,650
2022	26	192,000	2,094	2,145,664	11.18	239,774	34,180	619,829
2023	27	181,500	2,157	2,416,313	13.31	281,149	37,184	657,014
2024	28	171,000	2,221	2,731,645	15.97	325,832	39,983	696,997
2025	29	160,500	2,288	3,095,209	19.28	374,064	42,588	739,586
2026	30	0	2,357	3,510,809	N/A	576,100	60,856	800,442
2027	31	0	2,427	4,141,523	N/A	630,714	61,816	862,257
2028	32	0	2,500	4,831,131	N/A	689,608	62,709	924,966
2029	33	0	2,575	5,584,222	N/A	753,091	63,538	988,504
2030	34	0	2,652	6,405,711	N/A	821,489	64,306	1,052,810
2031	35	0	2,732	7,300,864	N/A	895,153	65,014	1,117,823

- Liquidity Check:

  Although the "Net Revenues" for the first six years is negative, the available "Cash for Debt Service" remains positive throughout the concession period.

- Project's Net Present Value (PNPV):

  PNPV = C$1,118-Million

- Investment's Net Present Value (INPV):

  INPV = C$1,118-M – C$44-M = C$1,074-M

- Comparison with the Economic Feasibility Analysis:

  It can be concluded that the economic feasibility analysis, conducted in the first step of the proposed framework, underestimated the investment's net present value by approximately 40%. The principal reason contributing to this difference is the low discount factor used in the take out stage financial analysis. Because the project's revenue stream is so robust and reliable, the cost of the senior debt (7%) is very low. Furthermore, since the debt to equity ratio of this project's capital structure is very high (89%) and the cost of issuing the bonds is relatively low, the investment's weighted average cost of capital (WACC) remained very low (7.78%).

8.8 Financial Sensitivity Analyses

The financial sensitivity analysis included in this section for the Canada Confederation Bridge Project consists of evaluating the investment's net present value as well as its annual cash flows on three different scenarios.

- ***Scenario #1: Interest rate of bonds increased from 7% to 7.5%.***

As can be seen on Table 8.8.1, by increasing the bonds coupon rate by ½%, the weighted average cost of capital rose 44 base points, and the investment's net present value was reduced by 23%. In addition to the investment's high sensitivity to WACC, the project's annual cash flows turn negative between the sixth and eleventh year of operation. Because a negative annual cash flow means that the project would not be able to service its short-term debt (a coverage ratio below 1), a re-engineering of the capital structure will be required if the interest rates on the bonds are higher than approximately 7.25%.

- ***Scenario #2: Lower initial toll revenues.***

Table 8.8.2 shows the effect of lowering by 5% the revenues during the first year of the bridge's operation. As in the previous scenario, despite a positive net present value, the project's coverage ratio falls below 1 (negative annual cash flows) between the seventh and ninth year. Because viable annual cash flows are very sensitive to the project's realized revenues, a restructuring of the funding scheme will be needed in order to increase the cushion provided by the Reserve Fund.

- ***Scenario #3: Different capital structure, higher interest on bonds, and higher equity opportunity cost.***

  - The new capital structure and cost is divided as follows:

Bonds:	C$	1,806-M	@	8.25%	
Subordinated Debt:	C$	150-M	@	12%	
Equity:	C$	44-M	@	25%	
Total:	C$	2,000-M		8.90%	- WACC

  - Since the PTEC and cost of raising capital have remained unaltered, the Reserve Bond's initial balance has increased from C$150-M to C$456-M.

Table 8.8.1 Take Out Stage Financial Sensitivity Analysis - Scenario #1

THE CANADA CONFEDERATION BRIDGE PROJECT

Discount Rate (WACC):	8.22%
NPV (C$):	823,327
Interest on Bonds:	7.50%
Interest on Subordinated Debt:	12.00%
Equity Opportunity Cost:	20.00%
Initial Revenue Reduction	0.00%

Note: Items highlighted are changes to the Base Case Scenario

Year	Index	Res. Fund Balance	Revenues	Res. Fund Interests	Total Revenues	Finance Charges	Bonds Interests	Bonds Repay.	Sub. Debt Repay.
1997	1	150,000	89,660	9,000	98,660	30,000	112,500	0	22,020
1998	2	83,140	102,643	4,988	107,631	0	112,500	0	22,020
1999	3	55,221	107,775	3,313	111,088	0	112,500	0	22,020
2000	4	30,729	113,164	1,844	115,008	0	112,500	0	22,020
2001	5	10,124	118,822	607	119,430	0	112,500	0	22,020
2002	6	-6,092	124,763	-366	124,398	0	112,500	0	22,020
2003	7	-17,374	131,001	-1,042	129,959	0	112,500	0	22,020
2004	8	-23,129	137,551	-1,388	136,164	0	112,500	0	22,020
2005	9	-22,715	144,429	-1,363	143,066	0	112,500	0	22,020
2006	10	-15,436	151,650	-926	150,724	0	112,500	0	22,020
2007	11	-536	159,233	-32	159,201	0	112,500	0	22,020
2008	12	22,801	167,195	1,368	168,563	0	112,500	0	22,020
2009	13	55,459	175,554	3,328	178,882	0	112,500	0	22,020
2010	14	98,395	184,332	5,904	190,236	0	112,500	0	22,020
2011	15	152,643	193,549	9,159	202,707	0	112,500	0	22,020
2012	16	219,317	203,226	13,159	216,385	0	112,500	0	0
2013	17	321,645	213,387	19,299	232,686	0	112,500	0	0
2014	18	440,226	224,057	26,414	250,470	0	112,500	0	0
2015	19	576,543	235,260	34,593	269,852	0	112,500	0	0
2016	20	732,193	247,023	43,932	290,954	0	112,500	150,000	0
2017	21	758,894	259,374	45,534	304,907	0	101,250	150,000	0
2018	22	810,745	272,342	48,645	320,987	0	90,000	150,000	0
2019	23	889,872	285,960	53,392	339,352	0	78,750	150,000	0
2020	24	998,558	300,258	59,913	360,171	0	67,500	150,000	0
2021	25	1,139,255	315,270	68,355	383,626	0	56,250	150,000	0
2022	26	1,314,598	331,034	78,876	409,910	0	45,000	150,000	0
2023	27	1,527,414	347,586	91,645	439,230	0	33,750	150,000	0
2024	28	1,780,738	364,965	106,844	471,809	0	22,500	150,000	0
2025	29	2,077,826	383,213	124,670	507,883	0	11,250	150,000	0
2026	30	2,422,171	402,374	145,330	547,704	0	0	0	0
2027	31	2,967,518	422,493	178,051	600,544	0	0	0	0
2028	32	3,565,635	443,617	213,938	657,555	0	0	0	0
2029	33	4,220,690	465,798	253,241	719,039	0	0	0	0
2030	34	4,937,154	489,088	296,229	785,317	0	0	0	0
2031	35	5,719,819	513,542	343,189	856,731	0	0	0	0

cont.

THE CANADA CONFEDERATION BRIDGE PROJECT

Take Out Stage Financial Sensitivity Analysis - Scenario #1

Year	Index	Debt Service	O&M	Cash For Debt. Serv.	Cover. Ratio	Net Revenues	N.P.V. Cash Flow	Cumulative N.P.V.
1997	1	134,520	1,000	217,660	1.62	-66,860	201,121	201,121
1998	2	134,520	1,030	189,741	1.41	-27,919	-23,837	177,284
1999	3	134,520	1,061	165,249	1.23	-24,492	-19,323	157,962
2000	4	134,520	1,093	144,644	1.08	-20,605	-15,021	142,941
2001	5	134,520	1,126	128,428	0.95	-16,216	-10,923	132,018
2002	6	134,520	1,159	117,146	0.87	-11,282	-7,022	124,996
2003	7	134,520	1,194	111,391	0.83	-5,755	-3,310	121,686
2004	8	134,520	1,230	111,805	0.83	414	220	121,906
2005	9	134,520	1,267	119,084	0.89	7,279	3,574	125,480
2006	10	134,520	1,305	133,984	1.00	14,900	6,760	132,241
2007	11	134,520	1,344	157,321	1.17	23,337	9,784	142,025
2008	12	134,520	1,384	189,979	1.41	32,658	12,652	154,677
2009	13	134,520	1,426	232,915	1.73	42,936	15,370	170,046
2010	14	134,520	1,469	287,163	2.13	54,247	17,943	187,989
2011	15	134,520	1,513	353,837	2.63	66,675	20,378	208,367
2012	16	112,500	1,558	434,145	3.86	102,327	28,898	237,265
2013	17	112,500	1,605	552,726	4.91	118,581	30,944	268,209
2014	18	112,500	1,653	689,043	6.12	136,318	32,869	301,078
2015	19	112,500	1,702	844,693	7.51	155,650	34,679	335,757
2016	20	262,500	1,754	1,021,394	3.89	26,701	5,497	341,254
2017	21	251,250	1,806	1,061,995	4.23	51,851	9,864	351,118
2018	22	240,000	1,860	1,129,872	4.71	79,127	13,909	365,026
2019	23	228,750	1,916	1,227,308	5.37	108,686	17,653	382,679
2020	24	217,500	1,974	1,356,755	6.24	140,697	21,116	403,795
2021	25	206,250	2,033	1,520,848	7.37	175,343	24,316	428,110
2022	26	195,000	2,094	1,722,414	8.83	212,816	27,270	455,380
2023	27	183,750	2,157	1,964,488	10.69	253,324	29,994	485,374
2024	28	172,500	2,221	2,250,326	13.05	297,088	32,503	517,877
2025	29	161,250	2,288	2,583,421	16.02	344,345	34,810	552,687
2026	30	0	2,357	2,967,518	N/A	545,347	50,941	603,628
2027	31	0	2,427	3,565,635	N/A	598,116	51,625	655,253
2028	32	0	2,500	4,220,690	N/A	655,055	52,244	707,497
2029	33	0	2,575	4,937,154	N/A	716,464	52,800	760,297
2030	34	0	2,652	5,719,819	N/A	782,665	53,296	813,592
2031	35	0	2,732	6,573,818	N/A	854,000	53,734	867,327

Table 8.8.2 Take Out Stage Financial Sensitivity Analysis - Scenario #2

THE CANADA CONFEDERATION BRIDGE PROJECT

Discount Rate (WACC):	7.78%
NPV (C$):	873,901
Interest on Bonds:	7.00%
Interest on Subordinated Debt:	12.00%
Equity Opportunity Cost:	20.00%
Initial Revenue Reduction	5.00%

Note: Items highlighted are changes to the Base Case Scenario

Year	Index	Res. Fund Balance	Revenues	Res. Fund Interests	Total Revenues	Finance Charges	Bonds Interests	Bonds Repay.	Sub. Debt Repay.
1997	1	150,000	85,177	9,000	94,177	30,000	105,000	0	22,020
1998	2	86,157	97,511	5,169	102,680	0	105,000	0	22,020
1999	3	60,787	102,386	3,647	106,034	0	105,000	0	22,020
2000	4	38,740	107,506	2,324	109,830	0	105,000	0	22,020
2001	5	20,457	112,881	1,227	114,108	0	105,000	0	22,020
2002	6	6,420	118,525	385	118,910	0	105,000	0	22,020
2003	7	-2,849	124,451	-171	124,280	0	105,000	0	22,020
2004	8	-6,782	130,674	-407	130,267	0	105,000	0	22,020
2005	9	-4,765	137,208	-286	136,922	0	105,000	0	22,020
2006	10	3,870	144,068	232	144,300	0	105,000	0	22,020
2007	11	19,845	151,271	1,191	152,462	0	105,000	0	22,020
2008	12	43,943	158,835	2,637	161,471	0	105,000	0	22,020
2009	13	77,010	166,777	4,621	171,397	0	105,000	0	22,020
2010	14	119,962	175,115	7,198	182,313	0	105,000	0	22,020
2011	15	173,786	183,871	10,427	194,298	0	105,000	0	22,020
2012	16	239,552	193,065	14,373	207,438	0	105,000	0	0
2013	17	340,432	202,718	20,426	223,144	0	105,000	0	0
2014	18	456,971	212,854	27,418	240,272	0	105,000	0	0
2015	19	590,591	223,497	35,435	258,932	0	105,000	0	0
2016	20	742,821	234,671	44,569	279,241	0	105,000	150,000	0
2017	21	765,308	246,405	45,918	292,324	0	94,500	150,000	0
2018	22	811,325	258,725	48,680	307,405	0	84,000	150,000	0
2019	23	882,870	271,662	52,972	324,634	0	73,500	150,000	0
2020	24	982,087	285,245	58,925	344,170	0	63,000	150,000	0
2021	25	1,111,284	299,507	66,677	366,184	0	52,500	150,000	0
2022	26	1,272,935	314,482	76,376	390,858	0	42,000	150,000	0
2023	27	1,469,699	330,206	88,182	418,388	0	31,500	150,000	0
2024	28	1,704,431	346,717	102,266	448,983	0	21,000	150,000	0
2025	29	1,980,192	364,052	118,812	482,864	0	10,500	150,000	0
2026	30	2,300,268	382,255	138,016	520,271	0	0	0	0
2027	31	2,818,183	401,368	169,091	570,459	0	0	0	0
2028	32	3,386,215	421,436	203,173	624,609	0	0	0	0
2029	33	4,008,324	442,508	240,499	683,008	0	0	0	0
2030	34	4,688,756	464,633	281,325	745,959	0	0	0	0
2031	35	5,432,063	487,865	325,924	813,789	0	0	0	0

THE CANADA CONFEDERATION BRIDGE PROJECT

Take Out Stage Financial Sensitivity Analysis - Scenario #2

Year	Index	Debt Service	O&M	Cash For Debt. Serv.	Cover. Ratio	Net Revenues	N.P.V. Cash Flow	Cumulative N.P.V.
1997	1	127,020	1,000	213,177	1.68	-63,843	197,788	197,788
1998	2	127,020	1,030	187,807	1.48	-25,370	-21,839	175,949
1999	3	127,020	1,061	165,760	1.30	-22,047	-17,609	158,340
2000	4	127,020	1,093	147,477	1.16	-18,283	-13,548	144,792
2001	5	127,020	1,126	133,440	1.05	-14,037	-9,651	135,141
2002	6	127,020	1,159	124,171	0.98	-9,269	-5,913	129,228
2003	7	127,020	1,194	120,238	0.95	-3,934	-2,328	126,900
2004	8	127,020	1,230	122,255	0.96	2,017	1,108	128,007
2005	9	127,020	1,267	130,890	1.03	8,635	4,399	132,407
2006	10	127,020	1,305	146,865	1.16	15,975	7,552	139,959
2007	11	127,020	1,344	170,963	1.35	24,098	10,569	150,528
2008	12	127,020	1,384	204,030	1.61	33,067	13,456	163,984
2009	13	127,020	1,426	246,982	1.94	42,951	16,217	180,201
2010	14	127,020	1,469	300,806	2.37	53,825	18,855	199,056
2011	15	127,020	1,513	366,572	2.89	65,766	21,375	220,431
2012	16	105,000	1,558	445,432	4.24	100,880	30,421	250,851
2013	17	105,000	1,605	561,971	5.35	116,539	32,606	283,457
2014	18	105,000	1,653	695,591	6.62	133,619	34,686	318,143
2015	19	105,000	1,702	847,821	8.07	152,230	36,664	354,807
2016	20	255,000	1,754	1,020,308	4.00	22,487	5,025	359,832
2017	21	244,500	1,806	1,055,825	4.32	46,017	9,541	369,373
2018	22	234,000	1,860	1,116,870	4.77	71,545	13,763	383,136
2019	23	223,500	1,916	1,205,587	5.39	99,218	17,708	400,844
2020	24	213,000	1,974	1,324,284	6.22	129,196	21,394	422,238
2021	25	202,500	2,033	1,475,435	7.29	161,651	24,836	447,074
2022	26	192,000	2,094	1,661,699	8.65	196,765	28,049	475,123
2023	27	181,500	2,157	1,885,931	10.39	234,732	31,045	506,168
2024	28	171,000	2,221	2,151,192	12.58	275,761	33,839	540,007
2025	29	160,500	2,288	2,460,768	15.33	320,076	36,442	576,449
2026	30	0	2,357	2,818,183	N/A	517,915	54,710	631,159
2027	31	0	2,427	3,386,215	N/A	568,032	55,672	686,831
2028	32	0	2,500	4,008,324	N/A	622,109	56,571	743,402
2029	33	0	2,575	4,688,756	N/A	680,432	57,408	800,810
2030	34	0	2,652	5,432,063	N/A	743,307	58,186	858,995
2031	35	0	2,732	6,243,120	N/A	811,057	58,906	917,901

