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The major contributions of this study are: (1) the development of a toll highway pre-project planning tool that integrates probabilistic risk analysis and simulation concepts that were not of practical use before into an affordable and easy to use computer model, and (2) a conceptual and mathematical representation of the major variables that affect the financial outcome of a toll highway project and their interaction.

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FEASIBILITY EVALUATION MODEL
FOR TOLL HIGHWAYS

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Research Report SWUTC/05/467502-1

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ABSTRACT

This report describes the development of a Feasibility Evaluation Model for Toll Highways (FEMTH). FEMTH is a financial feasibility and risk analysis computer model developed to assess the degree of financial risk associated with a toll highway project in the pre-project planning stage. The model incorporates the use of simulation through a spreadsheet add-in that enables probabilistic risk analyses of the most important variables that affect the financial outcome of a toll highway project.

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EXECUTIVE SUMMARY

Assessing overall financial risk of a toll road project demands realistically describing the variability associated with the inputs to the analysis, a task that is partly quantitative and partly subjective. The context in which toll road projects exist, within a larger transportation system with competing modes, and within the strategic economic plan of a state, region or nation, must be well understood in order to reasonably describe the variables influencing their behavior, and hence, their feasibility. Chapter 2 situates the reader in this macroeconomic transportation framework and Chapter 3 provides an understanding of the origination of a toll highway and other essential BOT project concepts. Chapters 4 and 5 set the project life cycle stage at which this feasibility evaluation model (FEMTH) is intended to be used, and discusses the feasibility and risk analysis concepts used for project evaluation.

Chapter 6 discusses the development of the FEMTH, from a theoretical concept to its final application and incorporation of risk analysis in a computer model. This chapter also describes all the feasibility evaluation input variables and their proposed probabilistic description, as well as the incorporation of a toll-traffic demand model to predict one of the model's most important inputs, traffic.

Chapter 7 brings to light the recent experience with the BOT concept for toll roads in Mexico, which provided extensive data for this research. It's problematic example illustrates the importance of a realistic feasibility and risk evaluation, and exemplifies the high impact that risk can have in this type of project. In addition, this chapter describes in detail the toll-traffic demand model within the context of the Mexican toll road network. Chapter 8 applies the FEMTH to two case studies in the Mexican network, demonstrating that the results yielded by both the FEMTH and the toll-traffic demand model are fairly reliable when compared to actual performance of the case studies.

Chapter 9 draws the following major conclusions and recommendations:

1. The application of the risk analysis methodology and computer simulation can effectively assess the financial risk associated with a toll highway in its early stages and lead to better investment decisions.
2. The application of the FEMTH before a decision on whether to commit the resources for the project is made can lead to a total reconfiguration of the project or its definitive abandonment. The results yielded by the FEMTH can expose and measure the specific weaknesses of a project. If these weaknesses can be re-assessed, by a reduction in project

scope or a change in the design strategy, a marginally risky project can be turned into a profitable investment.

3. The results of the FEMTH help identify critical risk areas in a toll road project. One of the most important characteristics of a successful toll road concession agreement is an adequate risk allocation strategy.
4. The results yielded by the model can also help governments establish the amount of financial support granted to projects that are socially needed but not commercially profitable. In this manner, a financially constrained government can leverage its infrastructure construction funds.

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CHAPTER 1: INTRODUCTION

Governments throughout the world in both industrialized and developing countries are experiencing financial problems to expand and maintain their road networks. The causes of these problems include issues such as development needs, nature of travel demand, growth pressures, competing modes, and limited government fiscal resources. Traditional government means are not enough to solve this problem, and a number of alternative solutions to road infrastructure funding have been explored in recent years. Toll financing and direct private sector involvement (OECD, 1987) are among the most widely used.

This report views toll highway projects from a private investment perspective. The primary objective of any private sector investment decision is profitability. According to Schaevitz (1988), any user-fee financed project, whether public or private, involves the private sector as lender/investors. Public-private projects, such as a toll highway, involve a degree of risk and control granted to a private entity. As a condition to assume a greater risk, the private sector will require greater control and a higher return on the investment. Risk is present in all stages of a toll highway project, and the degree of risk involved in it will be proportional to its financial attractiveness. A comprehensive tool that could help to effectively assess the financial risk associated with a proposed toll highway would certainly be of extraordinary value to potential investors and analysts.

BACKGROUND

In recent years there has been a strong worldwide movement towards the involvement of the private sector in the provision of public infrastructure, especially highways. Some of the forces that are driving this movement are the scarcity of public resources, a political trend towards the deregulation of infrastructure, and the expansion of global capital markets.

Due to the size and nature of this type of project, the financing strategy has to be more complex than traditional construction project finance (Queiroz, 1997). The large amounts of capital needed, the uncertainties and risks in the project itself, such as cost, schedule and traffic projections, and the political and economic conditions of the particular time and country are only some of the factors that have influenced the success of these projects.

Nevertheless the worldwide experience of the private sector in highway infrastructure finance is still very limited. There are both success and failure stories, the latter being more common. Lessons have been learned, and the experiences have served to redesign the diverse contractual and financing schemes for private participation in a sort of trial and error process.

One of the countries that has recently embarked on a comprehensive program of highway construction involving the private sector is Mexico. In 1989 the Mexican government launched a very aggressive program, with a private sector investment equivalent to US $6.5 billion, for 5,400 km of new toll roads and eight bridges to be completed before 1995 (Roth, 1996). However, in some cases construction costs exceeded substantially the initial budget and most of the new roads carried significantly less traffic than initially projected. This placed the private highway corporations in a difficult financial situation trying to meet their debt payments that depended on toll income. This became worse with the economic crisis that hit Mexico in 1995. Inflation and interest rates soared, traffic slowed down further, and the financial situation of the private toll roads became unmanageable. In 1997 after many attempts to solve the problem, the Mexican government finally took over most of the financially troubled highways (Gómora, 1997).

The case of the Mexican toll highway network is thoroughly analyzed in a later chapter. Its problems are a good example of the dramatic impact that risk and uncertainty can have on the success of this type of project, especially when private capital is at stake, and the bottom line is profits. In order to justify the investment on a certain project, a private sector investor needs to perform a thorough feasibility analysis to quantify the potential outcome, and more importantly, the risk associated with it.

The importance of developing a decision making tool, a comprehensive feasibility evaluation model that can help to realistically assess the financial outcome of a proposed toll highway project and the risk associated with this outcome, is very evident. This model should encompass all the variables that affect a project's financial outcome through its lifecycle phases, from design through construction and specially those that are fundamental to the success of the operation phase, tolls, and traffic. These two variables and their relationship were thoroughly analyzed especially for this research project in the study by Orozco (1997) that is thoroughly discussed later in this report.

At the present time risk analysis concepts and tools that were not of practical use before can be incorporated into the feasibility evaluation model thanks to the continuously improving computer technology and affordable hardware and software prices. Thus, the model should be comprehensive enough to include all the intricacies and complexities of a toll highway project, but it must be a user-friendly tool that yields realistic results that help investors make a better decision when embarking on such an enterprise.

OBJECTIVES OF THE RESEARCH

This research is part of a broader toll highway research project that included the toll-traffic demand study mentioned in the previous section. This study essentially developed a set of mathematical models that describe the interaction between toll prices and the volume of traffic using a toll highway facility. These models are integrated into this report as a fundamental part of the project evaluation process.

The overall objective of the research work presented in this report is the creation of a financial feasibility evaluation model to be used as a tool that facilitates the iterative financial and risk analysis processes of the planning and feasibility stages of a proposed toll highway. The major sub-objectives of the research are:

1) Develop an understanding of the variables that affect the financial outcome of a toll highway project and their interaction.
2) Develop a computer model that incorporates the variables and represents their interaction to calculate the financial function chosen to evaluate feasibility.
3) Determine the probabilistic nature of these variables and the probability density function (PDF) that best describes them.
4) Incorporate into the computer model risk analysis tools that perform Monte Carlo simulation on the most sensitive variables to obtain the PDF of the financial outcome of a proposed project.
5) Bring together the results of this research with the toll-traffic study mathematical model discussed previously.
6) Implement and test the computer model on a real world case study.

SCOPE OF THE STUDY

The feasibility evaluation model for toll highways is intended for use during the conceptual planning stages of the project lifecycle, that is, before committing further resources for project development and the facility is finally authorized for detailed design and construction. The model provides decision-makers in the public and private sectors with an effective tool to assess the overall financial outcome of a toll highway project investment. This tool comprises all of the elements that influence the facility during its lifecycle, describes their interaction, and more importantly, accounts for their probabilistic nature.

The results yielded by the model include probability distribution functions and detailed statistics for the project profitability measures (i.e. net present value and internal rate of return), and for all of the input variables in the model. In addition, the project's most critical variables can be determined and ranked thanks to the sensitivity analysis capabilities built into the model's risk analysis engine. This is an invaluable tool to evaluate the financial feasibility of a project, since the decision-maker not only obtains a figure of the expected financial outcome of the investment, but also a measure of the likelihood of attaining it and the variables that most affect this outcome. The ability to measure the risk associated with a project can make the difference between a good and a bad investment decision, and definitely provides a cutting edge in a go/no-go situation for any major investment project.

RESEARCH APPROACH AND METHODOLOGIES

Figure 1.1 shows the research approach for this study. The study began with a literature review of different aspects of toll roads, such as history, recent past experiences, and current worldwide practices, as well as the economic and financial theory of toll roads. The case of the recent toll road program in Mexico was selected for study due to its extent and the availability of fresh data. Government transportation authorities, private consultants, and concessionaires directly involved in the Mexican toll road program were contacted in order to facilitate the data gathering process. Data about the construction, operation, and maintenance of the projects, as well as financial and legal aspects of the program was gathered. Extensive literature about the program origins, characteristics, criticisms, and experiences was also obtained.

The development of the model began with the analysis of the data gathered and the information obtained in the literature review. The variables that affect the financial outcome of a toll road project (a pre-selected measure of investment worth) and the relationships among all of them were identified. These relationships were expressed by a series of numerical computations by which the measure of investment worth is calculated and put together in a computer spreadsheet template. The computer model was then manually tested with data from the Mexican toll road program and the results evaluated to detect computational problems, missing variables and then verified to yield realistic figures. Additional data was gathered and analyzed to correct problems found and refine the model. This process was repeated several times, resulting in the final version of the model template structure.

The variables of the model were then classified into random and deterministic, and the toll-traffic demand model mentioned earlier was programmed into the spreadsheet template. The probability distribution functions that best described each of the random variables were determined through statistical data analyses where data was available, from the literature review and from expert subjective judgments. Finally, the spreadsheet template was automated for easier user input and integrated with the simulation software engine that serves to model these random variables.

Once the model was deemed as ready, two case studies in the Mexican toll road network, which had recently been re-evaluated by the Mexican Ministry of Transportation (SCT), were analyzed in depth with the final version of the model. The results obtained from the analysis performed were documented, interpreted and then compared against those obtained by SCT.

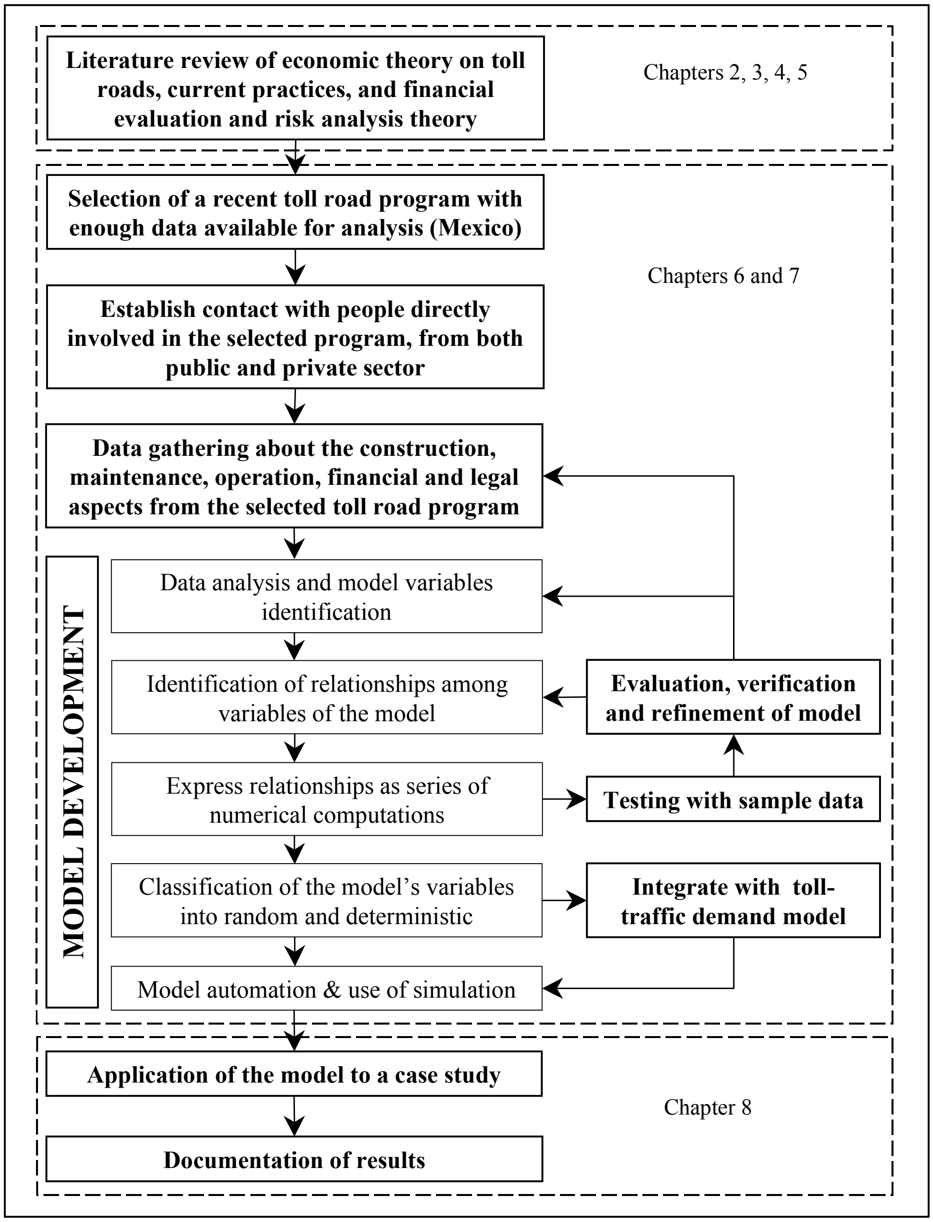


Figure 1.1 Research Approach

ORGANIZATION OF THE REPORT

This report consists of nine chapters. Chapter 1 presents the background, objectives, research approach, and methodologies of the study. Chapter 2 discusses the role of transportation infrastructure in the economy of a country; where being part of a much larger transportation system, toll roads necessarily interact with other roads and transportation modes. Chapter 3 provides an overview of private sector involvement in the provision of road infrastructure, the legal and financial framework under which this participation occurs, and a review of recent worldwide experiences and practices in this area. Chapter 4 discusses issues related to toll highway project feasibility and planning, and introduces the financial evaluation concepts and methods used in the development of the model. Chapter 5 offers an overview of project evaluation under uncertainty, risk analysis, and the Monte Carlo simulation method as applied to financial feasibility analysis.

Chapter 6 presents the final version of the feasibility evaluation model, the model variables, their interaction, and the computer model structure. The software used to incorporate the simulation capabilities is introduced here as well. The toll-traffic demand model developed as part of this research is integrated at this point to the feasibility evaluation model, and the issue of the selection of an appropriate probability density function for the variables modeled in the simulation process is also covered in this chapter. Chapter 7 discusses the Mexican toll highway program, its origins, characteristics, problems, and final rescue by the government. The data gathered from the Mexican toll road network is summarized and analyzed to expose the high impact that risk and uncertainty can have in the success of such projects. The toll-traffic demand estimation model developed as part of this research project is thoroughly discussed under the light of the Mexican experience. Chapter 8 presents the application of the model to two actual case studies in the Mexican toll road network, and the results obtained from the analysis are discussed and compared to the actual performance of these cases. Finally, Chapter 9 presents the summary, conclusions and recommendations.

CHAPTER 2: ROAD INFRASTRUCTURE AND THE ECONOMY

Toll roads are an integral part of a nation's larger road infrastructure network. Roads can be very seldom treated as isolated projects. They interact with a number of other socioeconomic variables and infrastructure elements. This chapter is intended to develop an understanding of the macroeconomic environment surrounding toll roads. This background will serve to establish an economic framework for the feasibility analysis of these projects and illustrate the powerful reasons that motivate governments to constantly pursue the improvement of their transportation networks.

At the present time, as the world economy expands, international markets, finance, and manufacturing are rapidly intensifying their integration. This expansion and integration are both the result and the source of an unprecedented level of personal mobility and increasing freight activity. As a result, both industrialized and developing nations are experiencing similar transportation challenges. Adequate and efficient transportation infrastructure is key if a country is to take advantage of the opportunities for growth in a rapidly changing global economic environment.

This chapter discusses first the role of transportation infrastructure in the economy of a region or country. The concepts of multimodal and intermodal systems in transportation planning, and the importance of viewing individual transportation projects as elements of a larger macroeconomic system are explored as well. Finally the discussion focuses on road infrastructure as the dominant transportation mode in this new economic order. The relationship between road infrastructure and a nation's economic development is discussed in order to develop an understanding of its strategic role in the modern economy.

ECONOMICS OF INFRASTRUCTURE

Although the scope of this report is only within transportation infrastructure, and more specifically within toll roads, in order to clearly realize their significance in the economy, it is important to understand the overall role of infrastructure in a socioeconomic system. According to the Civil Engineering Research Foundation (CERF, 1997), infrastructure is defined as:

> Infrastructure is the basic facilities, services, and installations that are needed for a society to function – such as roads, bridges, airports, dams, buildings and housing, landfills, drinking water, sewage treatment plants, etc. Safe, efficient infrastructure is vitally important to the well being of our society. Quality infrastructure is critical to our economic future, quality of life, and productivity because it is essential to our ability to carry out our daily activities.

Adequate infrastructure is fundamental to the social and economic activity of the human society. Throughout history the development of economic and social systems has been closely linked to phases of infrastructure development (Hudson, 1996). As the World Development Report of 1994 (World Bank, 1994) analogizes, infrastructure represents, if not the engine, the "wheels" of economic activity.

The world's economic environment is rapidly evolving and becoming closely interlinked in the process known as "globalization". As geographical regions integrate their national economies, the boundaries between them virtually disappear. Euritt and Harrison (1994) state that "businesses that are 'of markets' and not 'of nations' are a "new reality" in the world context. More competitive global trading demands more dependable and sophisticated transportation, telecommunications and energy.

A region's socioeconomic system is supported by its infrastructure. Grigg (1988) illustrates the flow of goods and labor in an economic system and the points where infrastructure is necessary with the diagram presented in Figure 2.1. Industry and government provide goods and services to the public in exchange for money. The public supplies labor to industry and government, which pays salaries and wages in return. The public uses this money to purchase the goods and services mentioned first. Both of these entities use natural resources and energy to perform their activities. Infrastructure is necessary to furnish the transportation to deliver goods, services, water, and energy. It is also necessary to handle waste products and provide buildings to house the economic and social activities. Efficient infrastructure boosts labor productivity and reduces the cost of producing goods thus benefiting the entire economic system, but it has to expand fast enough to accommodate growth (World Bank, 1994).

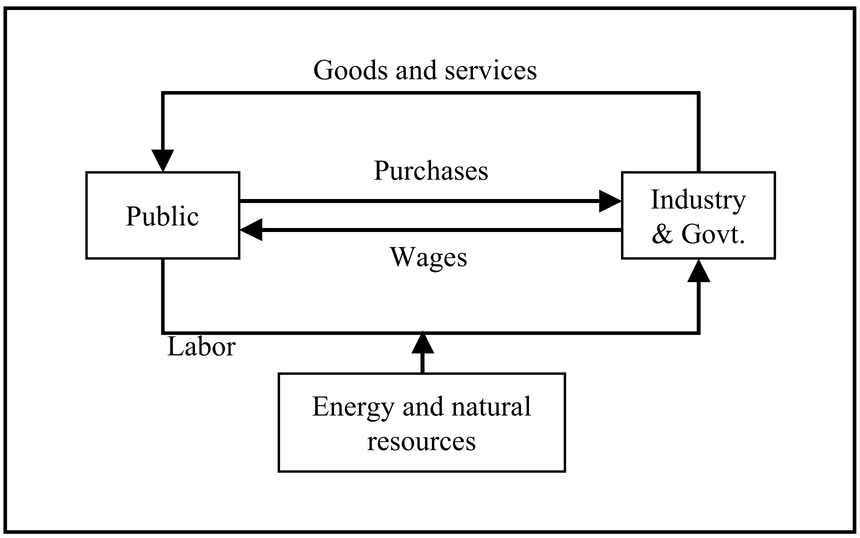


Figure 2.1 Economic System Supported by Infrastructure (Grigg, 1988)

Research carried out by the World Bank has demonstrated that the economic strength of a nation is strongly linked to its infrastructure assets (Queiroz, 1997). As Queiroz points out, infrastructure plays a strategic role in a nation's economy by diversifying production, increasing trade, coping with population growth, reducing poverty, and improving environmental conditions. This relationship is further discussed later in this chapter, focusing on the role of road infrastructure in the economy.

Regional Transportation Infrastructure Planning

The largest of all infrastructure categories is transportation. It is integrated by a complex set of systems interwoven throughout a region's economy (Grigg, 1988). Adequate development of transportation infrastructure promotes an efficient distribution of population, industry, and income throughout a country or region (Queiroz 1992). The development of such a system is the result of the elaboration of a comprehensive transportation sector program/plan that is aligned with the economic development objectives and regional transportation policies that a government plans to pursue. This program/plan provides the framework to evaluate the incorporation of individual transportation projects into the national or regional system.

The transportation sector plan works in two phases. The first is to assess the region/country's overall transportation needs and provide a basis for weighing these needs against the requirements of other sectors of the economy. The second phase is a detailed survey of the conditions of the region/country's transportation system and policies so that priorities within the sector can be established (Adler, 1987).

The objective of the plan is to identify promising projects, relate them to one another, determine priorities, and to relate all projects together to the macroeconomic plan. Analysis of isolated projects is not sufficient because in the transport sector projects tend to be closely related (Adler, 1987). For example, the success of a toll highway project may depend on whether a competing railway or a parallel road is improved; a port investment may depend not only on what is done to competing ports, but also on rail and road connections to the port. An efficient coordination between transportation modes must be pursued when elaborating the transportation sector master plan. This concept is known as multimodalism and is further discussed in the following section.

Multimodal and Intermodal Transportation Systems

The organized transfer of goods and people moving from one mode to another is an essential ingredient for an efficient transportation system. The integration of the transportation systems network within a region improves mobility and fosters economic growth. Reducing travel cost and duration, improving safety and providing smoother, quicker, and fewer transfers between modes achieve these objectives. In addition to the mobility issue, other social objectives can be attained such as sustainable energy, environment preservation, etc. Euritt and Harrison (1994) have addressed this issue in several studies. The concepts discussed throughout this section are taken from their research work on multimodal and intermodal transportation.