Table 8.8.3 Take Out Stage Sensitivity Analysis - Scenario #3

THE CANADA CONFEDERATION BRIDGE PROJECT

Discount Rate:	8.90%
NPV (C$):	627,959
Interest on Bonds:	8.25%
Interest on Subordinated Debt:	12.00%
Equity Opportunity Cost:	25.00%

Note: Items highlighted are changes to the Base Case Scenario

Year	Index	Res. Fund Balance	Revenues	Res. Fund Interests	Total Revenues	Finance Charges	Bonds Interests	Bonds Repay.	Sub. Debt Repay.
1997	1	456,000	89,660	27,360	117,020	30,000	148,995	0	22,020
1998	2	371,005	102,643	22,260	124,903	0	148,995	0	22,020
1999	3	323,863	107,775	19,432	127,207	0	148,995	0	22,020
2000	4	278,994	113,164	16,740	129,904	0	148,995	0	22,020
2001	5	236,790	118,822	14,207	133,030	0	148,995	0	22,020
2002	6	197,679	124,763	11,861	136,624	0	148,995	0	22,020
2003	7	162,129	131,001	9,728	140,729	0	148,995	0	22,020
2004	8	130,649	137,551	7,839	145,390	0	148,995	0	22,020
2005	9	103,794	144,429	6,228	150,657	0	148,995	0	22,020
2006	10	82,169	151,650	4,930	156,581	0	148,995	0	22,020
2007	11	66,430	159,233	3,986	163,219	0	148,995	0	22,020
2008	12	57,290	167,195	3,437	170,632	0	148,995	0	22,020
2009	13	55,523	175,554	3,331	178,886	0	148,995	0	22,020
2010	14	61,968	184,332	3,718	188,050	0	148,995	0	22,020
2011	15	77,534	193,549	4,652	198,201	0	148,995	0	22,020
2012	16	103,208	203,226	6,192	209,419	0	148,995	0	0
2013	17	162,073	213,387	9,724	223,112	0	148,995	0	0
2014	18	234,585	224,057	14,075	238,132	0	148,995	0	0
2015	19	322,069	235,260	19,324	254,584	0	148,995	0	0
2016	20	425,956	247,023	25,557	272,580	0	148,995	180,600	0
2017	21	367,187	259,374	22,031	281,405	0	134,096	180,600	0
2018	22	332,091	272,342	19,925	292,268	0	119,196	180,600	0
2019	23	322,702	285,960	19,362	305,322	0	104,297	180,600	0
2020	24	341,211	300,258	20,473	320,730	0	89,397	180,600	0
2021	25	389,971	315,270	23,398	338,669	0	74,498	180,600	0
2022	26	471,509	331,034	28,291	359,324	0	59,598	180,600	0
2023	27	588,542	347,586	35,313	382,898	0	44,699	180,600	0
2024	28	743,985	364,965	44,639	409,604	0	29,799	180,600	0
2025	29	940,969	383,213	56,458	439,671	0	14,900	180,600	0
2026	30	1,182,853	402,374	70,971	473,345	0	0	0	0
2027	31	1,653,841	422,493	99,230	521,723	0	0	0	0
2028	32	2,173,137	443,617	130,388	574,005	0	0	0	0
2029	33	2,744,642	465,798	164,679	630,477	0	0	0	0
2030	34	3,372,543	489,088	202,353	691,440	0	0	0	0
2031	35	4,061,332	513,542	243,680	757,222	0	0	0	0

cont.

THE CANADA CONFEDERATION BRIDGE PROJECT

Take Out Stage Financial Sensitivity Analysis - Scenario #3

Year	Index	Debt Service	O&M	Cash For Debt. Serv.	Cover. Ratio	Net Revenues	N.P.V. Cash Flow	Cumulative N.P.V.
1997	1	171,015	1,000	542,020	3.17	-84,995	497,724	497,724
1998	2	171,015	1,030	494,878	2.89	-47,142	-39,751	457,973
1999	3	171,015	1,061	450,009	2.63	-44,869	-34,743	423,230
2000	4	171,015	1,093	407,805	2.38	-42,204	-30,009	393,221
2001	5	171,015	1,126	368,694	2.16	-39,111	-25,537	367,684
2002	6	171,015	1,159	333,144	1.95	-35,550	-21,315	346,369
2003	7	171,015	1,194	301,664	1.76	-31,480	-17,332	329,038
2004	8	171,015	1,230	274,809	1.61	-26,855	-13,577	315,461
2005	9	171,015	1,267	253,184	1.48	-21,625	-10,040	305,421
2006	10	171,015	1,305	237,445	1.39	-15,739	-6,710	298,711
2007	11	171,015	1,344	228,305	1.34	-9,140	-3,578	295,133
2008	12	171,015	1,384	226,538	1.32	-1,767	-635	294,498
2009	13	171,015	1,426	232,983	1.36	6,445	2,128	296,625
2010	14	171,015	1,469	248,549	1.45	15,567	4,719	301,344
2011	15	171,015	1,513	274,223	1.60	25,673	7,146	308,490
2012	16	148,995	1,558	311,068	2.09	58,866	15,046	323,536
2013	17	148,995	1,605	383,580	2.57	72,512	17,020	340,556
2014	18	148,995	1,653	471,064	3.16	87,484	18,856	359,412
2015	19	148,995	1,702	574,951	3.86	103,886	20,561	379,973
2016	20	329,595	1,754	696,782	2.11	-58,769	-10,681	369,292
2017	21	314,696	1,806	646,786	2.06	-35,097	-5,857	363,435
2018	22	299,796	1,860	622,498	2.08	-9,388	-1,439	361,996
2019	23	284,897	1,916	626,108	2.20	18,509	2,605	364,601
2020	24	269,997	1,974	659,968	2.44	48,760	6,301	370,902
2021	25	255,098	2,033	726,607	2.85	81,538	9,676	380,578
2022	26	240,198	2,094	828,740	3.45	117,033	12,753	393,331
2023	27	225,299	2,157	969,284	4.30	155,443	15,554	408,885
2024	28	210,399	2,221	1,151,368	5.47	196,984	18,100	426,985
2025	29	195,500	2,288	1,378,352	7.05	241,884	20,409	447,394
2026	30	0	2,357	1,653,841	N/A	470,988	36,493	483,887
2027	31	0	2,427	2,173,137	N/A	519,296	36,947	520,834
2028	32	0	2,500	2,744,642	N/A	571,505	37,339	558,173
2029	33	0	2,575	3,372,543	N/A	627,901	37,671	595,843
2030	34	0	2,652	4,061,332	N/A	688,788	37,946	633,790
2031	35	0	2,732	4,815,822	N/A	754,490	38,169	671,959

Table 8.8.3 demonstrates that by restructuring the capital structure of the investment so as to permit a higher initial balance of the reserve fund, the project can still service its short term debt even under a higher interest rate on bonds and a higher equity opportunity cost.

8.9 Remarks and Conclusions

After applying the proposed financial modeling methodology to the Canada Confederation Bridge case study, it is evident that this project constituted a very attractive business proposition to the prospective private sector consortia interested in sponsoring this BOT venture. Not only did the well-planned and transparent procurement strategy implemented in this project facilitate its economic analysis, but also the guaranteed annual payments by the government enhanced the financial viability of this undertaking.

In addition to being an excellent investment for the private sponsors, the Canada Confederation Bridge Project was also a sound business decision from a public sector perspective. Quantitatively, this is best appraised when we compare the present value life cycle cost (PVLCC) of the bridge option versus the one corresponding to continuing the existing ferry operations.

- ***PVLCC – Bridge Option***

  Analysis Period = 100 yrs. = Bridge Design Life

  Discount Factor = 7%

  Annual Subsidy (C$1997) = 48,690,000 Growing (G) @ 3% per year

$$PVLCC_{Bridge} = \text{PV of Bridge Toll Earnings after Concession Period} - \text{PV of Annual Subsidy Payments During Concession Period}$$

Concession Period = 35 yrs.

Bridge Toll Earnings at End of Concession (C$) = 409,996; Growing (G) @ 5% per year (from Table 8.3.1)

$$\text{PV of Bridge Toll Earnings after Concession Period} = \underbrace{(P/F, i = 7\%, n = 35)}_{\text{from PV Tables} = 0.0937} * (409{,}996) * \underbrace{(P/G = 5\%, i = 7\%, n = 65)}_{\text{from PV Tables} = 35.3334}$$

$$\text{PV of Bridge Toll Earnings after Concession Period} = C\$1{,}357{,}390$$

$$\text{PV of Annual Subsidy Payments During Concession Period} = -48{,}690{,}000 * \underbrace{(P/G = 3\%, i = 7\%, n = 35)}_{\text{from PV Tables} = 18.9600}$$

$$\text{PV of Annual Subsidy Payments During Concession Period} = -C\$923{,}162{,}400$$

$PVLCC_{Bridge} = 1,357,390 - 923,162,400 = -C\$921,805,010$

- ***PVLCC – Ferry Option***

Annual Subsidy (C$1992) = 42,000,000 Growing (G) @ 3.6% per year

Equivalent Annual Subsidy (C$1997) = $42,000,000 * (1.036)^5 = 50,124,270$

$$PVLCC_{Ferry} = -50{,}124{,}270 * \underbrace{(P/G = 3.6\%, i = 7\%, n = 100)}_{\text{From PV Tables} = 28.2473}$$

$PVLCC_{Ferry} = -C\$1,415,875,292$

- ***Money Saved by the Government of Canada (MSGC)***

  $MSGC = PVLCC_{Ferry} - PVLCC_{Bridge}$

  $MSGC = 1{,}415{,}875{,}292 - 921{,}805{,}010 = C\$494{,}070{,}282$

From the financial analyses included in this chapter, we can conclude that the Canada Confederation Bridge Project was in effect a "win-win" situation for the private and public sectors. While the investment has a net present value of approximately C$1.1 Billion (Refer to Table 8.7.1), the government will save C$500,000 by substituting the ferry system with the fixed link.

Although the modeling methodology applied in this case study is performed from the private sponsors perspective, it could also be employed by the host government promoting the BOT venture to gain more insight into the financial underpinning of the project. By going through the financial modeling process, the government will improve its understanding of the viability of the BOT project investment, and will be in a better position to manage and negotiate the final concession agreement.

Chapter 9

Mini Case Studies from the United States

9.1 Introduction

This chapter contains four case studies of recent infrastructure projects in the United States developed by the private sector. Instead of applying the proposed financial engineering framework to each of the four projects, the idea is to identify and discuss some of the most important issues affecting the financial viability of BOT infrastructure projects in the U.S. By analyzing the lessons learned from each case study, the overall objective is to establish key success factors for BOT projects.

The four case studies presented are very different from one another in terms of their scope of work and in light of the political, legal and economic environment underlying each project. The first one is an independent power plant developed in Florida, the second and third constitute the first two BOT transportation projects in the U.S. in over one hundred years, and the final case is the construction of the new international passengers terminal at the John F. Kennedy International Airport in New York City.

The information for these case studies has been assembled from a number of sources including publications, projects' request for proposals, MIT Department of Civil and Environmental Engineering class notes, and case studies of the MIT Infrastructure Development Systems developed by various research assistants under the supervision of Professor John B. Miller.

9.2 The Indiantown Cogeneration Project

The Indiantown Cogeneration Project is an excellent example of how the implementation of sound financial engineering, in combination with various key project attributes, are instrumental in successfully arranging a non-recourse financing strategy for a major privately developed infrastructure facility in the public securities markets.[60]

Based on the sponsors' excellent reputation, the project's high quality revenue stream and the host government's support, the financial analysis-design tasks resulted in an efficient allocation of risks. This optimal risk distribution was the basis for strong contractual agreements, which in turn proved to be crucial in obtaining an investment-grade rating by both, Moody's Investors Service and Standard & Poors, for the project.

Since the Indiantown Cogeneration Facility is owned by the private sector and will not be transferred to the government at the end of a pre-determined concession period, the delivery-finance strategy employed in this project does not conform with the BOT model. Nevertheless, the fact that the economic and financial feasibilities are dependent on a 30-year power purchase agreement with the public sector (a franchise period for all practical purposes), makes this venture an interesting and relevant case study.

Project Overview

The Indiantown Cogeneration Project consists of the private development and operation of a coal-fired cogeneration facility, with an electric net generating capacity of

[60] Note: This case study is based on John D. Finnerty's *Project Financing, Asset Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, Chapter 11.

330 megawatts (MW) and a steam export capability of 175,000 pounds per hour. The Indiantown power plant is located in southwestern Martin County, Florida.

The capital development of the facility was implemented following a turnkey contract that included the design, construction, procurement of equipment and materials, start-up and testing services. Construction costs were $438.7-Million, and the approximate schedules for substantial and final completions were 3-year and 4-year, respectively. The total capital costs for the project amounted to $770-Million, including the financing expenses (Refer to Table 9.2.1).

CAPITAL COSTS	
Engineering, Procurement, and Construction Costs	$438,730
Electrical, Potable Water and Sewer Interconnection	6,850
Property Acquisition Costs	8,811
Steam Host Modifications	14,500
Development Costs and Fees	30,442
Mobilization and Spare Parts	10,618
General & Administrative Costs and Fees	13,057
Taxes	8,827
Start-up Consumables	3,584
Initial Working Capital	3,450
Fuel Reserve	5,000
Title Insurance	3,187
Other Construction-Related Costs	4,223
Owners' Contingency	37,000
TOTAL CAPITAL COST	$588,279

Source: Indiantown Cogeneration, L.P./Indiantown Cogeneration Funding Corporation, *Prospectus for $505,000,000 First Mortgage Bonds* (November 9, 1994), p. 53.

Table 9.2.1: Capital Costs for the Indiantown Cogeneration Project[61]

From an operation and revenue perspective, the Indiantown Cogeneration facility was primarily developed to sell electric power to Florida Power & Light Company (a government utility), in accordance to a 30-year power purchase agreement. In addition,

[61] John D. Finnerty, *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 206.

the new power plant would provide steam to Caulkins Indiantown Citrus Company (a citrus juice processing private enterprise) under a 15-year energy services agreement.

The project's overall design was in accordance to sound electrical utilities engineering codes, standards and practices. Its power and thermal generation processes were based on conventional and commercially proven coal technology.

Principal Stakeholders

The Indiantown Cogeneration Project was a joint venture between Pacific Gas and Electric Company, Bechtel Enterprises, Inc. and General Electric Capital Corp. The project company, Indiantown Cogeneration L.P., was registered in Delaware in October of 1991 following the limited partnership form of organization (Refer to Section 6.4). As shown in Figure 9.2.1, a simplified ownership structure diagram for the project, the general partners were Bechtel Enterprises and Pacific Gas with General Electric Capital as the limited partner.

Bechtel Enterprises is part of the engineering and construction mogul Bechtel Group, Inc. (1997 Revenues: $11.3-Billion) and engages in the development, financing and ownership of large capital projects. Since its establishment in the early 1980's, Bechtel Enterprises has become a recognized leader in its industry, with expertise in the financing and development of independent power generation, transportation, pipelines and water system facilities. Since 1990, it has structured, through its subsidiaries and joint companies, over $12-Billion in project financings. In terms of its ownership and operation interests, Bechtel Enterprises has invested in over 34 projects with a total asset value exceeding $11-Billion.