Multimodal transportation systems concentrate on transportation links and providing system users with modal alternatives along those links. An example of a multimodal system is two urban centers connected by air routes, highways, and railroads. There are two key issues to multimodalism: choice and competition. The choice of a particular mode will depend on how competitive it is with other modes. Equitable competition for traffic among different modes is a requirement for successful multimodal transportation systems.

Intermodalism refers to the connection of several different modes into a seamless transportation system with efficient intermodal transfer terminals. The most important part of an intermodal network, are these connective terminals or nodes. Intermodal transportation networks improve efficiency by using the modes best suited for each portion of a transport route. An example is an automobile parts manufacturer located in Mexico City that uses trucks to ship parts to Laredo, Texas. In Laredo, the trailers are transferred as containers to a train that will deliver them to the automobile assembly plant in Detroit. The use of trucks is more reliable and thus cost-effective for the Mexican portion of the route than rail service. However for the U.S. portion of the route, rail is preferred for its lower transportation cost coupled with a reliable service.

Myers (in Euritt and Harrison, 1994) presents a description of multimodalism and intermodalism from a planning perspective:

Multimodal planning is a process of:

- Defining a transportation problem in a non-mode-specific manner,
- Identifying more than one modal option to solve the problem, and

- Evaluating these options and obtain an impartial estimation for each mode's contribution, individually or combined, to assess a transportation problem.

Intermodal planning is a process of:

- Identifying interactions between one or more modes of transportation where affecting performance or use of one will affect another,
- Defining schemes for improving the effectiveness of these modal interactions,
- Evaluating the effectiveness of these schemes to enhance the performance of the whole system affected by intermodal connections.

Hence, within the planning context multimodal is treated from a larger transportation systems macro-perspective, while intermodal focuses on the study of modal interactions affecting the transportation system performance. Myers states that "Multimodal planning provides the general context within which intermodal planning occurs" (Euritt and Harrison, 1994).

The interest on multimodal and intermodal transportation systems is relatively recent, and has arisen from both the public and the private sectors. Scarcity of public sector resources and intensifying global competition for trade are forcing governments to seek more efficient transportation through intermodal and multimodal systems. On the private sector side the reasons to pursue these systems include maintaining competitiveness, improving efficiency and quality of transportation, securing greater regional and international markets, and meeting international standards (Euritt and Harrison, 1994).

The trend towards multimodal and intermodal transportation systems will have a tremendous impact in the process of planning national and regional transportation networks, including infrastructure financed with private funds. According to Euritt and Harrison (1994), the evaluation of the economic consequences of various transportation alternatives from a multimodal systems perspective will yield transportation operations different from what exists today. The evaluation of any transportation project should be performed within this entire macroeconomic framework in mind, whether it is a toll or toll free highway or a railroad. Failure to do so will probably result in an unsound investment, from any point of view, whether it is public or private.

ROAD INFRASTRUCTURE AND ECONOMIC DEVELOPMENT

Having an idea of the interaction of the different transportation modes, and the planning implications that this interaction has, the rest of this chapter narrows down the discussion to the transportation subsystem where toll roads dwell, the regional road networks. According to recent statistics, roads are currently the dominant surface transportation mode in every country for both passengers and freight. Table 2.1 shows data for specific countries. The statistics also show that roads continue increasing their modal share, although this gain is occurring at a faster pace in developing economies than in industrialized countries (United States Department of Transportation [USDOT], 1997).

Table 2.1 Road Transport Share for Selected Countries (USDOT 1997)

COUNTRY	PASSENGERS		FREIGHT	
	Roads	Other Modes*	Roads	Other Modes*
United States (1994)	87.7%	12.3%	52.5%	47.5%
European Union (1993)	89.0%	11.0%	70.6%	29.4%
Japan (1994)	60.2%	39.8%	52.5%	47.5%
India (1992)	85.0%	15.0%	60.0%	40.0%
Canada (1994)	92.5%	7.5%	50.0%	50.0%
Mexico (1993)	95.0%	5.0%	80.0%	20.0%

*Other modes include railroad, air and sea transportation

The basic structure of a region's transportation system is its network of roads, streets, and bridges. Almost every industrial or consumer good is transported on a highway at some point of its economic cycle. The retail price of these goods to the consumer ultimately reflects the cost of transportation. Most of workers in industrialized countries travel to and from the workplace on motor vehicles, and particularly in developing countries, roads serve to market agricultural products and provide access to basic services (Organization for Economic Cooperation and Development [OECD], 1987). Businesses insist on transportation speed, efficiency, and flexibility in meeting their needs, relying heavily in logistics, and usually road transportation offers the most flexibility and reliability.

Efficient road networks combined with a balanced multimodal transportation system enhance a region's competitiveness by moving goods economically. Accessibility to transportation corridors is a major factor for the success of any marketing effort, from agricultural to high-tech products. On the other hand, inadequate access to transportation corridors or a deficient road network deters investment in agriculture, industry, and trade, and forces the transportation cost of goods to remain high. By nature, business decisions are based on competitive advantages, hence those regions with more adequate transportation networks have better development opportunities than those areas with a deficient transportation system (OECD, 1987). An adequate transportation network implies an economically efficient equilibrium among the different transportation modes.

Empirical Evidence

Queiroz (1992) has further researched the relationship between road infrastructure and economic development. His research has shown that there is a very strong association between economic development, in terms of per capita gross national product (GNP), and road infrastructure.

Queiroz's research on this subject can be broken down into two parts; the first one explores the association between GNP and road infrastructure density. The second compares the supply and condition of paved roads in developing and developed countries. Both analyses were performed on a per capita basis for comparison purposes. The variables used in the analysis are defined as follows: GNP is the total value of the goods and services produced in a nation's economy during a given year. GNP per capita is a country's gross national product divided by its population. Spatial road density is a country's road length per land area, and road density is per capita length of the road network.

The first part consists of a cross-section analysis of data from 98 developed and developing countries, and a time series analysis of United States and Canadian data from 1950 to 1988. Both analyses show a significant positive relationship between per capita GNP (PGNP, in US$1,000 per inhabitant, using 1988 constant dollars) and density of paved roads (length of paved roads, LPR in km per 1000 inhabitants). The equations yielded by the analyses are the following:

Cross-section analysis of 98 countries

$$PGNP_{88} = 1.39 * LPR \qquad (2\text{-}1)$$

Time-series analysis of U.S. data

$$PGNP_{88} = -4.1 + 1.5 * LPR \qquad (2\text{-}2)$$

Time-series analysis of Canadian data

$$PGNP_{88} = 0.86 + 1.33 * LPR \qquad (2\text{-}3)$$

The three equations are plotted in Figure 2.2, along with the associated statistics. The plot shows that there is a relatively fair consistency between the equation for the 98 countries and the equation for Canada. The equation for the U.S. data shows about a 13 percent greater road density for any given PGNP value (Queiroz in Hudson, 1996]. The statistics obtained reveal that a 1 percent increase in GDP is associated with approximately 0.8 percent increase in paved road density per capita. However, neither cross-country nor the time series analyses have fully established whether infrastructure investment causes growth or growth causes infrastructure investment (World Bank, 1994). Even though correlation does not entail causality, it is evident that economic development and road infrastructure investment are closely associated.

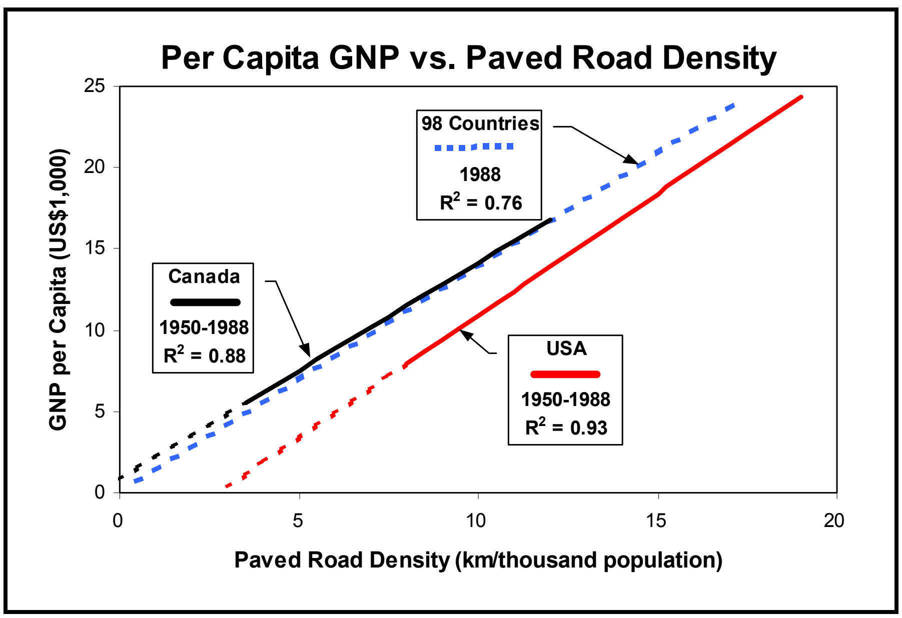


Figure 2.2 PGNP vs. Paved Road Density (Queiroz, 1992)

The second part of the study by Queiroz compares the supply and condition of paved road networks in 98 developing and developed countries. The World Bank classifies road conditions into three categories (Queiroz, 1992): (a) Good, (b) Fair, and (c) Poor. The countries analyzed were divided into three categories, according to their GNP per capita in 1988: (a) Low-income economies (PGNP of US$545 or less), (b) Middle-income economies (PGNP between US$545 and US$6000), and (c) High-income economies (PGNP larger than US$6,000).

The results of the analysis are presented in Figure 2.3. The results are plotted on a logarithmic scale, and the chart shows that the supply of roads in high-income economies is substantially higher than in middle and low-income economies. Another important result is the association between road condition and economic development. The average density of roads in good condition (km/million inhabitants) is also significantly higher in high-income economies than in low-income economies. The difference in density of paved roads in good condition among the three groups is even more dramatic. The association between economic development and quality of road infrastructure in terms of maintenance standards is also very clear.

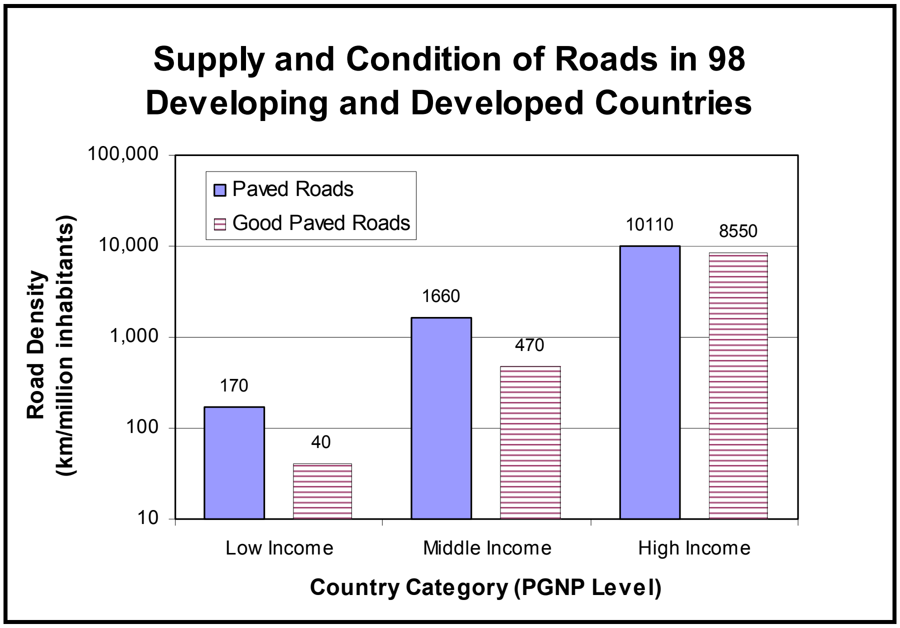


Figure 2.3 Average Road Density and Conditions (Queiroz 1992)

As mentioned earlier, it is very difficult to determine a direction of causality between economic growth and road infrastructure from this type of analyses. It could be argued that growth of the GNP leads to a less restricted budget for new construction and adequate maintenance of the existing network. However, Queiroz states that evidence has been found by several authors suggesting that roads should precede development (Queiroz, 1992).