Pacific Gas and Electric Company is a wholly owned subsidiary of PG & E Corporation (1997 Revenues: $15.4-Billion), and participates in the transmission and delivery of energy (natural gas and electric service). Pacific Gas and Electric is the second largest public utility in the U.S., servicing 4.5-Million electric customers and 3.7-Million gas customers in California.

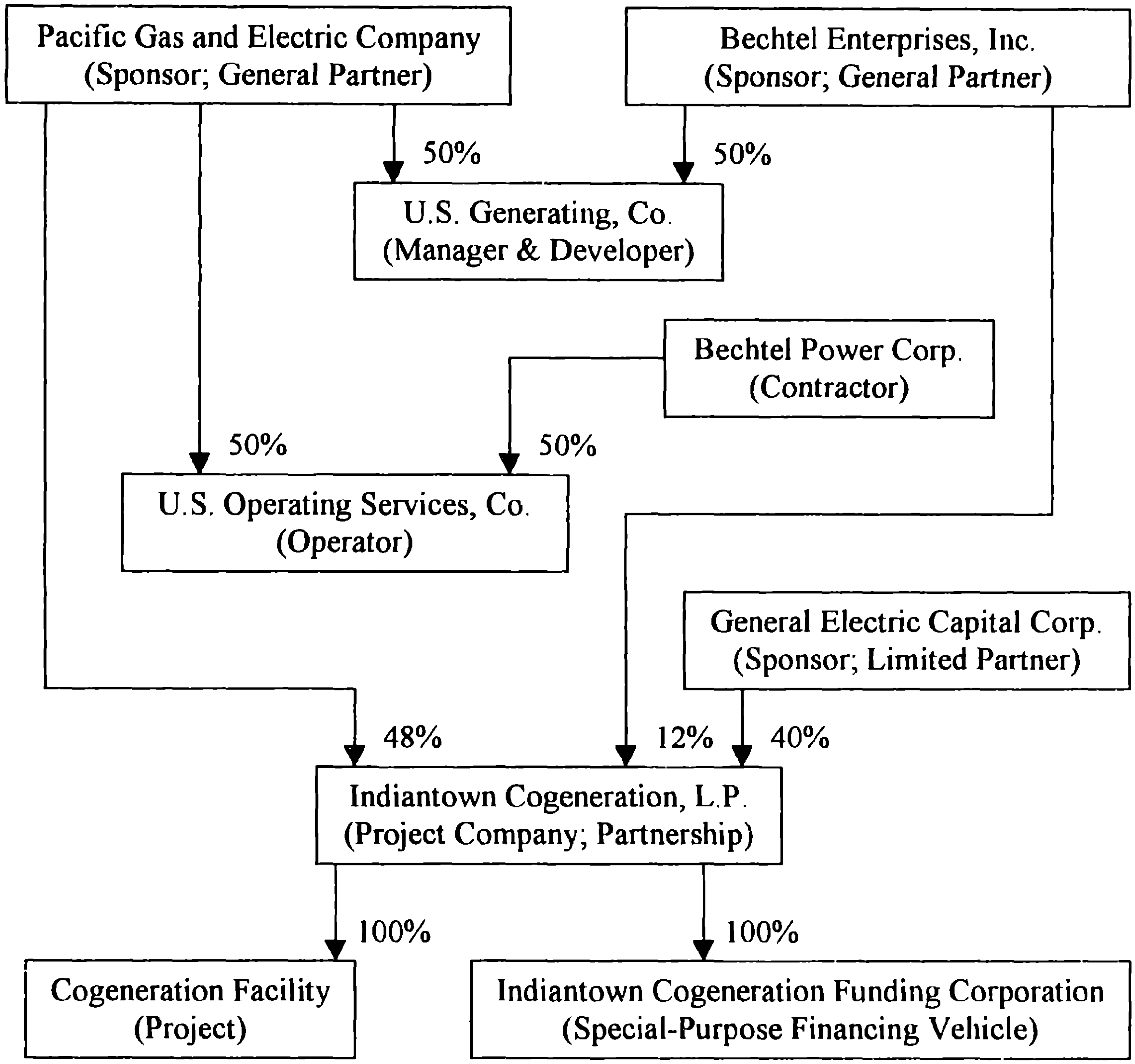

Figure 9.2.1: Simplified Ownership Structure – Florida Indiantown Cogeneration Project

General Electric Capital Corporation is a subsidiary of General Electric (1997 Revenues: $33.4-Billion) and offers comprehensive financial and insurance services worldwide. Through expertise in personal, business, industrial, consumer and project financing, General Electric Capital has a strong potential for positioning itself as a major provider of financial engineering services for the emerging U.S. BOT infrastructure projects' market.

The Indiantown Cogeneration Project was developed on behalf of Indiantown Cogeneration L.P. (the project company) by U.S. Generating Co., a California general partnership founded in 1989. U.S. Generating Co. is equally owned by Bechtel Enterprises and Pacific Gas. In addition to the development, U.S. Generating Co. is in charge of the overall management of the Indiantown Cogeneration Facility. By 1994, U.S. Generating Co. was involved in 14 independent power projects with an aggregate generating capacity of over 2,500 MW.

The project's contractor was Bechtel Power Corporation, a leading provider of engineering and construction services for the power generation market segment. In the last 40 years, Bechtel Power has been involved in power projects with a combined total electric generating capacity exceeding 50,000 MW. In connection to the Indiantown Project, Bechtel Power established early contractual relationships with two key subcontractors. Foster Wheeler supplied the coal-fired steam generator as well as the auxiliary equipment, and General Electric Company furnished the turbine generator. Also, Bechtel Power is 50% co-owner, with Pacific Gas as the other 50% owner, of U.S. Operating Services Co.

As with U.S. Generating Co., U.S. Operating Services, Co. is a California General Partnership, and was founded to provide operating and maintenance services for electrical power generating facilities. In addition to the Indiantown project, by 1994 U.S.

Generating Co. was responsible for the operations and maintenance of five other independent power plants.

The Indiantown Cogeneration Funding Corporation is a special-purpose corporate financing vehicle owned by the project company, and whose dual purpose is enabling the venture to comply with certain legal investment regulations (i.e. the incapacity of some lenders to purchase financial assets from partnerships), and facilitating the borrowing of funds. The project company is still liable for the debt obligations of the funding corporation.

The cogeneration facility's clients are Florida Power & Light Company and Caulkins Indiantown Citrus Company. Florida Power purchases electric power, in accordance to regulations by the Florida Public Service Commission, and sells it to approximately 6-Million people through an electric grid covering 35 Florida counties. Caulkins, a wholesale citrus juice processor, was founded in 1972 and uses steam to produce citrus concentrate and cattle feed. Since steam is a significant component in Caulkins's citrus juice production process, the relatively low cost steam produced by the Indiantown Cogeneration facility provides them with an important competitive advantage.

Finally, the coal supplier for the Indiantown Cogeneration Facility was Costain Coal, Inc. Costain Coal's selection was based on its adequate coal reserves, production capacity, vast operating knowledge and experience, and overall capabilities to meet the Indiantown project's coal demands. Costain Coal subcontracted the transportation of coal and ash waste to CSX Transportation, Inc. (Refer to Figure 9.2.2).

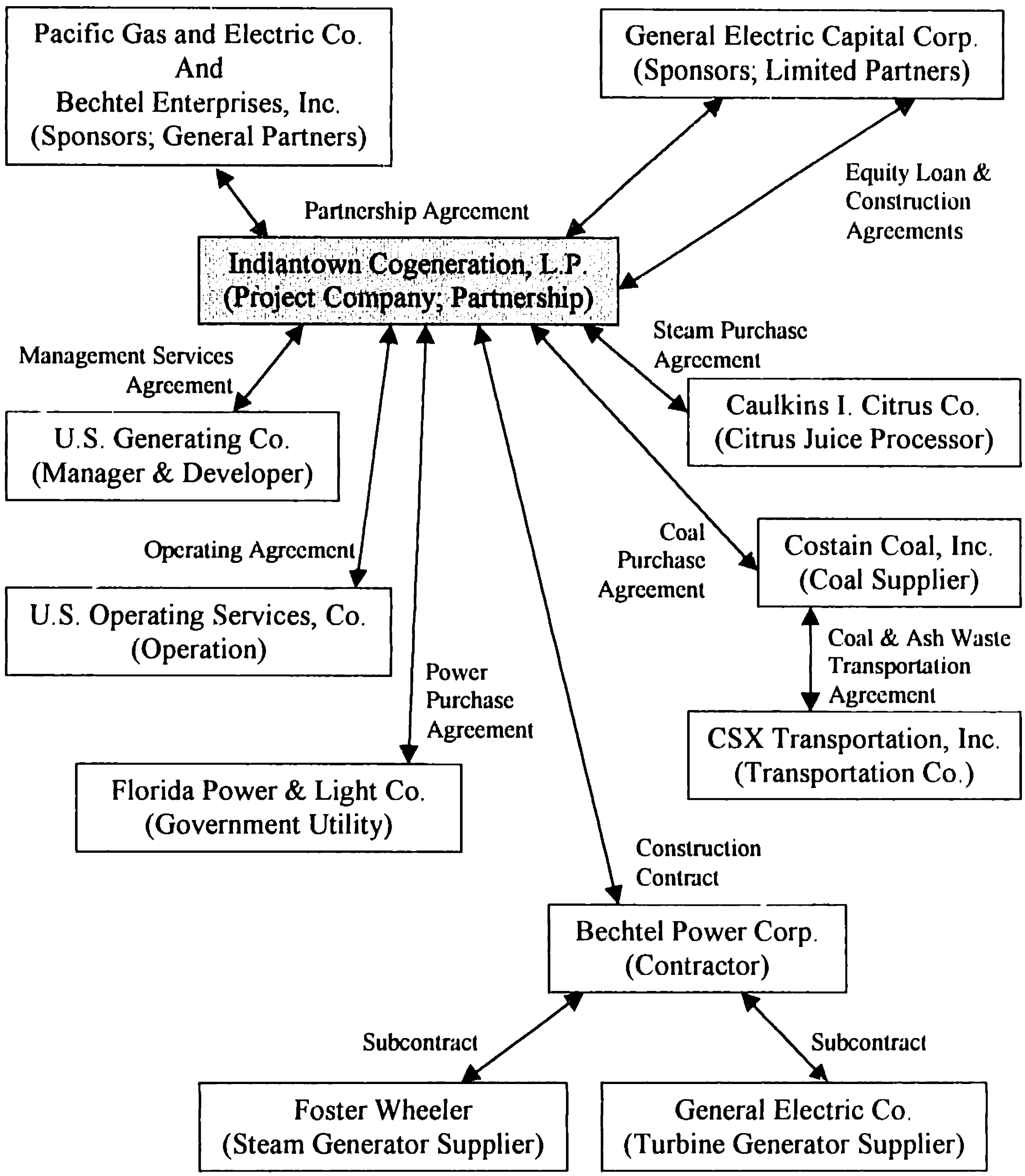

Figure 9.2.2: Principal Contractual Agreements – Florida Indiantown Cogeneration Project

Financial Strategy

The revenue stream for the Indiantown Cogeneration project was contract based rather than market based (Refer to Section 2.3). Because this project's revenue stream is, to a high degree, assured with more or little speculation, the associated business risk is relatively low. The low variance in the expected annual revenues was the consequence of both, the 30-year power purchase agreement with Florida Power & Light Company and the 15-year energy services agreement with Caulkins Indiantown Citrus Company.

Payments from Florida Power to the project company are based on a formula, which consists of the sum of the facility's electrical generating capacity (a fixed amount) and the energy actually dispatched (a variable component). Furthermore, payments corresponding to the energy supplied to Florida Power are to be adjusted for operating insufficiencies resulting from dispatches at less than full load. Although the proceeds from the sale of thermal energy account for less than 1% of the total annual revenues, its importance results from the fact that the supply of steam to Caulkins was a pre-requisite for the Indiantown project to qualify under the Public Utilities Regulatory Act (Refer to the Comments subsection). From a cost control perspective, since the project company secured advanced contractual arrangements with the venture's main suppliers and stakeholders, operating and administrative expenses were accurately estimated and carefully aligned with the facility's revenue profile.

Based on highly stable revenues and on accurately predicted costs, the economic and financial feasibility analyses of the project's cash flows revealed that the undertaking was viable in its base case (expected) scenario as well as in probable "what if" adverse situations. For these reasons, the project's expected revenue stream was considered to be of high quality (i.e. predictable, stable and adequate).

With strong contractual agreements put in place and a high quality revenue stream, the Indiantown Cogeneration Project's initial financing (from September-1992 to June-1994) consisted of $454,721,500 divided as follows:[62]

---

[62] John D. Finnerty, *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996, p. 229.

- $202,621,500 in commercial bank financing advanced by a syndicate of banks
- $113,000,000 in tax-exempt bonds issued by the Martin County Industrial Development Authority
- $139,000,000 in a subordinate loan from GE Capital
- $100,000 in equity contributed by the three partners in proportion to their ownership interests.

Since the debt capital within the initial financing was based on floating interest rates, the project company engaged in various SWAP agreements (Refer to Section 5.6) in order to hedge its financial risk exposure. Although the partnership anticipated refinancing the interim funds with fixed-rate long-term debt by 1994, the SWAP agreements' expiration date was set for 2010, to provide additional protection against interest rate risk exposure resulting from a delay in the take-out financing transaction date.

After refinancing the aforementioned interim funds, the permanent capital structure amounted to a total of $770,010,000. It was comprised of:

- $505,000,000 of first mortgage bonds with various maturity dates issued by Indiantown Cogeneration, L.P. and the Indiantown Cogeneration Funding Corporation to investors in a registered public offering.
- $125,010,000 in 31-year tax-exempt bonds issued by the Martin County Industrial Development Authority
- $140,000,000 in equity contributed by the three partners in proportion to their ownership interests.

In general, mortgage bonds are one type of secured debt in which the repayment of the borrowed funds is guaranteed by providing lenders with first right claims against a specific real estate asset. In the case of the private development of public infrastructure projects, where the ownership title is retained by the private sector, mortgage bonds are almost always secured by all of the project's company property.

The Indiantown first mortgage bonds consisted of ten tranches issued in series at interest rates fluctuating between 7.38% and 9.77% depending on their maturity dates (from 1 to 25-year). Among the protective covenants attached to these bonds were: the limit on the issuance of additional debt, a cap on cash distributions out of the partnership, the appointment of a disbursement agent (trustee), and the establishment of several dedicated cash reserve accounts. In addition to controlling the cash reserve accounts, the disbursement agent was responsible for ensuring the allocation of the project company's cash in accordance to the hierarchy specified in the Bond Indenture Agreement.

The tax-exempt bonds employed at the construction and take-out financings were issued by the Martin County Industrial Development Authority for the benefit of the project. Because of their tax-exempt status, nominal interests on these financial instruments were lower than those of equal maturity first mortgage bonds.

The project company's initial equity consisted mostly of a subordinated loan by the limited partner, General Electric Capital Corp. Finally, when the interim funds were completely refinanced, the subordinated loan was paid off, and each of the sponsors contributed equity in proportion to their ownership interests.

Concluding Comments

Contrary to most privately developed infrastructure projects, where long-term debt providers are reluctant to assume pre-completion risks, the Indiantown Cogeneration Project illustrates that the U.S. public debt market is willing to provide funds, prior to the completion of the construction, for ventures where strong contractual arrangements are in place to support the financing. As noted on Chapter 5, one of the most important aspects of financial engineering involves first identifying all significant project risks. Then, contractual agreements can be structured to allocate the identified risks to the parties best able to control and manage them, at the lowest cost to the project company. (Table 9.2.2 synthesizes the risk distribution pattern and the associated management strategies for the Indiantown Cogeneration Project.)