The strategic importance that road and highway infrastructure has for the economic development of any region is very clear. The availability of a good highway network is essential for any country to take full advantage of the developing opportunities that are arising with the economic integration of regions in the world. Governments throughout the world are exploring a number of alternatives to expand and improve their highway networks in order to be able to compete in the current world economic environment. One of these alternatives is to involve the private sector in the provision of road infrastructure projects, i.e. toll bridges and roads. The development of these public/private partnerships is discussed in the following chapter.

CHAPTER 3: PRIVATE PROVISION OF ROAD INFRASTRUCTURE

The participation of the private sector in the provision of public infrastructure has increased over the past two decades, and private toll highways are experiencing a worldwide surge in popularity. Creative financing techniques are being adopted to sustain the shift from public to private sector risk bearing in infrastructure provision. There are a number of reasons for this growing trend. One is the fact that governments at all levels are facing a shortage of fiscal resources and at the same time they are facing a growing public demand for infrastructure services, especially those requiring large investments such as roads and power projects. Another reason for this is the notion that the private sector is more efficient than the public sector, and can therefore construct and operate infrastructure at less cost.

This chapter presents an overview of private sector involvement in road infrastructure. First the rationale behind the global trend towards private sector participation in public/private partnerships in infrastructure provision is discussed, focusing on the BOT scheme. The legal and financial framework under which private toll roads operate and other basic concepts that will be used in later chapters are discussed as well. Finally, a review of toll road experiences and practices in several countries throughout the world is presented. This chapter is intended to complete the macroeconomic background that started in Chapter 2 and provides the framework under which toll highway projects must be analyzed for their overall feasibility.

PRIVATE PROVISION OF INFRASTRUCTURE AND PUBLIC/PRIVATE PARTNERSHIPS

In the modern era and especially in developing countries, infrastructure had traditionally been planned, financed and administered by the public sector, in part due to its crucial role in the economy but also due to the massive capital costs involved and governmental regulation. Under this system tax revenues and government borrowing were the predominant source of infrastructure finance. About 90 percent of all financial flows for infrastructure were channeled through sponsor governments, which bore almost all project risks. Many countries made a remarkable progress in infrastructure expansion under this scheme, but more recent experience has revealed a severe misallocation of resources as well as failure to respond to demand (World Bank, 1994).

The privatization wave that has recently swept the world shows that this public infrastructure provision scheme is not accepted any more. According to the World Bank, almost 1200 infrastructure privatization projects have been undertaken worldwide since 1989, and the infrastructure requirements over the next ten years can only be met through private investment. Private sponsorship and financing offer the benefits of additional funds and more efficient provision to meet the growing demand for infrastructure. This global privatization trend is also known by the acronym PPI, which stands for Private Provision of Infrastructure (Queiroz, 1997).

Factors Driving Private Participation in Infrastructure

There are a number of factors that have induced the increasing participation of the private sector in the provision of infrastructure. Among the most noticeable are the following:

The first is the shortage of public funds to meet infrastructure needs. Governments are experiencing a growing gap between infrastructure needs and availability of fiscal funds and aid from external agencies. Symptoms range from poorly maintained bridges and highways in rural areas, to congested city traffic and airports.

Governments have recognized that private investment is needed to meet their infrastructure shortfall and have responded by implementing policies that allow and encourage private participation. Deregulation of infrastructure, privatization of state owned enterprises, and concession of public services are some of the policy innovations that have increased the role of the private sector.

Second is the notion of efficiency in private enterprises. The private sector has proven to be more efficient than the public sector in terms of construction cost and schedule and operation of customer oriented services (Bond & Carter, 1994). The public sector usually plans, designs, bids, and builds major facilities in a sequential process, completing each stage before starting the next. Private firms can avoid numerous restrictions and obstacles and realize cost savings by constructing facilities more quickly, using fast track or design-build construction schemes, thus bringing the investment into service sooner. In addition, a private firm has profit as a clear incentive to operate the facility efficiently. Private enterprises operate within a restricted budget that is a function of revenues, operating costs and a targeted return on investment, thus having to control costs to achieve efficiency and profitability (Quinn & Olstein, 1985).

Third is the expansion of capital markets and innovative infrastructure finance mechanisms. In recent years the volume of trade and the range of instruments used on the international capital markets have substantially increased, as venture capitalists and institutional investors in developed countries seek to diversify their portfolios and achieve higher returns. Besides, the large size and long payback periods of infrastructure projects have required the creation of more innovative financing techniques (Bond & Carter, 1994, and Queiroz, 1997).

Private financing eases the burden on government budgets and encourages better risk sharing, accountability, monitoring, and management in infrastructure provision (World Bank, 1994).

PPI and the Creation of Public/Private Partnerships

There are conflicting considerations and arguments that must be balanced when assessing the efficiency advantages of PPI. On the one hand, there are the cost, productivity, and flexibility advantages that arise from private sector involvement. On the other hand, government involvement in issues such as siting of the facility may be quicker or unavoidable when disputes are complex and opposition intransigent. Another issue is the public fear to the creation of a private monopoly that could lead to governmental regulation, hence undermining the advantages initially provided by the private enterprise (Gomez-Ibañez & Meyer, 1993).

To address these issues, private sector involvement in infrastructure, particularly in roads, has been approached as Public/Private Partnerships, as opposed to outright deregulation and/or privatization. Full privatization and/or regulation imply that the private enterprise will be working under free market conditions, therefore assuming all the risk inherent to any private enterprise. Conversely, Public/Private Partnerships are cooperative undertakings between public and private sector entities to develop or improve public infrastructure.

The Public/Private Partnership concept only applies to those endeavors that produce benefits or profit opportunities for both entities, complementing their particular strengths. Risk sharing and allocation between public and private partners make possible the development of important and necessary projects that neither party would be willing to venture alone (Payson & Steckler, 1996). Toll roads are a good example of widely used Public/Private Partnerships.

Structure of Public/Private Partnerships

Public/Private Partnerships are characterized by the degree to which the public and private sectors share the risks, obligations, and benefits of a project. . The mix of public and private responsibilities and the risk allocation scheme varies from project to project, and the structure of a partnership depends on the particular mix of responsibilities. Some of the structural options available for Public/Private Partnerships in road infrastructure include the following models, organized in ascending order of private involvement and risk bearing (Payson & Steckler, 1996):

1. *Operation and Maintenance Contract.* The private partner operates and maintains a publicly owned road under contract with the sponsoring government, assuming no commercial risk.
2. *Lease-Develop-Operate (LDO).* The private partner gets a long-term lease to operate and expand an existing road. The private partner agrees to invest in road reconstruction and rehabilitation and can recover the investment plus a reasonable return at the end of the lease, either through direct government payment (shadow tolls) or charging tolls to users.
3. *Build-Transfer-Operate (BTO).* The private partner finances and builds the road, and upon completion transfers legal ownership to the sponsoring government. The government then leases back the road to the private partner under a long-term lease, during which the private partner operates the facility and has the opportunity to recover the investment plus a reasonable return through the tolls charged. This method is similar to the BOT model but can avoid some regulatory and liability issues that can arise from private ownership of transportation infrastructure.
4. *Build-Operate-Transfer (BOT).* The private partner receives a franchise to finance, build, operate, and collect tolls on a road for a specified period of time, after which ownership of the facility is transferred to the public sector. This type of structure is a form of concession.
5. *Build-Own-Operate (BOO).* The private partner finances, builds, owns, and operates a road in perpetuity. The private partner takes full responsibility for the project and all the risks but is entitled to all of the rewards.

Operation and management contracts are common in the United States for the maintenance of local authority roads. BOO is rare because of the public sector regulation on tolls and other aspects of highway projects (Roth, 1996). LDO and BTO are considered variations of the BOT scheme. At the present time most privately provided toll roads are operated under some variation of the BOT franchise scheme.

The Bot Scheme And Private Toll Roads

Levy (1996) states that developed and developing countries are embracing the BOT concept for a variety of reasons with the same end result: private consortiums assembling complex construction projects for public usage, anticipating high returns on investment over the life of that investment. As the most widely used Public/Private Partnership model BOT is the structural scheme under which toll highways will be analyzed throughout this report.

The BOT franchise arrangement is also a form of concession usually referring to totally new projects. Queiroz (1997) defines concession as “a contract whereby a public entity grants the right and obligation to provide a public service to a private company (the concessionaire).” In a concession the host government remains the owner of the facility and regulates its operation through the concession contract. The private partner is responsible for the capital investment, construction, operation, and maintenance of the highway. The private partner assumes the commercial risk of operation, and shares the investment risk with the public sector. The concession contract stipulates the toll to be paid by users and the duration of the concession, which typically lasts between 15 to 50 years (Queiroz, 1997). At the end of this period, when all the investment costs have been recuperated from tolls, and a profit obtained, title to the project passes from the private concessionaire to the host government.

The private concessionaire of a BOT project generally provides equity financing for 10 to 30 percent of the total project cost and seeks debt financing for the rest of the investment. The host government occasionally furnishes the right of way or a partial tax relief. Nevertheless, many BOT projects are structured without any form of governmental assistance (Levy, 1996).

The BOT Concession Agreement

The concession agreement is a formal legal contract between the host government and the private concessionaire that defines the responsibilities of each party and the terms of their relationship. Although important issues in concession agreements vary according to the specific context of individual projects, some common provisions include (Payson & Steckler, 1996):

- Minimum service and safety standards
- Mechanisms for dispute resolution
- Explicit provisions for the concessionaire to charge user fees and earn a reasonable return on the investment
- A reasonable rate of return and a mechanism to enforce the rate of return limitation
- Limits on the government’s ability to take over the facility except in case of private default or noncompliance
- Provisions for the extension of the franchise agreement in case of force majeure circumstances
- Allowance for the concessionaire to seek damages from the government in case of diminution of opportunity to earn a reasonable return
- Limits on the tort liability of the concessionaire
- Performance incentives for achieving public objectives (e.g. reduced accidents)

The limited experience with toll roads makes it very difficult to predict future revenues; therefore private partners often seek concession agreements that include government guarantees of traffic projections. The downside to this practice is that governments providing these guarantees retain the financial burden of the long-term liabilities for the roads. Furthermore, two of the main advantages of private provision disappear: the assumption of the traffic risks and the incentives to make their services attractive so as to get more customers (Roth, 1996). The Mexican toll road example, presented in a later chapter, shows that when risks can be shifted back to the government, incentives for good performance are greatly weakened.

Basic Elements of a BOT Concession Project

According to Levy (1996), the basic elements of a BOT concession project include a financially feasible project, a perceptive host government, private sponsors, local partners, and a group of experienced construction professionals interacting in a complex web of binding agreements. Figure 3.1 shows a detailed diagram of the elements involved in a BOT project (Roth, 1996).

The Host Government. The host government must be fully committed to the project, enact legislation that permits the creation and operation of the BOT project, provide the necessary support throughout the life of the concession, and in case of default, have the resources to take over the project.