Risk Identification	Risk Allocation	Risk Management / Comments
Initial Equity Risk	General Electric Capital Corp.	Equity loan agreement and equity contribution agreement
Technological Feasibility	Project Sponsors & Bondholders	Utilization of conventional and commercially proven technology. Bond underwriter performed an independent technology feasibility study.
Design & Performance Errors	Bechtel Power Corp. & Sponsors	Fixed-price turnkey contract with performance bond
Completion Risk	Bechtel Power Corp., Bondholders & Sponsors	Liquidated damages with cap of $100-M; Bonds sold before project completion
Cost Overrun	Bechtel Power Corp.	Fixed-price turnkey contract
Off-Take Risks	Bechtel Power Corp., Florida Power & Light & Caulkins Citrus Co.	Liquidated damages & performance bond, 30-year power purchase agreement, and 15-year energy services agreement
Operational Cost Overruns	U.S. Operating	30-year operating agreement
Supply Risk	Costain Coal, Inc. & CSX Transportation, Inc.	30-year coal purchase agreement and 30-year transportation contract
Interest Rate Construction Stage	Sponsors & SWAP Agreements' Partners	SWAPs agreements
Interest Rate Take-Out Stage	Bondholders	Fixed interest rates

Table 9.2.2: Indiantown Cogeneration Project's Major Risk Distribution and Management Program

The Indiantown Cogeneration Project's first mortgage bonds were successfully sold in the public securities markets as a result of the investment-grade rating awarded by Moody's and Standard & Poors. In addition to the solid risk management program implemented and, consequently, the strength of the contractual arrangements, this high mark from the rating agencies was achieved by:

- The excellent goodwill of each of the project's sponsors (Bechtel Enterprises, General Electric Capital and Pacific Gas and Electric), and their combined experience in the construction, financing and operation of electrical generating facilities.
- The support of the U.S. Government.
- The high quality (adequacy, predictability and stability) of the project's revenue stream.

In terms of the project's public sector support, the government assisted the private sponsors in the development of the Indiantown Cogeneration Facility in two ways. First and most important, by providing the necessary legal structure. By enacting the Public Utilities Regulatory Policy Act (PURPA) in 1978, Congress not only encouraged a more efficient use of traditional fuels to generate electricity, but also required local utility companies to purchase electric output from qualified private power producers under long-term contracts.[63] This is the basis for the assured revenue streams associated with private power projects. Secondly, by loaning funds to the project company from tax-exempt bonds issued during the construction and take-out stages of the project. The benefits of these special financial instruments were twofold: the bonds' lower nominal interest rates reduced the project company's weighted average cost of capital (the investment's hurdle rate), thus augmenting its financial viability, and projected the government's strong commitment to the project's stakeholders and to the capital securities markets.

---

[63] Bradley Lambert, "Construction Contracts for Independent Power Producers," *Construction Business Review*, HLK Global Communications, Inc., January-February 1994, p. 66-69.

Although the Indiantown Cogeneration Project constitutes an interesting financial engineering case study as well as an important benchmark, it is a relatively low-risk endeavor when compared to most private infrastructure projects.

9.3 The Dulles Greenway Project

In contrast to the Indiantown Cogeneration Facility, the Dulles Greenway Project illustrates the overall high risk inherent to BOT infrastructure ventures, where the revenue stream is subject to the market forces rather than being contractually based. For this reason, the private development of transportation projects like the Dulles Greenway Toll Road requires the financial engineer to focus his attention on correctly assessing the quality of their revenue stream and on designing, as well as implementing, innovative techniques to mitigate most of the associated uncertainties (Refer to Section 2.3).

Also, being the first privately developed toll road in the U.S. for over a century, the lack of both prior finance experience and an adequate public legal structure proved to be detrimental to the Dulles Greenway Project (Refer to Chapter 6). Contrary to the Indiantown Cogeneration Project, where the PURPA Act of 1978 laid a solid political foundation for the private development of power generation facilities in the U.S., the Dulles Greenway Project "forced its way through" the traditional segmented and publicly funded transportation projects delivery model. It took seven years of incredible determination by Magalen O. Bryant, the venture's major sponsor, over $70-Million in pre-construction costs, the enactment of a special statute, multiple agencies' approval, over 100 permits, onerous compromises to arrange the right of way, and extensive negotiations, to secure a workable financial structure to start the construction of the Dulles Greenway Project.

It is precisely due to the low quality of the expected revenues, the absence of an enabling legislation, and the lack of a supportive political framework that the Dulles Greenway Project is an excellent case study in connection to the financial engineering of BOT infrastructure projects. Although in hindsight one might conclude that the financial engineering for this undertaking could have been performed better, the Dulles Greenway Project constitutes a pioneering venture that provides important lessons for the successful private development of transportation projects.

Project Overview

The Dulles Greenway Project consists of a 14-Mile private extension of the existing Dulles Toll Road from the Dulles Airport to the town of Leesburg, in Loudoun County, Virginia.

The project is comprised of a four lane, limited access toll road located within a 250 feet right of way. Among the features included in its design were seven interchanges along its alignment and state-of-the-art toll collection technology that permits the automatic collection of tolls through transpondents installed in cars. With this innovative toll collection system, the commuters drive through the toll booths without stopping, while their accounts are instantaneously debited for the trip. The design also provided for the future construction of two additional interchanges, lanes' expansion and the incorporation of mass transit in its median strip, when traffic volumes reached certain levels.[64]

---

[64] O.P. Agarwall and J. B. Miller, "The Dulles Greenway," *Infrastructure Development Systems IDS-97-T-014*, Massachusetts Institute of Technology, 1997.

The planning of the project commenced in early 1987, after the Virginia Department of Transportation (VDOT) conducted a series of studies and hearings to assess the viability of extending the existing Dulles Toll Road and alleviating the growing congestion of nearby routes. Due to a $7-Billion shortfall in public funding for needed transportation projects, a group of northern Virginia business leaders headed by Mrs. Magalen O. Bryant became interested in the idea of privately developing the extension of the existing Dulles Toll Road.[65] Since the government has relied on a segmented and directly funded strategy for developing transportation projects for the last 100 years, a special legislation was required from the General Assembly of Virginia to transfer the authority of providing the Dulles Toll Road Extension from the VDOT to the private sector. After much deliberation and reluctance from VDOT, the Commonwealth of Virginia passed the bill in 1988 that allowed the private development of the Dulles Toll Road Extension. Although the construction ground-breaking for the California State Road #91 (Refer to Section 9.4), another private toll road venture, was performed two months prior to that of the Dulles Greenway Project, this latter undertaking constituted the first concrete initiative for the private development of transportation projects in the U.S. in over a century.

Under the terms of the legislation, the private sponsors were to design, finance, construct and operate the toll road for 42 ½ years before turning it over to the Government of Virginia. Furthermore, the State could not provide any funding or loan guarantees, nor could it assist in the acquisition of the right-of-way for the road alignment.

---

[65] Charles E. Williams and Suzanne Conrad, "The Return of the Private Toll Road," *Construction Business Review*, American Society of Civil Engineers, January/February 1996, p. 42-46.

In terms of the market demand, ridership forecasts were based on the economic boom of the 1980's, and assuming the start and completion of construction by 1989 and 1992, respectively. Due to extensive negotiations to get the right-of-way under contract, the numerous permits required, and the difficulties in arranging an adequate financial structure, the project's development phase took six years. As a result, the start of construction was delayed four years, from 1989 to 1993. During this period the Washington region entered a major recession, which resulted in commercial and industrial land value depreciation, high double-digit office vacancy rates and a shortfall in real estate financing funds. Despite these obstacles, the Dulles Greenway financial closure took place on September 29, 1993 and construction was completed in two years, six months ahead of the expected schedule.

Principal Stakeholders

The original project company formed to design, finance, construct and operate the Dulles Greenway throughout its 42 ½-year concession was the Toll Road Corporation of Virginia (TRCV). After new investors joined Mrs. Magalen O. Bryant, the primary sponsor of TRCV, a new project company was created under the name of Toll Road Investors Partnership II (TRIP II).

As in the Indiantown Cogeneration case study, the Dulles Greenway project company, TRIP II, was registered following the limited partnership form of organization. Figure 9.3.1 represents a simplified funding structure diagram for the project, which includes the major private stakeholders involved in this endeavor.

As shown in Figure 9.3.1, The Dulles Greenway Project was a joint venture between Shenandoah Greenway Corporation, Auto Strade International and Brown &

Root, Inc. The Shenandoah Corporation is controlled by the Bryant family and was formed to participate in innovative projects that, in addition to their economic attractiveness, were sensitive to the environment. Auto Strade International is an Italian company with a long track record in the operation and maintenance of toll roads in Italy. Finally, Brown & Root, Inc. is a recognized engineering-procurement & construction industry leader in the U.S. and abroad.

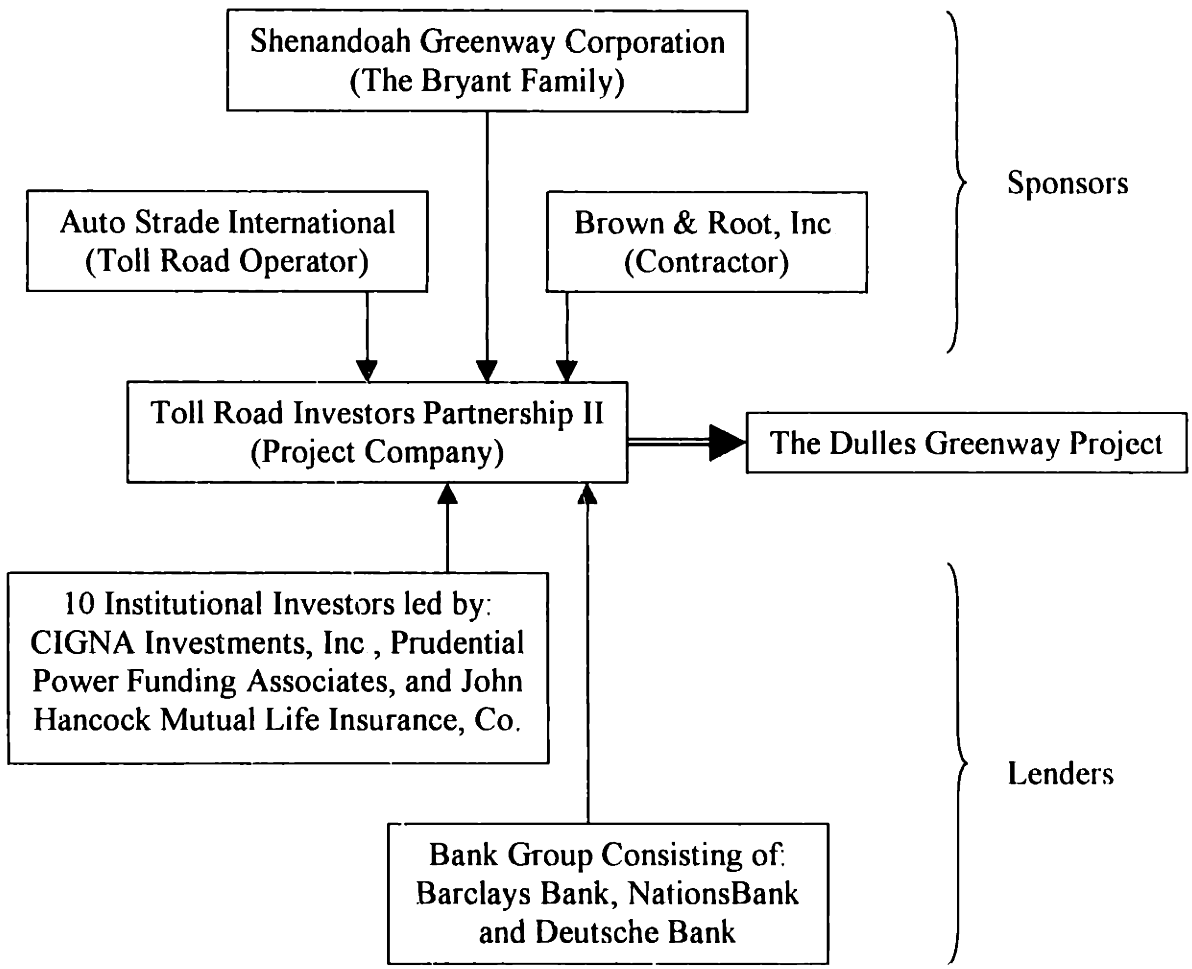

Figure 9.3.1: The Dulles Greenway Funding Structure Diagram

The providers of debt funds for this undertaking were a team of ten institutional investors and a group of three banks. The institutional investors provided approximately 80% of the long-term funds, and were led by CIGNA Investments Incorporated, Prudential Power Funding Associates, and John Hancock Mutual Life Insurance

Company. The bank group facilitated a portion of the construction financing, in addition to a revolving credit facility, and consisted of Barclays Bank, NationsBank and Deutsche Bank.

The public sector parties that had a major stake in this project were the Virginia Department of Transportation (VDOT), the Virginia State Corporation Commission, the Loudoun County, the Town of Leesburg and the Metropolitan Washington Airports Authority. While the VDOT had to approve all of the project's plans and specifications, the Virginia State Corporation was in charge of accepting the franchise as well as the proposed toll rates. The Loudoun County had to issue an amendment that permitted the Dulles Greenway's alignment within the region's Master Plan, and certain agreements regarding construction and operations practices had to be negotiated with the Town of Leesburg. To compound the already bureaucratic nature of this project, the sponsors had to negotiate a $500,000 annual lease with the Metropolitan Washington Airports Authority, since one third of the Dulles Greenway alignment passed through federal property.

Financial Strategy

Being a BOT transportation project, the Dulles Greenway's funding strategy consisted of a non-recourse financing scheme supported by a long-term binding contract with the public sector (in the form of a 42 ½-year concession agreement), and secured mainly by the strength of the anticipated traffic volumes. The project's total cost was estimated at $330-Million. Of this, $258-Million represented the actual design, construction and equipment procurement costs, while the balance included accumulated interest expenses during construction and other development costs.

The aforementioned bank trio provided approximately $114-Million in construction financing plus a $40-Million revolving credit line, to cover any uncertainties that occurred during the construction stage or throughout the operation ramp-up period. The ten institutional investors contributed $258-Million of long-term fixed rate notes with maturity dates between 2022 and 2026.

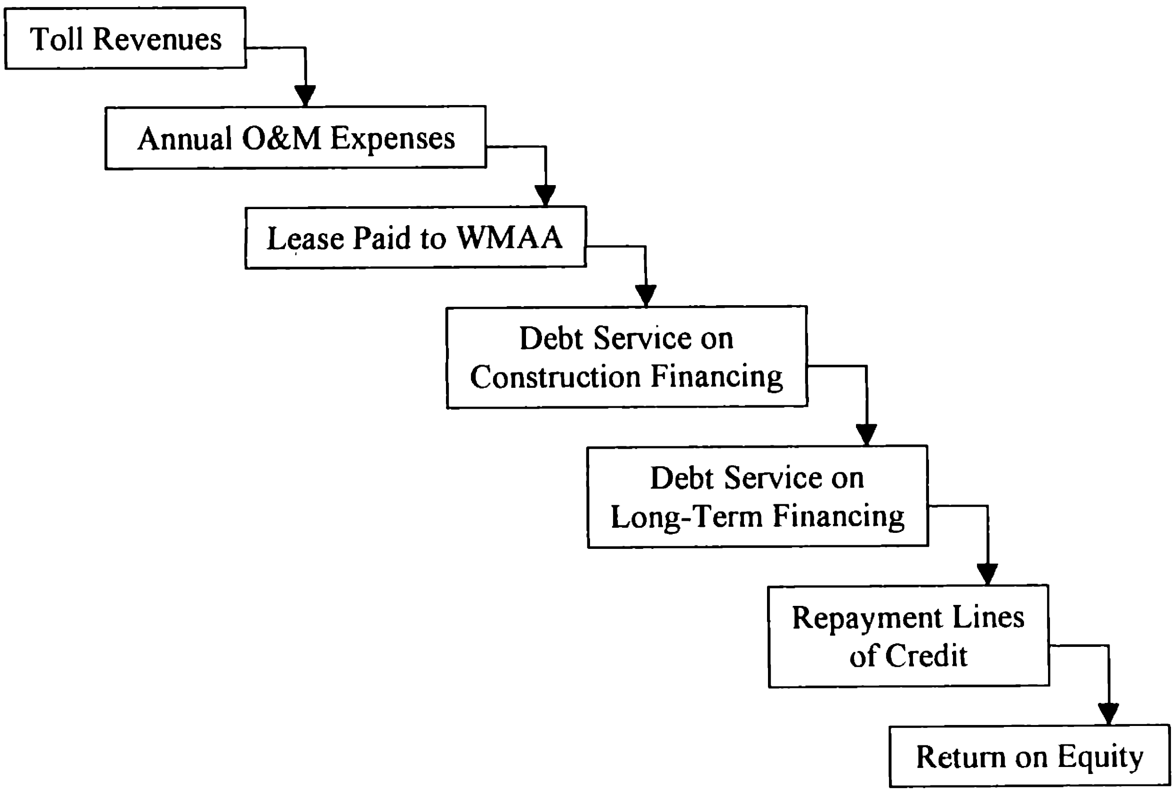

Figure 9.3.2: Payment Priority Flowchart – The Dulles Greenway Project[66]

Equity funds from the three project sponsors amounted to approximately $38-Million. In addition, a $40-Million line of credit was supported by the general partners to complement traffic revenues during the ramp-up period, as well as to assure payment on debt service throughout the first year of the operation stage. The rate of return that the project company was allowed to realize over the 42 ½-year concession was capped at

---

[66] Charles E. Williams and Suzanne Conrad, "The Return of the Private Toll Road," *Construction Business Review*, American Society of Civil Engineers, January/February 1996.

approximately 18%. If the project generated a higher profitability rate, the government would use the excess funds to upgrade the access roads feeding the Dulles Greenway.

Figure 9.3.2 sketches the payment priority structure set in the Dulles Greenway Project. Like most BOT infrastructure developments, the lenders and investors of this project were committed to the venture for its long-term profitability. This is explicitly demonstrated by the fact that payment of operating and maintenance expenses took precedence to both, the construction and take-out financing repayment. Funding a good O & M program not only keeps the facility in optimum shape, but also maximizes its ability to attract more ridership, therefore increasing the generation of toll revenues in the future.[67]

Concluding Comments

Although the Dulles Greenway project constituted a pioneering effort by TRIPP II in privately providing a quality transportation facility, its financial failure to this date is the combined result of the following interrelated factors:

- High revenue risks
- The absence of a solid supportive political system
- The lack of competition for the franchise

Since revenues are market based and not contractually set, there was a high degree of uncertainty in correctly assessing the demand for the existing Dulles road extension as well as the tolls price elasticity.

The high business risk of many toll road projects stems from their inability to compete with adequate publicly subsidized tax-exempt roads. If the proposed

[67] John B. Miller, *America's Emerging Public/Private Infrastructure Strategy: The End of Privatization*, Draft, Massachusetts Institute of Technology, 1997, p.323.

transportation project does not constitute a natural monopoly (like the Confederation Bridge Project; Refer to Chapters 7 and 8), its revenue stream will not have the strength to support the financial burden of this typically highly leveraged venture. In the specific case of the Dulles Greenway Project, at the same time that its construction was being completed, the State of Virginia finished widening Route 7, a competing free access public road.

In addition to the already high business risk of most transportation projects, the traffic volume forecasts of the Dulles Greenway Project were based on the economic boom of the end of the 1980's, and not on the recession that plagued the Washington area at the time of the project's completion. The unanticipated long development stage resulted in a time lag between the proposal submittal and the start of construction, that had a significant negative impact on the project. Not only were ridership studies not based on the deteriorating economic reality, but also non-productive transaction costs increased substantially during this period. This in turn increased the financial burden on the already weak revenue stream.

Unlike the Indiantown Cogeneration Project, where the PURPA legislation created a fertile environment for the private development of independent power plants, the Dulles Greenway Project required a special statute to enable its sponsorship by the private sector. The bureaucracy and plethora of political obstacles encountered by the project company resulted in a four-year start of construction delay. As previously mentioned, this schedule shift forced the toll road to open in the middle of a recession, which caused ridership volumes to be approximately one third of those predicted by the traffic studies. Today, after three years of existence, the Dulles Greenway Toll road is barely covering its operation costs, and has not been able to service its debt. Although TRIP II officials are trying to restructure the project's debt (thus taking advantage of the current lower interest rates), there is a high possibility that lenders could foreclose at any time.

From a procurement standpoint, the fact that the Dulles Greenway concession was based on a sole unsolicited proposal by a private developer did not benefit either the government or the project company. Having been able to compare various proposals would have assured the government that they were getting the best deal, thus protecting the interests of the constituents. Furthermore, the submittal of more than one proposal would have provided everyone with several financial feasibility checks on the project.

In general, the lessons learned from various private sector proposals would have undoubtedly contributed to a fair and win-win final concession agreement negotiation between the government and the selected bidder. For example, by having more than one private entity participating in the public procurement process of this project, would have given the government the flexibility to improve the quality of the Dulles Greenway's expected revenue stream without the appearance of favoritism towards any of the respondents. This could have been attained by integrating the toll collection of the existing Dulles Road with that of the new Dulles Greenway, or by delaying the upgrade to the competing public Route 7 until traffic volumes on the Dulles Greenway had reached certain levels. Likewise, the government could have increased the economic viability of the Dulles Greenway by facilitating the selected respondent with access to tax-exempt financing or by providing funds in the form of subordinated debt. Any of these measures could have been justified in a clear and transparent procurement process, in which more than one private developer participates and submits a serious and responsive proposal.

Notwithstanding its disappointing operation results to this date, the Dulles Greenway Toll Road has provided important lessons for future BOT transportation projects. These positive contributions can be grouped into two broad statements:

- the need for less restrictive legislation enabling the establishment of true public/private partnerships, and
- the importance of engineering the project's financial structure with the venture's expected revenue pattern.

The original 1988 Virginia Statute that commissioned the private development of the Dulles Greenway Project was too limited. In 1995, the Commonwealth of Virginia passed a new bill to encourage the private development of roads and bridges that substantially reduced the red tape associated with these undertakings. Among the major revisions included in the new bill are: the public sector's ability to provide right-of-way, invest in projects, guarantee loans or become a true partner to the private sector in the development of these ventures.[68]

In terms of a better financial engineering, the structuring of the debt repayment schedules should be aligned with the fact that transportation projects are usually designed for long-term service levels and not short-term demands. This implicates that debt payments should follow a ramp-up period as well as grow along with traffic revenues and expenses. Full payments on the initial years of the operation put too much burden on the

---

[68] Charles E. Williams and Suzanne Conrad, "The Return of the Private Toll Road," *Construction Business Review*, American Society of Civil Engineers, January/February 1996, p. 48-51.

project, and will eventually discourage private sponsors from getting involved in these long-term investments.

In synthesis, other things being equal, private transportation projects and other BOT infrastructure ventures that rely on a market based revenue stream present bigger challenges to the financial engineer than those undertakings in which revenues are contractually determined. The economic feasibility of the former kind of BOT infrastructure projects will depend, to a great extent, on the financial engineer's creativity as well as ability to implement innovative mechanisms that will ultimately enhance the quality of the revenue projections.

9.4 The SR91 Express Lanes Project

The California State Road #91 Express Lanes Project demonstrates how the implementation of conscientious financial engineering can lead to good investment decisions and workable financing schemes for transportation projects. By effectively identifying and capitalizing on certain project strengths, the sponsors of the SR91 venture were able to minimize the high business risk associated with most private transportation capital undertakings.

Compared to the Dulles Greenway, the SR91 Express Lanes Project represented a substantially more solid investment. Not only did the SR91 project sponsors implement innovative techniques that contributed to the viability of this venture, but also the Government assumed a very pro-active role in enabling its development. According to Mr. William G. Reinhardt, Editor of *Public Works Financing*, the SR91 Express Lanes

Project represented a true public-private partnership because the Government leaders and the private sponsors were able to:[69]

- share risks and rewards
- enter into long-term binding contracts
- expand the reach of the capital markets into public infrastructure
- innovate together effectively.

Among the lessons learned in the Dulles Greenway case study is the overall low economic attractiveness of most private transportation projects, due to their revenue stream's uncertainty and high level of government involvement in their regulation and development. Through the implementation of state-of-the-art traffic forecasting analytical techniques, and a collaborative interactive process with the public sector, the SR91 Express Lanes Project sponsors were able to transform this venture into an excellent investment.

Project Overview

The SR91 Express Lanes Project was one of four demonstration projects established by the California Assembly Bill 680 (AB 680) which was signed into law on July 10, 1989. AB 680 was the result of a joint initiative between the public and private sectors to provide highly demanded transportation facilities in California, without increasing the Government's debt or imposing additional taxes. In general, the AB 680 legislation authorized the California Department of Transportation (Caltrans) to pursue agreements with companies for the private development of needed transportation projects. Under this program, the State delegated to the private sector the traditionally

[69] William G. Reinhardt, "Kiewit Moves SR91 Financing to Closure Launching a New Era in U.S. Toll Roads," *Public Works Financing*, New Jersey, July/August, 1993

public duty of defining and proposing the transportation facility to be developed. In other words, the government limited itself to the provision of very general parameters and relied on the various project sponsors for the identification of the specific public needs (projects) to be satisfied (constructed). With this scheme, the various project companies did not compete against each other for the concession agreement in connection to a pre-determined project but, instead, for the right to win one of the four experimental concession agreements based on a subjective evaluation criteria developed by the government.

The main objectives of the AB 680 program were to provide new transportation facilities, to promote innovation and to attract private capital. The basic scheme consisted on 35-year franchises in which a private company would plan, finance, construct and operate a specified transportation facility without any state or federal funds or credit. Because the AB 680 was considered to be an experimental model, that radically departed from the traditional paradigms of providing infrastructure facilities, its implementation was restricted to four projects.

The SR91 Express Lanes Project consisted of the private development of a ten-mile controlled access road located within the median of the existing eight-lane Riverside Freeway between State Route 55 in Orange County and the Riverside County Line, California. The SR91 project added four lanes, two in each direction, which supplemented the eight toll-free lanes of the existing Riverside highway segment. All vehicles, except those with three or more occupants, will either ride on the free public highway or pay for the use of the private express lanes. Vehicles with three or more persons are permitted to use the express lanes at no cost.

Groundbreaking for the SR91 Express Lanes Project occurred in July 27, 1993, two months before that of the Dulles Greenway, and construction took 29 months (5 more months than the Dulles Greenway schedule). The facility was open to traffic on December 27, 1995, approximately three months after the commissioning of the Dulles Greenway. The total cost for the project amounted to $126-Million, of which $56.8-Million was spent on the actual design and construction of the new four-lane facility.

Among innovative features that characterize this pioneering project are the utilization of an existing freeway median for its alignment location, the use of highway congestion pricing instead of the traditional flat toll rates, and the implementation of state-of-the-art Intelligent Vehicle/Highway System (IVHS) technology.

By constructing the express lanes along the median of the existing freeway, the sponsors were able to significantly enhance the economic viability of the investment by lowering the cost, as well as shortening the time needed to secure the project's right-of-way. Not only did the project company avoid the otherwise prohibitive expenses of building a new highway in the adjacent rugged terrain but also, because the median strip is government's property, it was able to lease it at a relatively nominal cost. Likewise, leasing the State's right-of-way considerably reduced the bureaucratic and lengthy permitting process, which in turn contributed positively in shortening the development stage of the project.

Through the implementation of congestion pricing and of the IVHS technology, the SR91 Project became the first highway in the United States to vary toll prices depending on traffic volumes, as well as the world's first toll highway without toll booths.[70] By adjusting toll prices in accordance to the demand at various times throughout the day, traffic revenues are maximized and congestion is kept to a minimum. In accordance to this innovative pricing system, tolls were to vary from $0.25 to $2.50 (in 1993 dollars) depending on the congestion levels in the existing free outer roadway. Also, by fully automating the toll collection system, the SR91 operation procedures are discharged more efficiently and customers are guaranteed meaningful time savings.

In addition to meeting the AB680 objectives and of having been an excellent investment to the project sponsors, the SR91 Express Lane Project has been honored with major industry and government awards. These include: ***Deal of the Year*** by Institutional Investor Magazine, ***10 Most Creative Deals*** by Infrastructure Finance Magazine, ***Innovative Project Award*** by the Institute of Transportation Engineers, and ***Excellence in Highway Design*** by the Federal Highway Administration.

Principal Stakeholders

Like the previous two case studies, the project company for the SR91 Express Lanes Project consisted of a limited partnership between three private sector sponsors. As shown in Figure 9.4.1, the project company was named California Private Transportation Co. (CPTC) and the two general partners were Peter Kiewit Sons', Inc. and Cofiroute Corporation. Granite Construction, Inc. was the limited partner of the joint venture with approximately 25% of CPTC's equity.

Peter Kiewit Sons', Inc. is based in Omaha, Nebraska and has business interests in the construction, mining, telecommunications, infrastructure and energy industries. Peter Kiewit was the lead equity sponsor and provided project and construction management

[70] Robert W. Poole, Jr., "SR91: A Triple-Header for Privatized Infrastructure," *Public Works Financing*, July-August, 1993, p. 8-10.

and financial services for the SR91 Project. In addition to underwriting the $35-Million institutional debt of the venture, its then subsidiary, MFS Communications Company, Inc. provided all the Automotive Vehicle Identification (AVI) equipment for the project.

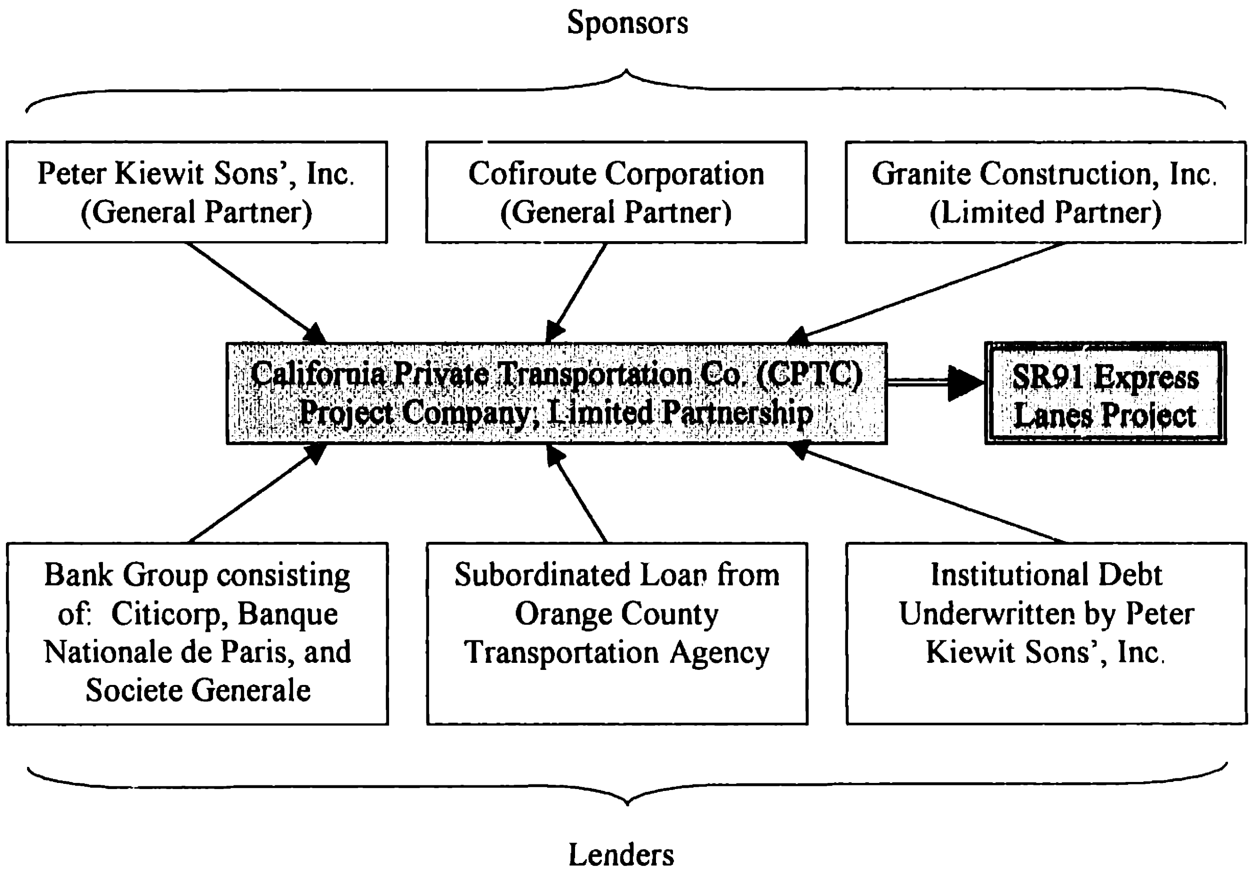

Figure 9.4.1: SR91 Express Lanes Project Funding Structure Diagram

Cofiroute Corporation is a French organization and one of the world's largest private toll road developers and operators. Based on its traffic management expertise, Cofiroute provided services to the consortium in the areas of operations and electronic toll collection. Granite Construction, Inc. from Watsonville, California is a recognized construction industry leader for transportation projects in the United States, and acted as the general contractor for the SR91 endeavor. From the private creditors' side, the group of commercial banks and institutional lenders included Citicorp USA, Banque Nationale de Paris, Societe Generale, DeutscheBank and CIGNA Investments.