Private Sponsors. The private sponsorship of a BOT concession project is generally a complex organization composed of one or several large construction or engineering firms, lending institutions, insurers, institutional investors, and other types of equity investors (private or government backed).

Local Partners. Some host governments require the use of local labor, contractors, etc. The participation of local members, especially if they are politically well connected is a major advantage.

Construction Consortiums. A BOT project is generally rather large and complex; it usually requires participating construction companies to assume some degree of the project's risk.

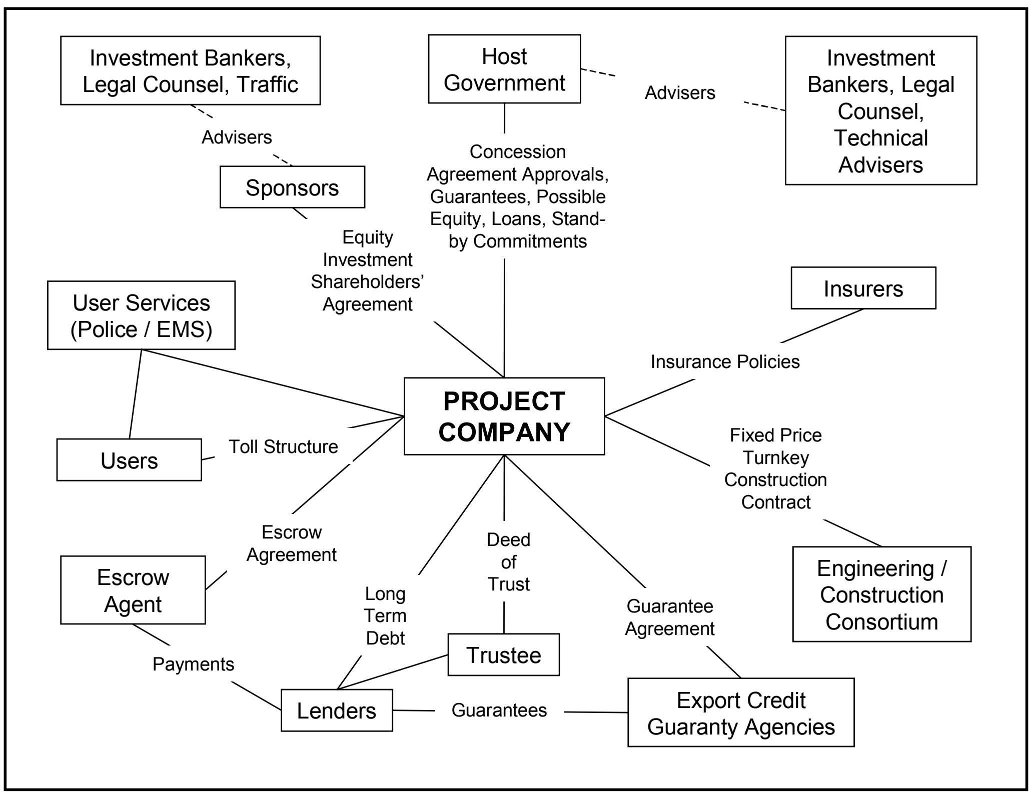


Figure 3.1 BOT Concession Project Structure (Roth, 1996)

The BOT Concession Process

The concession award process of a BOT project differs from the regular public works bid process. Typically the host government specifies the project to be bid upon, but instead of using the lowest construction cost as the award criteria, the bid is awarded to the bidder offering the lowest competitive toll. The winner builds and operates the road over the specified concession period and is paid from the tolls collected from users or from a specified "shadow" toll. Shadow tolls are amounts paid to road providers on the basis of traffic counts on their roads. These are not paid by the users but directly to the concessionaire by the host government (Queiroz, 1997).

BOT Project Financing

In BOT projects the concessionaire raises the project funding and then pays the financing costs from project revenues, relying on the independent financial feasibility of the project. The profitability of the project over its entire life must be clearly demonstrated in order to attract long-term investment at competitive interest rates. The project cost estimate must be sound and the projected toll-traffic revenues realistically estimated. The funds for the project are generally raised through capital markets and other institutional investors.

As mentioned earlier the private members of the BOT project generally provide equity financing for up to 30 percent of total project cost. Debt financing on the other hand is provided by commercial banks, international financing institutions such as the World Bank, or bilateral government lenders. This type of debt is called "non-recourse" debt, because lenders do not have recourse to the project sponsors. The only source of repayment for creditors is the revenue generated by the project. A well-structured project is likely to get financing from international development banks for 15 years or more. Commercial banks represent a more flexible source of capital, but there are some risks that they will not bear or will price very high. They require earlier repayment and thus are not very appropriate for use on long-term projects (Levy, 1996).

World Bank Guarantees for BOT Projects

The World Bank can provide partial risk guarantees to commercial lenders for projects involving a government and the private sector. Partial risk guarantees are instruments that are intended to bridge the gap between international and commercial bank infrastructure project financing by mitigating those risks that private lenders are not prepared to accept. Queiroz (1997) defines World Bank guarantees as: "An irrevocable commitment to a third party that has loaned funds to a borrower in a Bank member country that the Bank will repay the guaranteed portion of the obligation if, under specified conditions, the borrower does not." A partial risk guarantee is triggered by debt service default resulting from the host government noncompliance with one or more of its obligations as specified in the concession agreement with the concessionaire (World Bank, 1998).

The partial risk guarantees offered by the World Bank share a project's risks between the Bank and the private lenders. The guarantee covers those risks that the Bank is uniquely positioned to bare, given its credit experience and special relationship with governments. These risks include nonperformance of the host government contractual obligations and other political force majeure aspects of a BOT project, for example a guaranteed minimum revenue, currency exchange transfer risks or changes in law that affect the project's ability to service its debt. The World Bank requires a counter-guarantee from the host government, which is provided through an indemnity agreement between the Bank and the government. Figure 3.2 illustrates the approach to a World Bank guarantee in a BOT concession project (Queiroz, 1997).

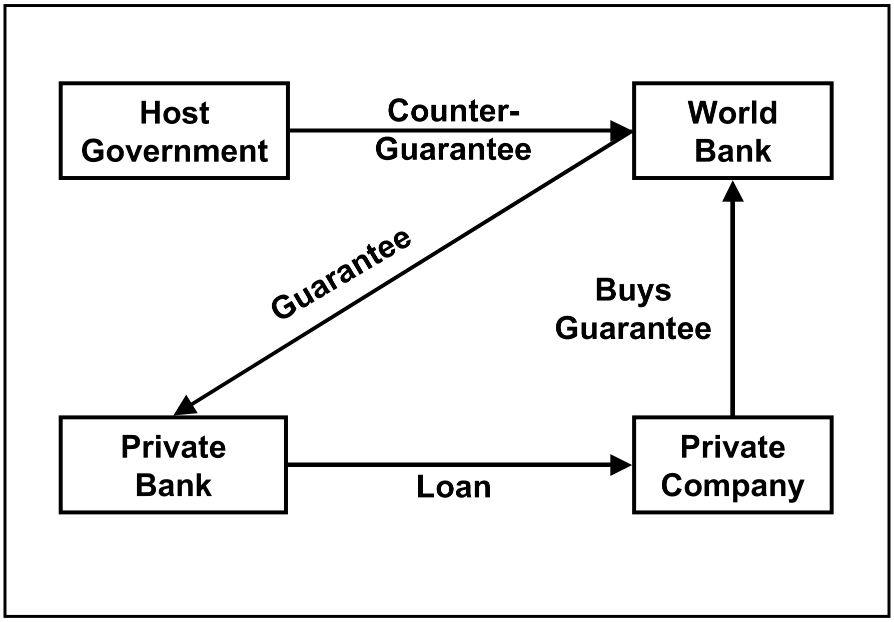


Figure 3.2 World Bank Guarantee Approach (Queiroz, 1997)

The guarantee can help the private sector and host governments in a variety of ways. The guarantee reduces the cost of financing by covering the risks that the private lender would not bear. The repayment period of the loan can be extended beyond the term for which commercial banks would normally lend, a fundamental consideration for toll road projects that require long-term debt in order to match debt service with their long payback periods.

With a guarantee the private sponsors can choose the best financial structure for the project, such as the currencies and markets they borrow in and the type of interest rate (fixed or floating). On the other hand, governments benefit by reducing their contingent liability to the minimum required to make a project feasible, letting the private sector take on all or a substantial part of the commercial risks. This pattern differs substantially from the traditional model where a government bears the entire risk in a project (World Bank, 1998).

Advantages And Disadvantages Of Private Toll ROADS

Advantages

There are several major advantages and disadvantages of private toll roads. Nonetheless, at the present time the advantages that arise from private provision of roads clearly exceed its disadvantages. Some of the advantages that are often cited include:

- *Additional funds for road construction*. The main advantage is that toll financing enables governments to raise more money for road construction than would be possible through regular public financing (OECD, 1987).
- *Enhanced performance.* According to the OECD (1987), in countries with toll roads it has been found that toll facilities provide better quality maintenance than comparable free facilities. The reason for this is that the typical finance arrangement for a BOT concession requires periodic inspection and maintenance reports to protect users and lenders.
- *Construction cost and schedule.* Private toll roads will often be built sooner and at less cost than projects financed through public agencies (Roth, 1996).

- *Ability to finance expansion.* Private providers have access to sources of funds seeking profitable investments, and can use them to improve and extend the road. The public sector, on the other hand, can be subject to political constraints on expansion for a variety of reasons (Roth, 1996).
- *Other economic considerations.* Tolls can be used as a method of congestion pricing, encouraging users to make more efficient route choices or use alternative transportation modes (OECD, 1987).

Disadvantages

On the other hand, toll roads in general have been criticized for being inefficient in the following ways:

- *Costs of toll collection.* Manual toll collection causes indirect costs, such as delays and increases fuel consumption, by requiring vehicles to stop or slow down at toll plazas. Besides, direct costs can absorb up to a third of total revenues (Roth, 1996). The recent advances achieved in automatic vehicle identification (AVI), and electronic toll collection (ETC) will progressively make toll collection easier and less costly (OECD, 1987).
- *Total traffic costs increases.* Traffic cost can increase due to longer traveling distances. Some users will increase their trip length in order to avoid toll roads, resulting in increasing congestion on the parallel "free" roads (OECD, 1987).
- *Never gets to be a free road.* Very seldom do toll roads become free roads, even after they have been paid off. Once a road has been perceived as a secure source of income, it is difficult for governmental authorities to surrender the extra revenue.

Shadow tolls, mentioned earlier, can help overcome these obstacles, since the user does not directly pay for the toll. On the other hand, the advantage of congestion pricing cannot be achieved by the use of shadow tolls (Roth, 1996).

Overview Of Current Toll Road Development Activity

Privately provided toll roads have been part of the transportation scenery well before the motorcar. Hundreds of toll road companies operated in Great Britain and the United States early in the nineteenth century. However, by the middle of the century, the upsurge of the railroad put most of these companies out of business, and the roads reverted to the public through abandonment, interrupting the development of roads (Poole, 1996).

After World War II, toll roads became very common in Europe. According to the International Bridge, Tunnel, and Turnpike Association (IBTTA), as of 1990 there were more than 14,000 kilometers of toll roads in Europe. Most of the major intercity highways in France, Italy, and Spain are toll highways, developed under the BOT scheme. A similar network was established in Japan. Sharp increases in construction and maintenance costs, and lower traffic growth after the 1973 oil crisis led to financial difficulties for numerous toll road projects. In all four countries the governments had to step in to assist unprofitable highways by using the excess revenue from the lucrative ones (Roth, 1996).

The privatization revolution of the 1980's renewed worldwide interest in private provision of road infrastructure. There have been successes as well as failure stories. The following are some highlights of the more recent experience with private toll road projects for several countries throughout the world.