Finally, the public sector was represented in this venture mainly by the California Department of Transportation (Caltran) and the Orange County Transportation Agency (OCTA). While Caltran partnered with CPTC to facilitate the development of this project, OCTA became an investor in the project by providing a $7-Million subordinated loan.

Financial Strategy

Similarly to the Dulles Greenway Toll Road, the SR91 Express Lanes Project's funding strategy consisted of complementing a non-recourse financing structure secured only by the expected traffic volumes and revenue forecasts. In both of these projects, the capital and operating expenses are to be paid by users and not the taxpayers. In the specific case of the SR91 Project, the uncertainty of the market based revenue stream was mitigated by conducting innovative traffic studies, adapted to the particularities of the project, and by employing a congestion pricing system in lieu of flat tolls. Since the SR91 Express Lanes were constructed inside the median of an existing roadway, the traffic studies were based on reliable historical information.

Rather than constituting an altogether new transportation facility, like the Dulles Greenway Toll Road, the SR91 project was considered to provide a supplemental traffic capacity to the already heavily congested existing SR91 Freeway. The investment on the $126-Million Express Lanes project was justified by the fact that ridership volumes at peak periods exceeded the theoretical capacity of the existing roadway almost daily. Also, since the proposed project's alignment crossed through a canyon, it had, for all practical purposes, no competing routes. The nearest alternate freeways to the north and south of the new east-west express lanes were 10 miles and 15 miles away, respectively.[71]

Based on the strengths of the project and its solid revenue projection forecasts, the sponsors were able to structure the following funding scheme:

- $65-Million in variable rate, 14-year term loans from a bank group
- $35-Million in 25.5-year institutional debt underwritten by Peter Kiewit Sons'
- $7-Million in 9% subordinated debt by the Orange County Transportation Authority
- $19-Million in equity capital contributed by the three project sponsors.

In addition to covering construction and development costs, the above capital structure included contingencies for adverse traffic scenarios and for a 12-month debt service reserve. From a risk management perspective, the project company mitigated construction schedule and cost overruns by negotiating a $56.8-Million Lump-Sum Turnkey contract with Granite Construction Co. This engineering and construction agreement included high liquidated damages and incentive bonuses for schedule delays and early completion, respectively.

In terms of profitability, the government limited the project company to an overall 17% rate of return on investment throughout the 35-year concession period. However, provided that overhead expenses were reduced, ridership volumes increased, and the additional revenues were shared with the public sector, the sponsors were permitted to earn as much as 23% rate of return on investment. With this scheme, it is excess profits and not toll rates which are regulated by the government.

[71] Edward J. Regan III, "Estimating Traffic and Revenue on SR91," *Public Works Financing*, July-August, 1993.

Concluding Comments

Because need for new and better transportation facilities grew more rapidly than available public funding, in 1989 the California Legislature passed its Assembly Bill Number 680 to attract private capital for the financing and development of these socially and strategically important projects. With this objective, AB680 became the enabling and supportive political framework for the implementation of public-private partnerships in connection with the provision of four experimental transportation projects in California.

The collaborative process that resulted from the joint venture between the various government agencies and the private company sponsoring the SR91 Express Lanes project, enhanced the economic attractiveness of this capital undertaking. Specifically, the crucial contributions by the public sector are represented mainly by:

- The $7-Million subordinated loan extended by the Orange County Transportation Agency. More important than bridging the gap between the sponsor's equity and the lenders' long-term debt, it demonstrated the local government's commitment to the financial success of the venture, thus minimizing the associated political risk. Also, since equity funds are expensive (Refer to Section 4.6), there is a limit to the risk capital that can be invested in a user-fee transportation project before the pricing on the service becomes prohibitive. In this regard, the relatively inexpensive subordinated debt by OCTA helped by lowering the weighted average cost of capital for the project.

- Facilitating the right of way of the project at a low cost. This, in turn, helped the project schedule and contained the direct as well as non-productive transportation costs.
- Assisting the private sponsors, throughout the development phase of the project, in expediting permits and other bureaucratic requirements imposed on this construction program.

Although plans for the private development of the SR91 Express Lanes Project commenced after those for the Dulles Greenway, its financial closing and start of construction preceded the corresponding dates of the Dulles Greenway Project. In addition to the strong government support, the financial superiority of the SR91 Project over the Dulles Greenway were the combined result of:

- The high quality of the expected revenue stream. The heavy traffic congestion on the existing SR91 freeway, and the congestion pricing scheme implemented, resulted in adequate and stable revenue projections. Furthermore, the absence of a traffic volume ramp-up period, and the lack of a truly competing public freeway to serve the excess traffic, significantly reduced the business risk associated with this venture.
- The substantially lower construction and operating costs. These in turn were accomplished by a relatively short development period, the utilization of the existing freeway median for the location of the express lanes, the lower cost of capital and the implementation of an Intelligent Vehicle/Highway System.

Table 9.4.4 summarizes and compares the features that made the SR91 Express Lanes Project a superior investment than the Dulles Greenway Toll Road.

Due to the SR91 venture's unique strengths, it may not constitute a prototype for the private development of transportation projects in the future. Nevertheless, since the financial engineering of BOT infrastructure projects starts by considering the investment decision, the SR91 Express Lanes undertaking is an excellent example of a sound investment evaluation and selection. Under the provisions of AB680, projects rather than proposers were the ones competing among each other, based on a subjective evaluation criteria prepared by the government. Inasmuch as respondents had the freedom to choose the project to be pursued, the California Private Transportation Co. performed an excellent initial financial engineering analysis that resulted in the selection of the SR91 venture.

	Dulles Greenway	**SR91 Express Lanes**
Enabling Legislation	Very restrictive; Did not encourage government collaboration	Flexible model based on public-private partnerships
Legal & Political Environment	Bureaucratic, Complicated	Simple, Supportive
Public Support	Some opposition by VDOT	Strong backing by CALTRANS
Government Regulation Focus	Toll rates	Excess profits
Government Financial Assistance	None	$7-Million subordinated loan
Development Stage	7 years	3 ½ years
Project Cost	$330-Million	$126-Million
Right-of-Way	Expensive, Extensive negotiations	Nominal lease expense, Secured rapidly
Traffic Forecasts	Based on outdated data	Realistic, Predictable, Tailored to protect particularities
Traffic Ramp-up Period	Long	None
Competing Routes	Alternate freeway widened at same time	Practically none
Pricing Scheme	Flat toll rates	Variable congestion pricing

Table 9.4.4: Comparison Between the Dulles Greenway Toll Road and the SR91 Express Lanes Project

Finally, although the SR91 case study has been presented from a financial engineering perspective, the procurement strategy included in the AB680 legislation has been constructively criticized by renowned scholars in the area of infrastructure development. According to John B. Miller, one of the ten key elements (Refer to Section 6.3) for a sustainable and effective public infrastructure procurement strategy is the provision of a government defined scope of work.[72] From this standpoint, since the AB680 program did not require the public sector to describe the specific infrastructure facility to be procured, the government neither adequately defined the public need nor implemented a leveled playing field in which to objectively evaluate the proposal submitted by each of the respondents. By not limiting the private sector's proposal to a specific project, the government AB680 concession grants were based, for all practical purposes, on sole and unsolicited proposals.

As discussed in the Dulles Greenway case study, it is in everyone's best interests to count with the participation of more than one respondent in this type of procurement process. While the government benefits by creating a competitive environment that fosters cost-effective and high-quality proposals, the private sponsors gain from confirming the financial feasibility before committing to these typically long-term and high-risk investments.

9.5 John F. Kennedy International Airport's International Arrivals Terminal

The last mini case study to be discussed in this thesis, from among BOT infrastructure projects in the United States, is the new International Arrivals Terminal

[72] Miller, John B., America's Emerging Public/Private Infrastructure Strategy: The End of Privatization, Draft, Massachusetts Institute of Technology, 1997, Chapter 5.

(IAT) at the John F. Kennedy International Airport (JFK) located in Queens County, New York City.[73]

Like the Indiantown Cogeneration Project, The Dulles Greenway and the SR91 Express Lanes, the new JFK International Arrivals Terminal presents an interesting approach as well as a new set of issues relating to the financial engineering of BOT infrastructure projects. Among the most important aspects that lead to the successful closing of this venture's non-recourse funding scheme, were the extensive financial analyses performed by the host government agency promoting this project.

Through the thought process that resulted from the preparation and analysis of various financial models, the Port Authority of New York and New Jersey, the project's government promoter, was able to better understand the risks and the most critical factors affecting the economic feasibility of this venture. By going through the financial engineering process, the Port Authority not only chose the best course of action to satisfy a public need, but also designed a procurement strategy that attracted the interest and facilitated the investment-financing decisions of the private sector respondents.

Project Overview

The JFK International Arrivals Terminal project consists of the construction of a new passenger terminal facility to replace the airport's current International Arrivals Building (IAB), which has been in service since 1957. Although the existing IAB has undergone several expansions and renovations over the past forty years, the facility is no

[73] The data included in this case study has been obtained from the following sources:

- Fitch Investors Service, L.P. Research Report: "The Port Authority of New York and New Jersey – JFK International Air Terminal L.L.C. Project," New York, New York, 1997.
- Melissa Huang and John B. Miller, "International Arrivals Building at John F. Kennedy International Airport," Infrastructure Development Systems Case #IDS-98-A-101, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1998.

longer adequate to meet the present and future passenger and airlines demands. The IABs overcrowding at peak travel times, inefficient interior layout, lack of vehicular access, and the obsolete state of its communication-information systems were among the specific factors that justified the development of the new multi-airline International Arrivals Terminal. Although the IAB will remain operational during the new International Arrivals Terminal construction period, it will be decommissioned and demolished once the IAT substantial completion, or Date of Beneficial Occupancy (DBO), is achieved.

The new International Arrivals Terminal will be a three-level facility encompassing approximately 1.5-Million square feet, and providing 16 gates, which can be expanded to 37 gates if future passenger demands warrants it. In addition, the IAT will house approximately 26 shops, 14 food-beverage retailers, large meeter-greeter areas and new custom and immigration areas. The new state-of-the-art facilities incorporated into the new IAT will result in the optimization of passenger processing, airline operations efficiency, concession-retail space usage and revenues.

The JFK International Arrivals Terminal project is being promoted by the Port Authority of New York and New Jersey following the BOT model for project delivery and finance. Under the lease agreement, the private sector's project company is responsible for financing, developing, constructing and operating the IAT for a concession period of 25 years after the new terminal's Date of Beneficial Occupancy. Also, until the BOT takes place, the project company is in charge of the operation and management of the current IAB.

As shown in table 9.5.1, the new JFK International Arrivals Terminal will be developed at a cost of approximately $1.3-Billion.[74] In terms of schedule, site work commenced in May of 1997 and both, Date of Beneficial Occupancy and final completion, are expected to take place in 2001.

Use:	Amount ($):
IAT Construction Costs	689,292,000
Access Improvements	82,000,000
Contingencies	74,028,000
Insurance	27,783,000
Planning, Design and Engineering	58,410,000
General and Administrative Costs	9,175,000
Debt Service Reserve Fund	93,240,000
Financing Costs	10,877,000
Interest on Bonds prior to DBO	217,171,000
Total	**$1,261,976,000**

Table 9.5.1: Uses of Funds – JFK New IAT Project

Principal Stakeholders

Unlike the previous case studies presented in this thesis, the project company for the new JFK International Arrivals Terminal was organized as a limited liability company (LLC) in lieu of a limited partnership (Refer to Section 6.4). Except for the fact that owners may participate actively in the management of the company without risking loss of their limited liability, LLCs offer private sector sponsors the same advantages that limited partnerships provide. If properly organized, a limited liability company is treated as a corporation for legal liability purposes and as a partnership for income tax considerations. By incorporating the JFK-IAT project company as an LLC, the project sponsors limited their liability to the extent of their equity contributions into the venture,

[74] Melissa Huang and John B. Miller, "International Arrivals Building at John F. Kennedy International Airport," Infrastructure Development Systems Case #IDS-98-A-101, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1998, p.15.

and benefit from the direct flow of income without any taxation at the project company level.

As shown in Figure 9.5.1, the project company was named JFK International Air Terminal, L.L.C. (JFKIAT) and its owners are Schipol USA, Inc., LCOR JFK Airport, L.L.C. and Lehman JFK, L.L.C. The Schipol group of affiliated companies is a recognized world leader in the development, operation and management of state-of-the-art airport facilities. Schipol and its affiliates own the Amsterdam Airport, which is considered by many industry experts as one of the premier airports of the world. The LCOR JFK Airport L.L.C. and its affiliated companies have a long track record in the real estate development and management of large-scale projects, including high-rise buildings, office parks, shopping centers, etc. LCOR has also been involved in the construction of major projects in the metropolitan New York area, including the Foley Square Federal Office Building and the Penn Station Development. The third equity partner, Lehman JFK, is part of Lehman Brothers Holdings, a prestigious global investment bank. Lehman Brothers Holdings has equity participation in other airports, and has substantial experience in airport projects' financing. Through their combined resources and experience, the three project company owners have extraordinary qualifications in the development, financing, operation and management of major airport facilities.