Europe

The world's largest BOT project to date is the $15 billion, 50-kilometer Channel Tunnel linking Folk stone, in the UK and Calais, France. It is composed of two rail tunnels linked by a central service tunnel at a depth of 24 to 45 meters below the seabed. This project is entirely funded by private capital (debt and equity) with no government loans or guarantees, only a long-term franchise agreement (Poole, 1996).

In the late 1980's the British government engaged the private sector for a major share of new road and bridge infrastructure. In 1989 the government requested proposals to finance, construct, and operate the Birmingham Northern Relief Road. This project is to be operated as a toll road for fifty years, after which it is to be transferred back to the government, free of debt. The project cost was almost £350 million (Roth, 1996).

In France, the law was amended in 1990 to allow private firms to provide urban and intercity toll ways. The French government announced in 1991 a major new intercity highway program to be developed in its majority under the BOT scheme (Poole, 1996).

The first privately financed road in Eastern Europe became a possibility when the Hungarian government passed a road concession law. The M1-M15 motorway will connect Budapest with the main highways to Vienna and Prague. The road segments in Hungary are a 42.4-km extension of the existing M1 road to the Austrian border, completing the 260-km Vienna-Budapest highway, and a 14.5-km branch to the Czech border, completing the link to Prague (Roth, 1996).

North America

Canada

In the early 1990's the economic recession suffered by Canada created a C$10 billion budget deficit. As a strategy to stimulate the economy, the Ontario provincial government announced its desire to seek private sector involvement in transportation infrastructure projects in 1993 (Levy, 1996).

As traffic congestion in Ontario was estimated to cost businesses around C$2 billion a year, the construction of Highway 407 was accelerated. Highway 407, a 99-km public/private multilane toll road project, will act as a major east-west connector and serve as a bypass to metropolitan Toronto. The total project cost is estimated at C$929.8 million and to be completed by the end of 1998 (Levy, 1996).

One of the most costly BOT projects in North America is located in he Canadian provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland. It is a 12.9-km bridge spanning the Northumberland Strait, from Jouriman Island, New Brunswick to Borden, Prince Edward Island. This bridge will eventually be tied to the Trans-Canadian highway system with Highway 104 in Amherst, Nova Scotia, another BOT project under development (Levy, 1996).

United States

The federal Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) contains comprehensive privatization provisions that encourage all types of highway facilities to be operated with tolls (except for the interstate system) and by the private sector under some form of franchise. Privately provided new toll roads, bridges, and tunnels not part of the interstate system became eligible for 50 percent grants from the federal Highway Trust Fund (Poole, 1996). However, probably due to the conditions attached to federal funds, no privately financed roads resulted from ISTEA in the four years following its passage. Private provision of toll roads has seen more advances in the states of California and Virginia, with each state opening a privately provided toll road in 1995.

In 1989 the California legislature passed a bill that enabled the California Department of Transportation (Caltrans) to develop partnerships with private entities to design, build, and operate toll highways under thirty-five year leases on state-owned rights-of-way. The first road opened in December of 1995 as a “congestion reliever” toll road consisting of four new “Express Lanes” (two in each direction), sixteen kilometers in length in the median of SR 91 in Orange County. Toll collection and enforcement are carried out electronically through transponders set in the vehicles’ windshields, which enable users’ accounts to be automatically debited. The SR 91 Express Lanes is the first highway in the world to use fully automated electronic toll charging (Roth, 1996).

In July of 1990, the Commonwealth of Virginia approved a twenty-three-km toll highway from Dulles Airport, near Washington, D.C. to the town of Leesburg. The highway is called the Dulles Greenway, and it is an extension of the Dulles Toll Road that connects the Dulles International Airport with the Washington Beltway. The total project cost was $418 million, borrowing $279 million from banks and insurance companies. Initial average daily traffic was of 9,500 vehicles, only a third of the initially projected level. Thus, in order to attract more traffic, tolls were reduced from $1.25 to $0.90. In 1996, the users of the Dulles Toll Road and the Greenway were given the option of using the Fastoll Electronic Toll Collection (ETC) system and using the same transponder for both roads, providing a “seamless" integration of the roads (Roth, 1996).

Mexico

The Mexican government launched an aggressive toll road construction program in 1989. The Mexican toll road program has already been mentioned in the introduction of this report, and it is thoroughly discussed in Chapter 7.

Asia

Early in 1978 the Chinese government announced a series of reforms aimed at modernizing the country’s economy. The provision of roads by the private sector using the conventional BOT scheme was part of these measures. The best example of these BOT projects in China is the Guangzhou-Shezen superhighway. The project is a joint venture between Hopewell Holdings, the private partner, and an agency of the Guangdong provincial government. Hopewell is responsible for the road’s design, construction, and maintenance, and is entitled to 40 percent of the project’s profits over a thirty-year concession period (Roth, 1996).

Japan’s modern toll road program was introduced after World War II through its government agency Japan Road Public Corporation (JRPC). Japan is considered “the most toll oriented nation in the world” (Takeda in Roth, 1996), with more than seventy toll expressways, for a total of 6,600 kilometers in length. However, the role of the private sector in the program has only been limited to support JRPC activities, serving as a contractor for research, construction and maintenance of the network (Roth, 1996).

In Thailand the experience with private provision of roads has not been the best. The Bangkok’s Second Stage Expressway project, a 35-km elevated expressway is the subject of a major international dispute between the Thai government and the project’s financial sponsors, including the Asian Development Bank. The project, with an initial cost of US$1.04 billion, was awarded as a thirty-year BOT concession by the government to a Japanese-led private consortium, which was to be allowed to charge a toll of 30 baht (about US$1.20). Just as the first stage of the road was about to be opened in 1993, the Thai government balked at the 30 baht toll initially specified and proposed a 20 baht toll. Hesitating to absorb the proposed reduction, the consortium delayed opening the completed sections of highway, and halted construction when its lenders suspended credit. The government issued a court order to force the road open, claiming to fear public disturbs on the part of frustrated drivers angered at being unable to use the highway, insisted in reopening negotiations, and ended up charging the original 30 baht toll (Roth, 1996).

CHAPTER 4: PROJECT FEASIBILITY ISSUES

The investment criterion used by the private sector in a market economy is that of profitability. Individuals and firms channel their capital to those activities that they expect to benefit them the most. Hence, road infrastructure provided by the private sector envisages that the users of the facility will repay the providers more than the cost of the investment. Financial profitability is a pre-requisite for a toll road project to attract private investment and must be demonstrated by a thorough feasibility assessment. *Profit* and *reasonable return on investment* are the lifeblood of private enterprise and are necessary to convince investors to undertake the risks that go with the reward (Levy, 1996). Toll roads are long-term investments and a thorough financial feasibility evaluation that spans the entire project life cycle must be performed in order to demonstrate their profitability.

This chapter is devoted to providing the background on project financial feasibility concepts that are used for the development of the financial feasibility evaluation model. First, toll road project life cycle planning and project feasibility appraisal issues and the theory of Pre-Project Planning are discussed. This section examines the aspects of project financial evaluation that provide the framework for the feasibility evaluation model presented in this report, the basic concepts of investment evaluation, the method for financial evaluation, and other factors affecting project cash flows.

PROJECT LIFE CYCLE AND FEASIBILITY EVALUATION

The programming of capital projects is modeled by the strategic plan of an organization (public or private), which is in turn influenced by market demands and resources constraints. Project evaluation or appraisal is an integral part of the project planning process and it must include all the factors that will affect the outcome of the investment over its entire life. Therefore, a feasibility evaluation requires complete understanding of the project life cycle concept and the project planning processes in order to be reliable.

Definition of Project

There are a number of definitions of project. In the case of transportation infrastructure, Gittinger (in Adler, 1987), defines a project as "an activity for which money will be spent in expectation of returns and which logically seems to lend itself to planning, financing, and implementing as a unit. It is the smallest operational element prepared and implemented as a separate entity in a national plan." The Project Management Institute (PMI) defines project as "a temporary endeavor undertaken to create a unique product or service." (PMI, 1996), adding the terms *temporary*, to imply a definite beginning and a definite end for every project, and *unique* to denote that the product or service is different in some distinguishing way from all similar products or services.

Project Evaluation

Project appraisal or evaluation is the process through which a public or private organization determines whether a project meets its strategic objectives and whether it meets these objectives efficiently. Project evaluation involves the investigation of six different aspects of a project (Adler, 1987) as follows:

- *Economic evaluation* relates to the identification and measurement of the economic costs of the project and the size and distribution of the benefits from a national (or regional) perspective. In this type of analysis all goods and services are assumed to be priced in a perfect market economy, that is, as “economic” or “efficient” prices (Dickey & Miller, 1984).

- *Social evaluation* relates to the social objectives of the project and the social, cultural, and human variables affecting the project, such as more equal income distribution or involuntary population resettlement.
- *Technical evaluation* is concerned with the engineering, design and environmental matters, capital, and operating costs estimates related to the construction stage and the operation of the facility after its completion.
- *Commercial evaluation* refers to the procurement of goods and services to implement and operate the facility and the marketing of its output.
- *Institutional evaluation* refers to management and organizational problems involved in the construction and operation of the facility.
- *Financial evaluation* is used to determine the required funds and whether the project is financially feasible, if it can meet its financial obligations and produce a reasonable return on investment. The financial analysis focuses on the actual costs and revenues of the enterprise responsible for the project, in contrast to economic analysis.

These six elements of project evaluation are closely interrelated and must be carried out adequately in a systematic manner. For example, if engineering costs are underestimated or construction is mismanaged, the project may no longer be financially or economically viable. Revenue and benefits forecasts are closely related since customers will not pay more than the benefits they receive, etc. Furthermore, Adler states that in general, a project should be undertaken only if it is both economically and financially justified (Adler, 1987).

However, evidence found by the World Bank reveals that standard project evaluation alone is not sufficient to ensure project success. The objectivity and internal consistency of standard evaluation techniques must be complemented by careful judgments about the implementation capacity of the organization and a rigorous analysis of project risks (World Bank, 1994).

The concept of risk analysis in project evaluation is introduced in the next chapter. The research work presented in this report deals only with financial evaluation, but under the assumption that adequate economic, social, technical, commercial, and institutional analyses have been properly conducted for the project and deemed satisfactory.

Project Life Cycle

The project life cycle serves to define the beginning and end of a project. It is the process through which a project is implemented from initial conception to termination. This process is often very complex, however it can be decomposed into several phases or stages, then the solutions at different stages are integrated to obtain the final outcome.

Adequate project life cycle planning is of utmost importance for feasibility evaluation, since facility operation and maintenance are also part of the project life cycle. The satisfaction of investment objectives requires consideration of the cost of operation and maintenance throughout the entire project life, and not only the initial construction cost.

Figure 4.1 depicts the project life cycle diagram and the project influence curve (Construction Industry Institute [CII], 1995). The project life cycle is divided into four different stages, defined as follows:

1. *Perform business planning.* The strategic planning involving the goals and objectives of an organization.
2. *Perform pre-project planning.* Also called front-end or conceptual project planning. This concept is discussed in detail in the next paragraphs.
3. *Execute project.* Perform the detailed engineering, procurement and construction, and start-up for a facility.
4. *Operate facility.* The use of a facility for its intended purpose.

As the diagram in Figure 4.1 indicates, the planning stages of the project life cycle have a much greater influence on a project's outcome than the project execution and operation stages. The curve labeled "influence" in the figure reflects the capacity to affect the outcome of a project throughout its different stages. It is much easier to affect a project's outcome during the early stages when expenditures are relatively minimal than it is to influence the outcome during the later stages when expenditures are more significant (CII, 1995). Hence, the importance of careful plans for a successful project outcome.

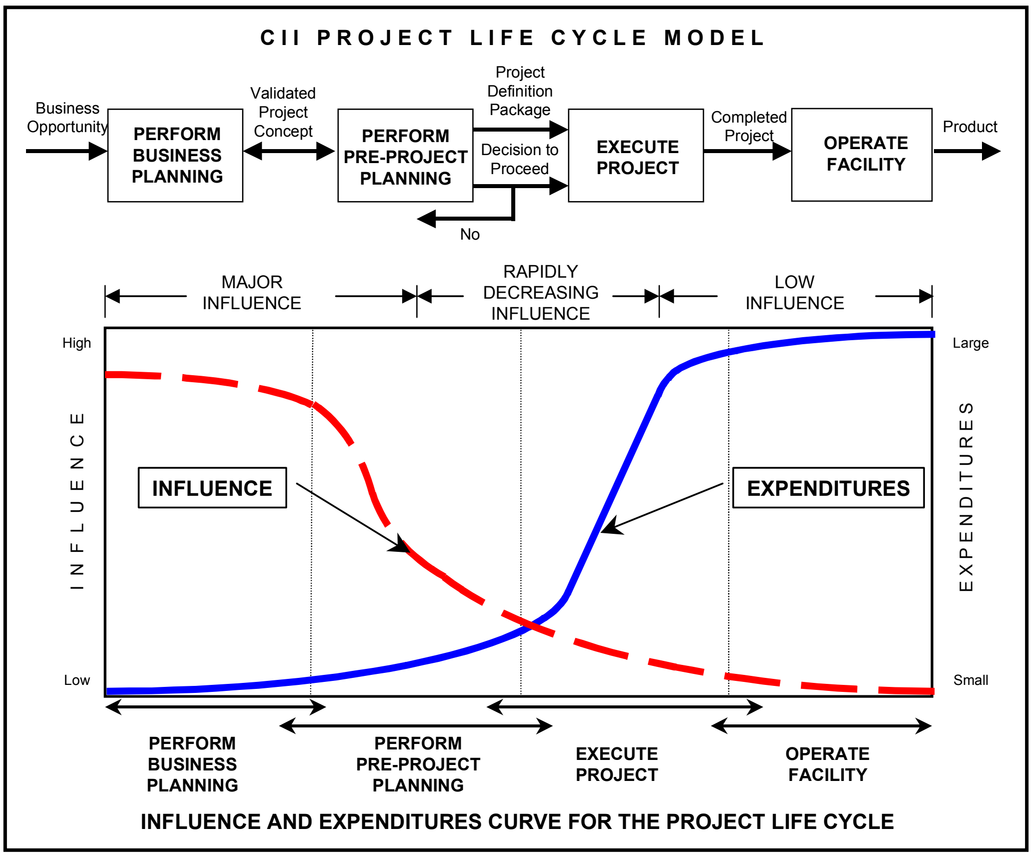


Figure 4.1 Demonstrating Project Life Cycle Diagram and Influence Curve (CII, 1995)

Pre-Project Planning

The Construction Industry Institute defines pre-project planning as "the process of developing sufficient strategic information for owners to address risk and decide to commit resources to maximize the chance for a successful project." This process provides a comprehensive framework for detailed project planning and is key in the feasibility analysis of capital projects (CII, 1995).

The *perform pre-project planning* stage comprises those sub-processes that occur after the project initial idea has been developed and validated in the business planning stage and before the project is finally authorized for detailed design and construction. It is at this project life cycle stage that the financial feasibility evaluation takes place and a decision on whether to commit the resources for a certain project investment is made. This process is discussed in detail in CII's Pre-Project Planning Handbook (1995), which provides an outline that can be used to develop specific steps and tools for the pre-project planning of capital projects.

The objective of this report is to develop a comprehensive financial feasibility evaluation and risk analysis computer model that provides an effective decision making support tool for this process. There are two functions within the pre-project planning process that are relevant for this purpose: *evaluate alternatives* and *analyze project risks*. Figure 4.2 depicts the pre-project planning process, the major sub-processes, and highlights the mentioned functions.

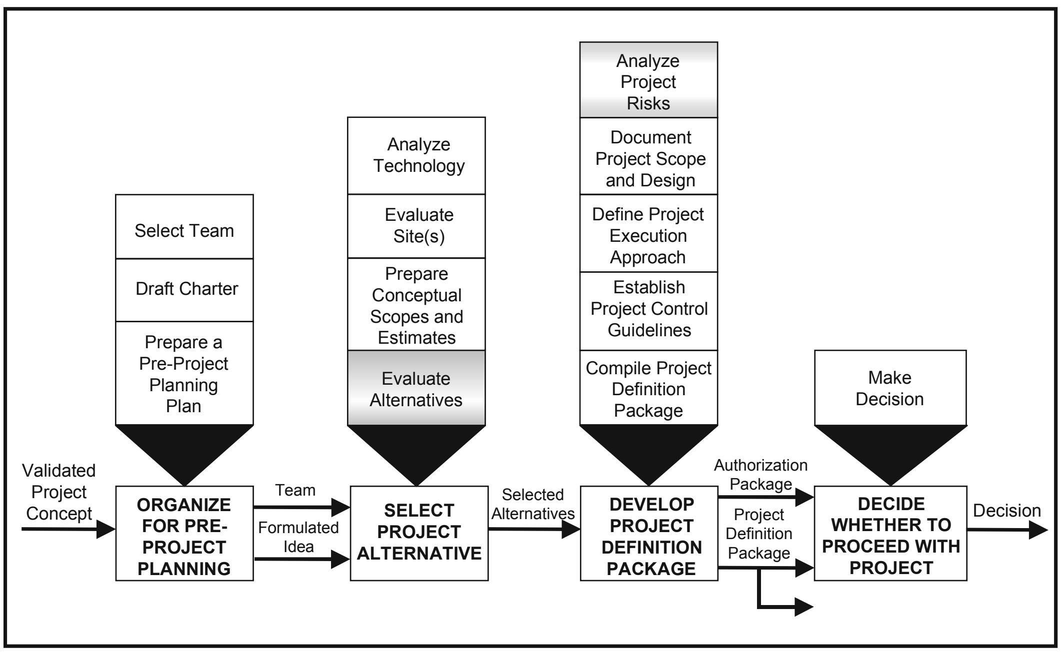


Figure 4.2 The Perform Pre-Project Planning Process,
Major Sub-Processes and Functions (CII, 1995)

Evaluate Alternatives. This function draws information from preceding efforts of technology selection, site evaluation, and conceptual scopes and estimates to develop a complete picture of each project alternative so that valid comparisons can be made. The evaluation criteria for alternative selection or go/no go decision must have a basis consistent with the organization's objectives. In most cases economics is the primary determinant for the alternative selected. CII recommends at this point the development of a computerized financial model for project profitability analysis. A financial picture can be developed to show the expected performance, and analyzing various economic scenarios can assess the major business economic risks by performing a sensitivity analysis.

Analyze Project Risks. This function refers to the identification, measurement and management of the risks associated with the selected project alternative(s). These analyses should include financial/business, technology, regulatory, operational, and project specific risk categories. The importance of project risk analysis in the project evaluation process has already been cited. For the purpose of this report, risk assessment has the objective of determining the business risk or the probability of the project being profitable. Business risk analysis seeks to determine the combined effects of uncertainty on market factors, cash flow needs, and capital and operating costs. Typically, these analyses are probability forms of the profitability analysis mentioned in the function *evaluate alternatives*.

TOLL ROAD PROJECT PLANNING FRAMEWORK

In line with the previous definition of project, toll highways can be seen as operational elements within a regional road network that can be planned, financed, and implemented as a unit. They are temporary and unique by nature. A concession has a limited life and every road project is different in size and complexity. Sound planning to ensure project success requires thorough knowledge of their characteristic project life cycle and the particular elements influencing it.

Toll Road Project Life Cycle

The previous chapter made clear that there is not a generally accepted standard model for implementing a private BOT toll highway project. The BOT concept is still relatively new, and the variations to the scheme are as broad as the number of governments throughout the world implementing this type of project. However, the general activities for creating a private toll road conform to the project life cycle concept previously mentioned in this chapter. These activities can be categorized as follows:

1. Identification of a viable route
2. Promotion (preliminary design/feasibility studies/concession award)
3. Detailed Design
4. Acquisition of right of way
5. Construction
6. Operation
7. Maintenance

Figure 4.3 presents these activities as the project life cycle stages. The first activity refers to the identification of a viable route by the host government. Promotion encompasses the process of the preliminary design, based upon which the feasibility evaluation is performed and the concession awarded. The next activities are the detailed design, right of way acquisition, and construction. It is at this point that financing for the project is obtained by going to the capital markets. The operation and maintenance stage starts when the project is ready for operation and ends when the concession period terminates. The increasing size of the arches in the diagram represents the increasing effort and expenditures at each phase. Overlap between each phase is a point where a transition occurs and where decisions are made (CII, 1995).

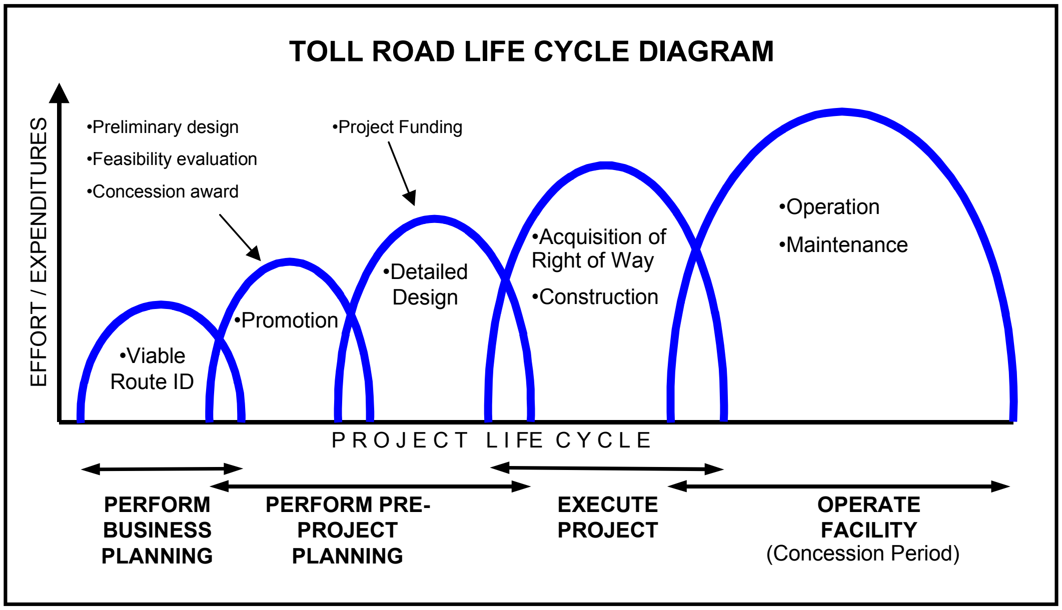


Figure 4.3 Activities and Phases in a Typical Toll Road Project Life Cycle

Toll Road Project Basic Planning Elements

Toll highway projects have several particular elements that must be well defined in the planning stage. These elements are shaped by the individual characteristics of the project, by its surrounding environment, and the macroeconomic and political variables, such as (Cervantes & Rubio, 1992):

1. *Scope definition.* The project's design should present an advance of at least eighty percent prior to construction start in order to avoid major changes in project scope and subsequent delays and additional costs
2. *Concession period.* The length of the concession period is the most important element in the feasibility evaluation, since it represents the project horizon and serves as a basis for the financing scheme.
3. *Legal and regulatory requirements.* The agreements for risk sharing and legal responsibilities. These include risk mitigation instruments such as performance bonds, guarantees, and insurance, as well as conflict and dispute resolution schemes, government regulatory issues, etc.
4. *Tolls, traffic and mechanism for price increases.* The agreed upon initial toll prices, the guaranteed minimum traffic if applicable and the mechanism for adjusting toll prices, in case of inflation or currency exchange rate fluctuation.
5. *Project Structure.* The organizational structure of the project is another key planning element. The role and responsibilities of the project members must be based upon their particular experience, qualifications, and the long-term nature of the investment.