The project promoter is the Port Authority of New York and New Jersey (PA). The PA was established in 1921 with the main mission of developing the commerce activity in the bistate port district. Although it is a government agency, the PA operates as a private company since it does not receive any tax revenue, and is financially dependent on the tolls, fees and rents associated with the facilities under its management. These include airports, bridges, trans-Hudson tunnels, container ports, industrial parks, bus terminals and The World Trade Center.[75]

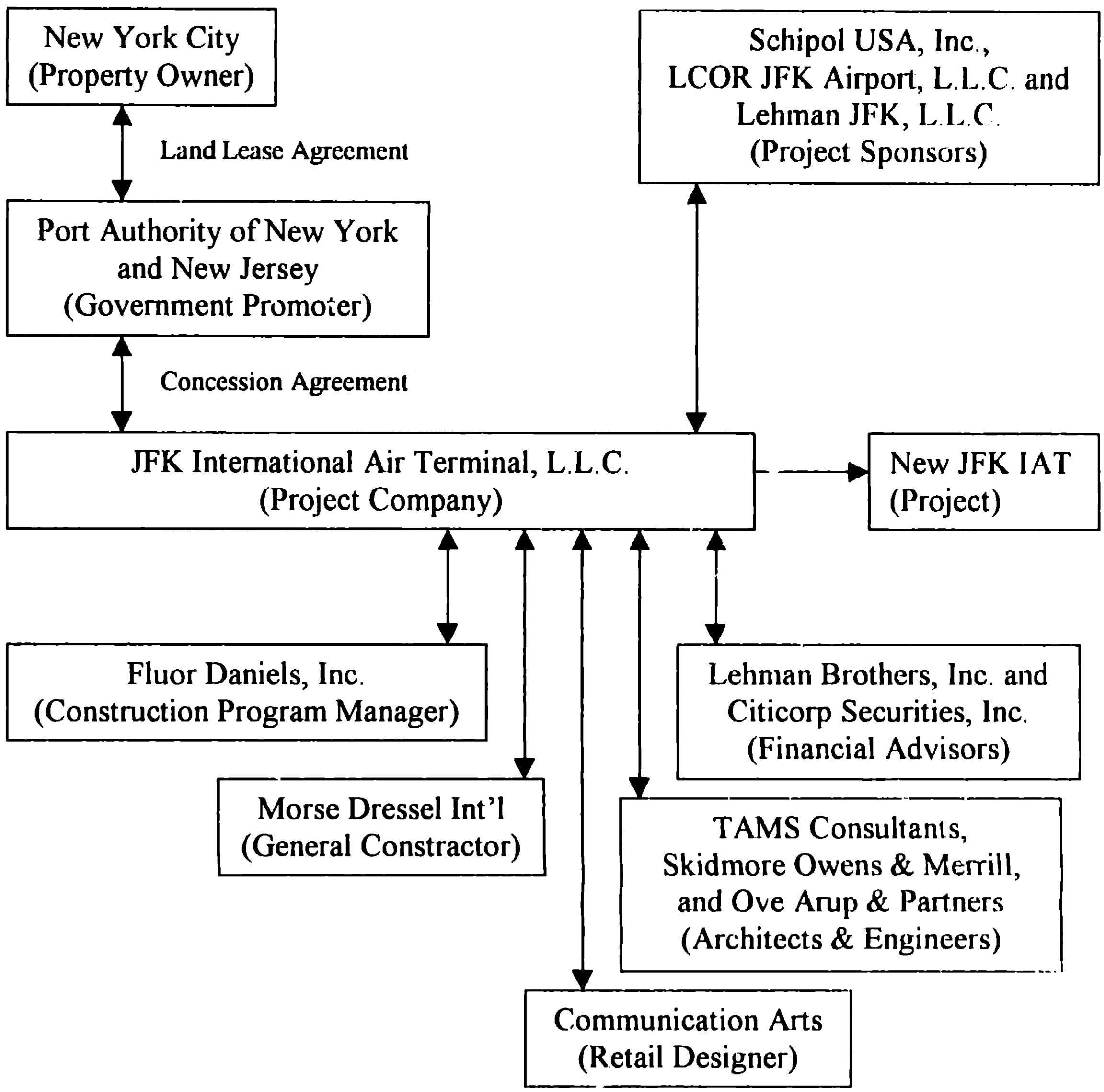

Figure 9.5.1: Simplified Contractual Relationships Diagram – The JFK New IAT Project

The owner of the land where the John F. Kennedy International Airport is located is the City of New York. Since 1947, the Port Authority has engaged in an operating

[75] Melissa Huang and John B. Miller, "International Arrivals Building at John F. Kennedy International Airport," Infrastructure Development Systems Case #IDS-98-A-101, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1998, p. 3.

lease with the City of New York based on a rent equal to the net revenues generated by the JFK operations with minimum guaranteed annual payment of $3.5-Million. Under the terms of the current land lease agreement the expiration date is set for 2015 and, unless the Port Authority and the City of New York negotiate an extension, the possibility exists that the City may not decide to continue the lease. Although highly improbable, if this occurs, any outstanding debt will be subject to special mandatory redemptions that will result in its defeasance by 2015.

The project's program manager and general contractor are Fluor Daniel and Morse Diesel, respectively. Fluor Daniel, one of the world's biggest and most prestigious EPC firms, is responsible for supervising the general contractor and all major construction related matters. Acting as consultants to the project are: Communications Arts (Detail Designer); TAMS Consultants, Skidmore, Owens & Merrill, and Ove Arup & Partners (Architects & Engineers); Lehman, Inc. and Citicorp Securities, Inc. (Financial Advisors).

Financial Strategy

Following a pure project financing scheme, the funding strategy implemented by JFK International Air Terminal, L.L.C. was based on no recourse to the Port Authority or any of the three project sponsors. Debt re-payment is secured only by the revenue stream resulting from the terminal operations during both, the four years before the Date of Beneficial Occupancy and the 25 years post-DBO concession period.

Table 9.5.2 and Figure 9.5.2 present a breakdown for the sources of funds to the project and a diagram of its financial structure, respectively. Of the total project cost of

$1.3-Billion, $934-Million were provided through special project bonds with the following maturity dates and yields:[76]

Installment	Amount ($)	Maturity Dates	Yield (%)
First	357,000,000	2003-2015	5.20-5.77
Second	91,000,000	2017	5.90
Third	278,000,000	2022	6.06
Fourth	208,000,000	2025	6.10

Source	Amount ($)
Private Sponsors' Equity	15,000,000
Bonds	934,000,000
Investment Earnings	125,203,000
Facility Rental prior to DBO	105,773,000
Port Authority Contribution	82,000,000
Total	**$1,261,976,000**

Table 9.5.2: Sources of Funds – JFK New IAT Project

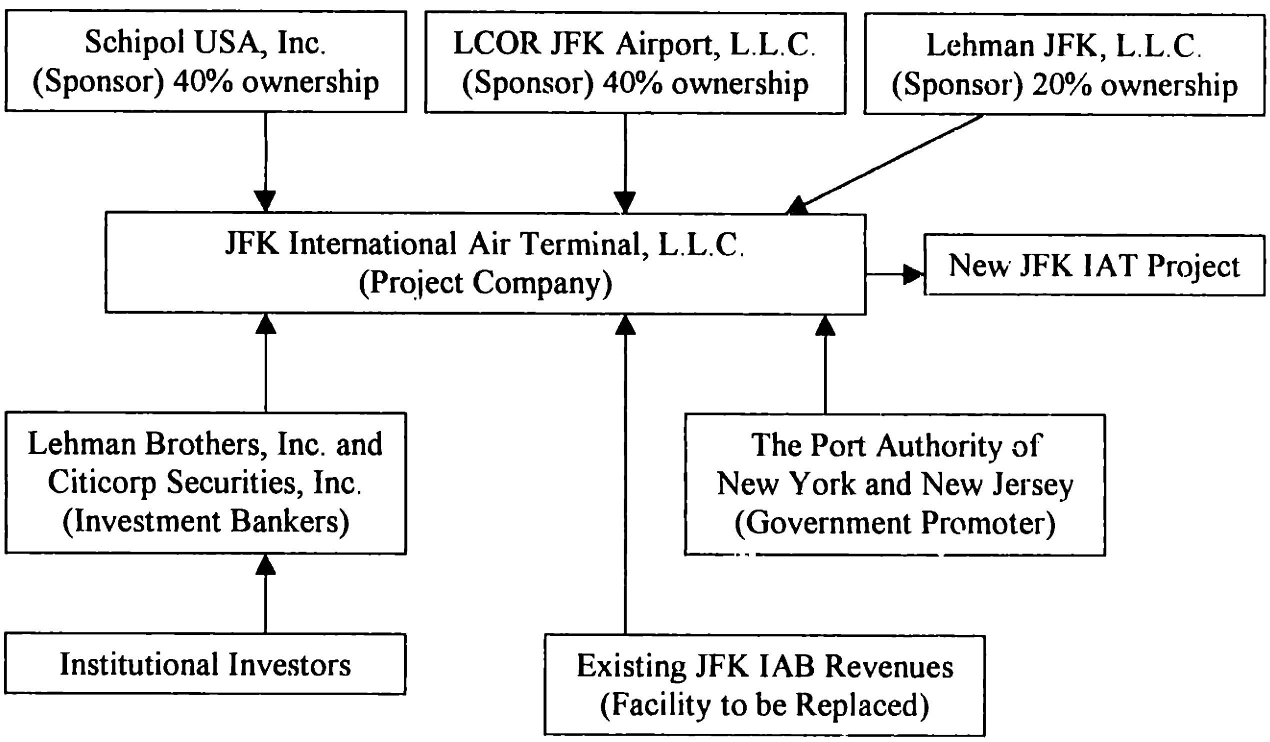

Figure 9.5.2: Funding Structure – The JFK New IAT Project

76 Melissa Huang and John B. Miller, "International Arrivals Building at John F. Kennedy International Airport," Infrastructure Development Systems Case #IDS-98-A-101, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1998, p. 15.

Even though the bonds were backed only by the projected revenues, the strong market demand for the new International Arrivals Terminal and the business risk mitigation clauses incorporated into the concession agreement helped this project to obtain an investment-grade rating from various agencies. With ratings of BBB+ from Standard & Poor's, Baa2 from Moody's, A from Fitch and insurance coverage by MBIA Insurance Corp., on April 25, 1997, the special project bonds were completely sold to institutional investors. This financial transaction, underwritten through a syndicate led by Lehman Brothers and Citicorp Securities, Inc., became the largest airport bond issue in the U.S. to date.

In terms of the project's capacity to service its operational and debt obligations, the following factors contributed positively to the high quality associated with the anticipated revenue stream:

- Detailed and sound passenger traffic projections were performed by both, the PA and the project company. These studies confirmed the strong demand for a new multi-airline facility as well as JFK's competitive advantage as the premier international passenger gateway airport in the U.S. This in turn suggested solid revenues, which guaranteed a strong debt service coverage throughout the concession period.
- The project company would benefit from the revenues earned by the existing IAB during the period between the signature of the concession agreement and the new terminal's Date of Beneficial Occupancy. This income stream during the development stage of the new IAT reduced the risks posed by construction cost and schedule overruns.

- The lease agreement between the Port Authority and the JFK – IAT includes clauses that mitigated most of the uncertainties associated with the competitive nature of the airline-airport industry. Specifically, the PA agreed that if an airline terminal becomes vacant, it would not permit the conversion of the facility into a direct competitor to the new JFK International Arrivals Terminal. In addition to contract clauses, the threat of future competition is also minimized by the fact that no other terminal at JFK has the land available to expand its operational capacity.

Due to the successful bond issue and the project's solid revenue projections, the private sponsors contributed equity amounted to less than 2% of the total capital needed for the undertaking. Based on their ownership interests, of the $15-Million in common stock invested in the venture, Schipol, LCOR and Lehman contributed with $6-Million, $6-Million and $3-Million, respectively. The Port Authority was also included in funding the project by providing $82-Million to finance the construction of roadways, utilities and other infrastructure facilities associated with the new IAT. In addition, the Port Authority became a beneficiary of the profits to be generated by the new terminal. As per the agreement, the PA is entitled to 60% of the net revenues, after operations and debt service payments, up to a cap of $60-Million a year. Also, the project company agreed to pay the PA a guaranteed minimum rent of $12-Million per year for the usage of the IAT premises.

Concluding Comments

As mentioned in the beginning of this section, the successful implementation of the BOT procurement strategy for the new JFK IAT facility was, to a great extent, the result of a sound financial engineering process performed by the Port Authority. As the host government agency promoting the IAT project, the PA is not only the most important stakeholder, but the entity best positioned to enhance the economic viability of the venture.

Before implementing a BOT procurement strategy, the host government has to first identify the critical variables affecting the feasibility of the investment, and then mitigate the risks in connection to these factors through an effective partnership between the public and private sector. In the specific case of the JFK IAT project, the Port Authority engaged in evaluating important issues such as: volatility of the aviation industry, anticipated passenger traffic volumes, projected market share, revenue per passenger emplanement rate, construction cost and schedule, PA's and private companies' capital capacity, restrictive covenants, concession period duration, etc. By going through the thought process involved in the analysis of these economic variables, the PA was able to intelligently analyze various options and design a procurement strategy that attracted the private sector's participation in the project.

The knowledge gained from the market studies led the Port Authority, among other important initiatives, to fund a preliminary design for the new JFK IAT facility. In addition to constituting a clear definition of the project's scope of work, the preliminary design became a tangible proof of the PA's interest in the undertaking. As a result of the clear and transparent procurement strategy implemented and of the overall strong commitment demonstrated by the PA on the project, four proposals were received from the private sector. The receipt of more than one proposal for the JFK IAT BOT concession not only confirmed the financial viability of the venture, but provided the PA with additional valuable knowledge for negotiating a fair lease agreement with the selected respondent.

The successful financial strategy implemented in the JFK International Arrivals Terminal project is the "tip of the iceberg," and the result of extensive economic analyses performed by both, the Port Authority and the project company. In this sense, expertise in financial engineering is not only a source of competitive advantage among private sector consortia interested in pursuing BOT infrastructure projects, but an essential qualification for host governments wishing to promote these ventures successfully.

9.6 Remarks and Conclusions

The Indiantown Cogeneration Project, the Dulles Greenway, the SR91 Express Lanes and the new JFK International Arrivals Terminal present different key issues in connection to the financial viability of BOT infrastructure projects in the United States.

The Indiantown Cogeneration Project's financial success was the combined result of the sponsors' excellent reputation, the efficient allocation of risks through strong contractual arrangements, and the high quality of its revenue stream. Based on these factors and on the overall low technical risk associated with this venture, the U.S. public debt market provided long-term funds to the project prior to its completion.

The Dulles Greenway case study introduced the high economic or business risk typical of most transportation projects. Because the revenue streams of these undertakings are not contractually based, but subject to the market forces, their financial feasibility is very dependent on considerable support from the host government promoting the project. In contrast, the SR91 Express Lanes Project is an example of a successful BOT transportation venture. Its economic viability was assured principally by its solid market demand and strong government support. The public sector's commitment was evidenced by the contribution of a subordinated loan, by facilitating the right of way, and by assisting the private sponsors in expediting the project's development stage.

Finally, the International Arrivals Terminal at the John F. Kennedy International Airport alludes to the importance of the host government in performing extensive financial analyses of the BOT project to identify the venture's critical economic variables. By understanding the financial underpinnings of the project, the government is better equipped to design a procurement strategy that effectively attracts private capital into the BOT undertaking.

In general, the four case studies presented in this chapter show that public-private partnerships are viable only if the risks and returns are properly allocated between the public and private sector entities involved in the BOT infrastructure project.

Chapter 10

Final Remarks

10.1 Conclusions

This thesis investigates and discusses issues relating to the financial engineering of Build-Operate-Transfer (BOT) infrastructure projects. The BOT model for the development of infrastructure projects follows a systems approach for the design, financing, construction and operation of the facilities. Contrary to the "traditional" segmented and publicly funded strategy for providing infrastructure facilities, under the BOT scheme a private sector consortium is responsible for all of the project's elements, including its funding. The rationale for incorporating the BOT model as an alternative for the delivery of infrastructure facilities is centered on the need to access private capital to leverage the insufficient government funds in the financing of these typically massive undertakings.

Once a BOT infrastructure facility is constructed, the private sponsors operate it throughout a pre-determined period of time before transferring it back to the government entity that promoted the project. It is during the facility's functional stage, that the private sector's consortium sponsoring the project plan to service its operational and financial expenses as well as to realize a fair return on its investment.

In terms of the generic funding strategy, BOT infrastructure projects are usually financed on a non-recourse or off-balance sheet basis. This means that the project's cash flows will be both, the source and the only collateral for the repayment of the loaned funds. Since there is no tangible asset guaranteeing the repayment of the advanced funds, most BOT ventures are considered risky investments and complicated financial challenges.

As a result, the BOT approach for the delivery of public infrastructure projects incorporates financial engineering as an important source of competitive advantage among the private sector consortia interested in pursuing these ventures. In his research relating to BOT contracts, Robert L. K. Tiong, et. al., has identified the preparation of competitive financial proposals as one of the most important factors for winning BOT project bids.[77]

As defined in this thesis, financial engineering is the systematic procedure for deciding first whether to invest in a BOT project, and then designing the most cost-effective funding structure. Once the decision to invest has been made, the optimal financial plan will augment the project's economic attractiveness as well as assure its cash solvency throughout the concession period. A BOT project's financial plan involves aligning its risks, expected profitability, sponsors' credit worthiness and accessibility to the various financial markets with a viable finding structure. In this regard, the financial engineering process should seek to achieve a balance, among all of the project's stakeholders, where the prospective economic rewards to each party are commensurate with the individual risks assumed.

Based on the scope, objectives and the issues discussed in this thesis, the eight steps involved in the proposed procedure for financial engineering of BOT infrastructure projects are:

1. Evaluating the clarity, transparency, fairness and financial requirements included in the project's Request for Proposal (RFP)
2. Assessing the quality of the project's revenue stream
3. Financial modeling
4. Formal risk assessment
5. Facilitating negotiations
6. Final capital structure design
7. Financial performance monitoring
8. Financial feedback.

As in most engineering processes, these steps are interdependent and performed following a systems approach in lieu of a sequential order. Furthermore, the financial modeling task constitutes the cornerstone of the process and the area to which most of the financial engineer's attention should be devoted.

In essence, the financial modeling of a BOT infrastructure project involves the development of analytical tools and techniques that enable the objective evaluation of the economic attractiveness and financial viability of the venture. The suggested framework for the financial modeling of BOT projects is comprised of the following tasks:

1. Economic Feasibility Analysis
2. Economic Sensitivity Analyses
3. Preliminary Capital Structure Assessment
4. Construction Stage Cash Flow Analysis
5. Take-Out Stage Financial Analysis

---

[77] Tiong, Robert L.K., Khim-Teck Yeo and S.C. McCarthy, "Critical Success Factors in Winning BOT Contracts," *Journal of Construction Engineering and Management*, American Society of Civil Engineers,

6. Financial Sensitivity Analyses

This financial modeling methodology is centered around the discounted cash flow techniques, the capital budgeting asset valuation theory and on the premise that the investment and financing decisions should be analyzed separately.

Within the context of financial engineering for BOT infrastructure projects, financial models are simplified illustrations of these complex undertakings, and are designed to facilitate the venture's systematic analysis. As stated in this thesis, the importance of this procedure is not in the generation of elaborate computer spreadsheets, but in the thought process that accompanies it.

In addition to the modeling process, one of the most important tasks within the financial engineering of BOT infrastructure projects is the correct identification, allocation and management of risks among the participants in the venture. By designing and implementing a sound risk distribution program, the overall cost of the BOT venture is minimized while maintaining the incentive among each party to perform its contractual duties.

For a sound financial engineering process to occur, a BOT infrastructure project has to count with a strong public sector support, and become a joint venture between the government entity promoting the undertaking and the private sector company sponsoring it. Due to the lack of recent experience with BOT projects, the mammoth dollar expenses involved in their procurement and development, and the often monopolistic markets in connection with the products or services to be provided, a strong backing from the host government is not only a pre-requisite, but usually a determinant factor for the success of these ventures. To a great extent, the attractiveness of the investment and the viability of

---

p. 217-228.

its financing scheme will be directly proportional to the degree of government's support to the BOT venture.

One of the ways through which the public sector can facilitate the implementation of a financial engineering process that adds value to a BOT project is by instituting a procurement strategy that is based on inalienable principles and sustainable over the long-run. Specifically, a government agency promoting a BOT infrastructure project should furnish a Request for Proposal (RFP) to potential respondents that:[78]

- clearly defines the scope of work of the facility to be developed
- effectively projects the government's long-term commitment to completing the procurement process and engaging in a concession agreement
- is based on an objective and non-biased evaluation criteria
- attracts the participation and wide open competition from the private sector.

A clear, transparent and fair procurement strategy by the public sector will facilitate the investment decision among prospective private sector participants and place the BOT model as a viable alternative for the provision of infrastructure facilities.

In addition to a sustainable procurement strategy, it is recommended for the host government to go through the suggested financial engineering procedure to gain valuable insight regarding the economic feasibility of a BOT venture. Not only will the government learn in which direct form (if any) to support a BOT project, but also will be in a better position to negotiate the final concession agreement.

---

[78] Miller, John B., *America's Emerging Public/Private Infrastructure Strategy: The End of Privatization*, Draft, Massachusetts Institute of Technology, 1997, p. 14-1.

As disclosed by the case studies included in this thesis, direct public sector support to BOT infrastructure projects is most effective when concentrated in the following areas:

- the elimination or significant reduction of the political risk associated with the venture
- actively participating as a creditor or investor to the project
- enhancing the quality of the project's revenue stream
- assisting the private sponsors in expediting and shortening the project's development phase.

With the assistance from the public sector, the Build-Operate-Transfer model will become a pivotal factor in the development of more and better infrastructure facilities.

Finally, since the nature and the underlying political, legal and economic conditions vary from one BOT venture to another, financial strategies have to be crafted and tailored on a project by project basis. Based on this and on the issues discussed throughout this thesis, expertise in financial engineering is not only the determinant factor in winning BOT concession agreements, but also a key element in incorporating the Build-Operate-Transfer approach for the delivery of infrastructure facilities as a sustainable procurement strategy option.

10.2 Further Research

By proposing a formal methodology for the financial modeling of BOT ventures in the United States, throughout the discussion of key issues and by presenting five case studies, this thesis had disclosed potential areas for further investigation, within the financial engineering of BOT infrastructure projects. Among these are the following:

- The standardization of feasibility studies for BOT infrastructure projects. Feasibility studies should be performed by both, the government agency promoting the BOT venture and the potential private sector respondents. After the social, commercial, technical, financial and environmental pre-requisites for an infrastructure project have been clearly defined, the feasibility studies should provide all the data necessary for the investment and financing decisions.
- Sophisticated procedures for risk analysis. This includes the development of techniques to complement the sensitivity analyses, in which the risks associated with economic and financial feasibilities of BOT projects are assessed by changing one uncertain factor at a time. These techniques could be the formal implementation of scenario and simulation analyses. While a scenario analysis changes several of the uncertain variables in a logical manner, a simulation could involve the assignment of probability distribution to each uncertain factor.
- The design and innovative and elaborate financial instruments or funding mechanisms specifically tailored to the risk-return characteristics of BOT infrastructure projects. One example could be the creation of a investment vehicle that serves like a mutual fund or a real estate investment trust (REIT) for BOT project ventures. An IPIT (infrastructure project investment trust) could be a business entity created to combine the capital of many investors to provide financing for infrastructure projects developed privately. As with REITs, IPITs could be exempted from federal and state

income taxes, and could be crafted to facilitate the participation of a diverse range of investors into strategically important and needed infrastructure projects.

- A comparison of the financial advantages between government and privately financed infrastructure projects. This research could include an analysis of the often perceived tradeoff between the "low cost" of government finance and the private sector's efficiency.
- The importance of financial engineering for private sector sponsors in their endeavors to win BOT infrastructure project contracts.
- The potential financial and social benefits of enacting legislation minimizing the political and regulatory risk of privately developed infrastructure projects.
- The development of a rating system specifically for evaluating BOT infrastructure project investments.

BIBLIOGRAPHY

Agarwall, O.P. and J.B. Miller, "Confederation Bridge over the Northumberland Strait," *Infrastructure Development Systems IDS-97-T-010*, Massachusetts Institute of Technology, 1997

Agarwall, O.P. and J.B. Miller, "The Dulles Greenway," *Infrastructure Development Systems IDS-97-T-014*, Massachusetts Institute of Technology, 1997

Agarwal, O.P. and J.B. Miller, "The Santa Ana Viaduct Express (SAVE)," *Infrastructure Development Systems IDS-97-T-011*, Massachusetts Institute of Technology, 1997

Agarwall, O.P. and J.B. Miller, "The SR91 Express Lanes," *Infrastructure Development Systems IDS-97-T-012*, Massachusetts Institute of Technology, 1997

Ainley, William M., "Making B-O-T Work for a Major Bridge Project," *Public Works Financing*, November, 1993

Augenblick, Mark and B. Scott Custer, Jr., *The Build, Operate, and Transfer (BOT) Approach to Infrastructure Projects in Developing Countries*, The World Bank, Washington, D.C., 1990

Azad, Bizhan and Michael D. Jacobs, *Infrastructure Finance and Institutions, A Review of International Experience*, Department of Urban Studies and Planning, MIT, 1986

Behrens, W. and P.M. Hawranek, *Manual for the Preparation of Industrial Feasibility Studies*, United Nations Industrial Development Organization, Vienna, 1991

Beidleman, Carl, Donna Fletcher and David Vesbosky, "On Allocating Risk: The Essence of Project Finance," *Sloan Management Review*, Spring 1990

Brealey, Richard A. and Stewart C. Myers, *Principles of Corporate Finance*, Fifth Edition, McGraw Hill Company, New York, 1996

Burns Fry Limited, "Nothumberland Strait Crossing – Private Sector Financing," The Department of Public Works of Canada, November, 1987

Canmac Economics Limited, "Travel Time Literature Review: Northumberland Strait Crossing Project," The Department of Public Works of Canada, February, 1993

Carter, Lawrence, *Financing Public Infrastructure*, The World Bank, Washington, D.C., 1996

Clark, Forrest D. and A.B. Lorenzoni, *Applied Cost Engineering, 3rd Edition*, Marcel Dekker, Inc. New York, N.Y., 1997

Delmar, Clare E. and Aurelio Menendez, *Infrastructure Financing in the United States, Issues and Mechanisms*, Department of Urban Studies and Planning, MIT, 1986

DeWolf, A. Gordon, "Financial/Economic Considerations of Northumberland Strait Crossing Project," 1995

Emerson, C., *Project Financing*, The Financial Times Business Enterprise Ltd., United Kingdom, 1983

Financing Private Infrastructure, The World Bank, Washington, D.C., 1996

Financing Private Infrastructure, The World Bank, Washington, D.C., 1994

Finnerty, John D., *Project Financing, Asset-Based Financial Engineering*, John Wiley & Sons, Inc., New York, 1996

Fitch Investors Service, L.P. Research Report: "The Port Authority of New York and New Jersey – JFK International Air Terminal L.L.C. Project," New York, New York, 1997

Gardner Pinfold Consulting Economists Limited, "A Benefit-Cost Analysis of the Northumberland Strait Crossing Project," The Department of Public Works of Canada, September, 1993

Giannakopoulos, Dimitris, *Creating Infrastructure for Europe's Unification: Financing and Management of Construction Projects in the European Union*, MIT Thesis, Master of Science in Civil and Environmental Engineering, 1995

Gordon, Christopher M., "Choosing Appropriate Construction Contracting Method," *Journal of Construction Engineering and Management*, American Society of Civil Engineers, Vol. 120 No. 1, March, 1994

Guidelines for the Development, Negotiation and Contracting of Build-Operate-Transfer (BOT) Projects, Draft, United Nations Industrial Development Organization, Washington, D.C., 1995

Higgins, Robert C., *Analysis for Financial Management*, Fifth Edition, Irwin/McGraw-Hill, USA, 1998

Huang, Melissa and John B. Miller, "International Arrivals Building at John F. Kennedy International Airport," Infrastructure Development Systems Case #IDS-98-A-101, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1998

Ichiniowski, Tom, "Federal Outlays Hit 50-Year Low," *Engineering News Record*, The McGraw-Hill Companies, New York, February 16, 1998

Irwin, Timothy, Michael Klein, Guillermo E. Perry and Mateen Thobani, *Dealing with Public Risk in Private Infrastructure,* The World Bank, Washington, D.C., 1997

Kayaloff, Isabelle J., *Export and Project Finance: A Creative Approach to Financial Engineering*, Euromoney Publications, London, 1988

Kerf, Michael, R. David Gray, Timothy Irwin, Céline Lévesque and Robert R. Taylor, *Concessions for Infrastructure, A Guide to their Design and Award*, The World Bank and The Inter-American Development Bank, Washington, D.C., 1998

Kreydieh, Ahmad, *Risk Management in BOT Project Financing*, MIT Thesis, Master of Science in Civil and Environmental Engineering, 1996

Lambert, Bradley, "Construction Contracts for Independent Power Producers," *Construction Business Review*, HLK Global Communications, Inc., January-February 1994

Lessons of Experience Financing Private Infrastructure, International Finance Corporation, The World Bank, Washington, D.C., 1996

Levitt, R.E., D.B. Ashley and R.D. Logcher, "Allocation of Risk and Incentive in Construction," *Construction Division Journal*, ASCE, September, 1980

Miller, John B., *Aligning Infrastructure Development Strategy to Meet Current Public Needs*, Doctoral Thesis, Massachusetts Institute of Technology, 1995

Miller, John B., *America's Emerging Public/Private Infrastructure Strategy: The End of Privatization*, Draft, Massachusetts Institute of Technology, 1997

Nevitt, Peter K., *Project Financing*, Fourth Edition, Euromoney Publications, London, United Kingdom, 1983

Nevitt, Peter K., *Project Financing*, Fifth Edition, Euromoney Publications, London, England, 1989

Peterson, George E., *Infrastructure Finance: Financing Urban Infrastructure in Less Developed Countries*, Office of Housing and Urban Programs, U.S. Agency for International Development, Washington, D.C., 1991

Peterson, George E., *Infrastructure Finance: Roundtable on Urban Infrastructure Financing*, Office of Housing and Urban Programs, U.S. Agency for International Development, Washington, D.C., 1991

Peterson, George, G. Thomas Kingsley and Jeffrey P. Telgarsky, *Infrastructure Finance: Institutional and Macroeconomic Issues*, Office of Housing and Urban Programs, U.S. Agency for International Development, Washington, D.C., 1991

Poole, Robert W., Jr., "SR91: A Triple-Header for Privatized Infrastructure,' *Public Works Financing*, July-August, 1993

Regan, Edward J., III, "Estimating Traffic and Revenue on SR91," *Public Works Financing*, July-August, 1993

Reinhardt, William G., "Kiewit Moves SR91 Financing to Closure Launching a New Era in U.S. Toll Roads," *Public Works Financing*, New Jersey, July/August, 1993

Reinhardt, William G., "P.E.I. Bridge Project Essentials," *Public Works Financing*, November, 1993

Robson, Andrew J., *Designing and Building Business Models using Microsoft Excel*, McGraw-Hill Book Company, London, U.K., 1995

Samii, Massood V.; MIT Visiting Professor, "Construction Finance Lecture Notes," MIT Course 1.145, September, 1997

Sawyer, James S., *A Comparison of Project Finance, Buy-Back and Joint Venture Agreements in Financing International Business Ventures*, MIT Thesis, Master of Science in Management, 1985

Smith, Suzanne, *The Private Sector in Infrastructure: Strategy, Regulation, and Risk*, The World Bank Group, Washington D.C., 1997

"Time and Change," *Bechtel Briefs*, McGraw Hill Publishing Company, May, 1993

Tiong, Robert L.K., Khim-Teck Yeo and S.C. McCarthy, "Critical Success Factors in Winning BOT Contracts," *Journal of Construction Engineering and Management*, American Society of Civil Engineers

Van Horne, James C., *Financial Management and Policy, 6^{th} Edition*, Prentice-Hall, Inc., New Jersey, 1983

Walker, C. and A.J. Smith, *Privatized Infrastructure: The Build Operate Transfer Approach*, Thomas Telford Publications, London, England, 1995

Williams, Charles E. and Suzanne Conrad, "The Return of the Private Toll Road," *Construction Business Review*, American Society of Civil Engineers, January/February 1996