TOLL ROAD FINANCIAL PLANNING

Toll highways are revenue-generating projects that must demonstrate their profit potential in order to attract private investment. These projects represent a major capital investment for which a comprehensive financial analysis must be carried out in the planning stages in order to determine its profitability. Financial planning decisions have a definite impact on project feasibility. Knowledge of the overall finance process, the potential sources of funds, as well as the innovative financing methods for infrastructure projects is necessary to develop a sound feasibility analysis. In addition, understanding the different financial needs of a toll road project over the different stages of its life cycle is a fundamental part of the financial evaluation.

Project Finance Process

The project finance process is an integral part of the planning stage of a private toll highway. The project's preliminary financial feasibility must be demonstrated early in the planning process in order to attract potential investors. The financial feasibility of a project can be explained as a balance among its expected cost, expected operating performance, and the investors' required return. The project's financing options and capital structure will be affected by the organizational structure of the project (see 4.2.2). The objectives of an integrated project financial analysis and planning process are the following (Payson and Steckler, 1996):

- Provide an objective method to evaluate the project options
- Integrate other project analyses (such as technical and economic analyses) into a unified implementation plan
- Ensure the consideration of the financial impact of other non-financial factors
- Identify and eliminate infeasible projects at an early stage
- Yield the various financial analyses and documents needed to attract investors

The finance process of a private toll road has three basic phases: planning and feasibility analysis, financing options analysis, and structuring and execution. From a project life cycle perspective, this process would be an integral part of the *perform pre-project planning* stage. The diagram in Figure 4.4 depicts the project finance process, its basic phases, and the functions within each phase (Payson & Steckler, 1996).

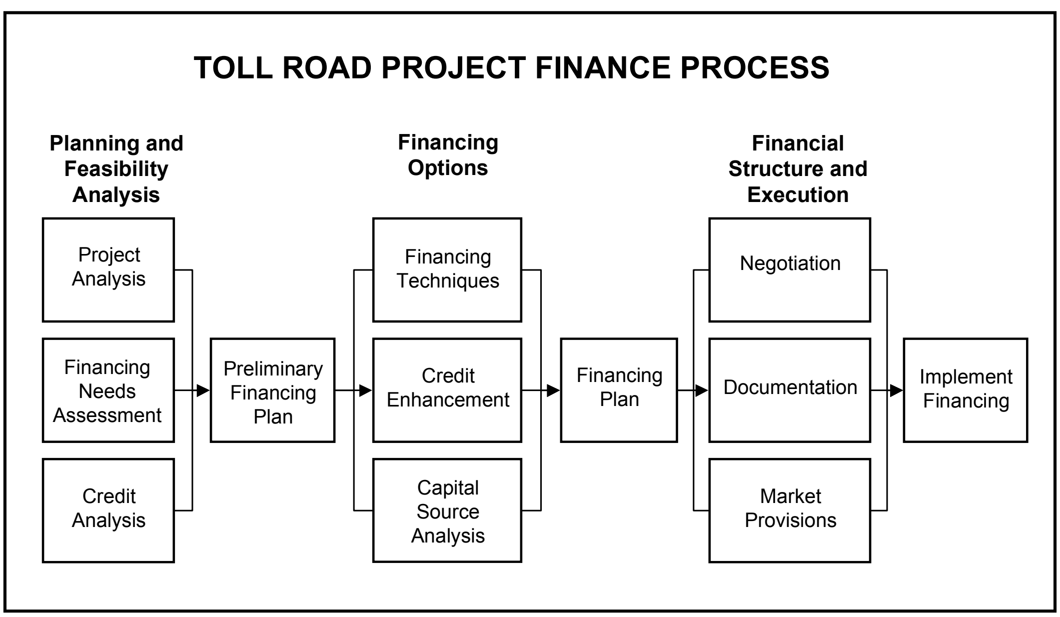


Figure 4.4 Phases and Functions within each Phase of the
Toll Road Project Finance Process (Payson & Steckler, 1996)

- *Planning and Feasibility Analysis.* This is the first phase in the finance process of a toll road project. In this phase the overall project economics are reviewed, other issues affecting project feasibility are identified and assessed, and a project implementation plan developed. This is an iterative process that includes an analysis of demand, revenue potential, capital and operating costs, and non-financial factors that affect financial feasibility. It is at this point where the standard techniques used to perform the financial analysis need to be complemented with risk analysis techniques to carry out a thorough financial feasibility analysis. Financing needs are preliminarily identified and the cost of financing is examined based upon the project's potential credit worthiness.
- *Financing Options Review.* In this phase potential financing instruments and sources are weighed and the preliminary financing plan is refined in the light of the project's financing limitations.
- *Financial Structure and Execution.* This phase begins with the financing plan and leads to financial closing (e.g. loan or securities issuance), focusing on the legal and technical aspects of project finance. Concession and other contract negotiations must be completed and the documentation prepared.

Hence, the *feasibility evaluation model for toll highways* would work as a tool to facilitate the iterative financial and risk analysis process of the *planning and feasibility analysis* phase of the project finance process mentioned.

Financing Sources

Successful financing of a toll road involves matching project characteristics with the risk-return requirements of the different sources of finance. As previously mentioned, equity financing is generally provided by the members of the concessionaire company, usually ranging between 10 to 30 percent of total project cost, whereas debt financing is obtained from commercial banks, international financing institutions or multilateral government lenders. Some of the most common financing instruments for toll road projects include the following (Bond & Carter, 1994):

- *Equity.* Long-term capital provided in the form of shares, signifying part ownership of the company. Equity holders receive dividends and capital gains (or losses) based on the project net profits.
- *Commercial Bank Project Debt.* Funds lent to a project company, secured by the project's underlying assets. Lenders seek: (a) projected cash flows that can finance debt repayment with a safety margin; (b) enough equity from project sponsors to demonstrate commitment; (c) recourse to sponsors in the event of specified problems. Besides, the time profile is a constraint for commercial banks. Their longest loans are typically 7-12 years, while toll road projects generally require financing beyond 15 years maturity.
- *Bonds.* Financial securities usually issued by large, established companies with a credit rating, to borrow long-term finance. Bonds are purchased by long term institutional investors, such as pension funds and life insurance companies, which are typically risk averse. Toll roads in operation seeking to finance expansion are good candidates for this type of financing.

- *Revenue Bonds.* Financial instruments that are secured against a project's cash flow and assets rather than those of an established company. Purchasers require a high level of confidence in the project (e.g. strong sponsors, contractual arrangements, and country environment). This instrument is a variant of the project financing method, which is discussed later.

The financing arrangements can involve a long negotiation period and review, particularly in the case of bonds, where specific legal requirements for issuance must be met. Typically, issuance of revenue bonds has a seven-month schedule between the initial financial analysis and the closing and receipt of funds. Frequently, the speed in which funds may be obtained will determine the project's financing mechanism (Hendrickson & Au, 1989).

Project Financing

Generally, toll highway projects are built and operated by corporations formed for this sole purpose. These "special-purpose corporations" bring together project sponsors and other equity holders and hold the concession title. Established companies, such as manufacturing industries, have a credit history, a customer base, and tangible assets that can be offered as security to creditors. On the other hand, toll highways, being new companies, only have the prospect of future revenues to attract investment and support loans.

Project financing is one method of raising long term debt that has arisen in recent years, usually for large, capital intensive projects such as toll highways. This method permits sponsors to raise funds secured only by the revenues and assets of the particular project, but also requires a clearer assessment of risk than traditional public projects. This form of financing can be very complex, as the interests of various parties have to be secured through contractual agreements. Lenders generally demand construction cost, schedule, and quality performance guarantees from project sponsors, or from the host government in the case that performance depends on its policy (World Bank, 1994).

Project financing is also known as non-recourse or limited-recourse financing. In *non-recourse* financing, lenders are repaid only from the cash flow generated by the project or, in case of total failure, from the value of the project's assets. On the other hand, in *limited-recourse* financing, lenders also may have claims against the assets of a parent company sponsoring the project (World Bank, 1994).

Life Cycle Financing

The project finance problem is in essence, bridging the time between making expenditures and obtaining revenues. Based on the project life cycle plan and the construction cost estimate and schedule, the cash flows of costs and receipts can be estimated. As the project cash flows will involve expenditures in early periods, this negative cash balance must be covered in the most cost-effective way. During the pre-project planning stage expenditures are moderate, while during project execution they become larger, and not until the project is complete, do revenues begin.

In spite of the different sources of borrowed funds previously mentioned, there is a fair equivalence in the actual cost of borrowing for particular types of projects. Lenders participate in many different capital markets and generally switch to those loans with the highest yield for a certain level of risk. Hence borrowed funds that are obtained from different sources usually have comparable costs, including interest charges and issuance costs (Hendrickson & Au, 1989).

The cost of funds for construction varies inversely with the risk of a loan. In order to protect from default, lenders generally require a security for a loan in the form of a tangible assets or performance guarantees, and sound feasibility analyses. To the degree that the security is of uncertain value the higher will be the interest rate demanded by the lender. Projects under construction represent considerable risk to a financial institution since there is probability of project abandonment, construction cost increases or even anticipated unprofitability of the tollway. Thus loans for projects under construction often demand a premium interest charge of several percentage points compared to loans for completed facilities (Hendrickson & Au, 1989). A reliable feasibility analysis and the use of guarantees to mitigate project risks can effectively reduce the interest rate on borrowed funds for a project and increase the return on investment and attractiveness of the project.

The most appropriate financing strategy must be used for each stage of the project life cycle. As mentioned before, the project's financing mechanism will often be determined by the timing needed for the funds. Funding for the business planning and the pre-project planning stages is likely to come from the project sponsors or potential concessionaires. The project execution and operation stages, which involve the largest expenditures, are those that demand more creative financing strategies.

There are a number of combinations of funding alternatives that can be used for the project execution and operation stages. The following are some potential scenarios:

1. Raise capital for both stages through direct equity or debt offerings in the financial markets. The major disadvantage of this scenario is the time consuming process of security issuance mentioned earlier, which in turn could delay the opening of the facility and revenue stream.
2. Obtain a loan from a commercial bank for project execution and operation. The issuance of a commercial loan is more expeditious than a bond issue, with the corresponding disadvantages on shorter maturity and higher interest rates. Although the use of performance guarantees, such as those offered by the World Bank, can attenuate these drawbacks and make commercial bank financing a competitive alternative for a sound project.
3. Complementary bank-bond financing. As previously mentioned, bonds have certain advantages that offset the constraints of commercial bank loans and vice-versa. This scenario contemplates the provision of commercial bank financing during the early, more risky years of a project, followed by refinancing with longer-term bond financing once the project is completed. Using bank-bond financing lowers project risk profiles and overcomes the obstacles to rapid fund mobilization (Bond & Carter, 1994).

Throughout the project life cycle, especially in the execution stage, unforeseen expenses, cost increases, or cash flow problems may arise. During the operation stage of the project, initial toll revenues may be lower than maintenance and debt repayment costs, and temporary revenue is needed. As a result, a reserve amount must be included in the financing plans. This reserve can be implemented as a contingency amount in the project budget, as a short term borrowing agreement with a commercial bank, or in the case of bonds, as reserve funds administered by a third party (Hendrickson & Au, 1989).

FINANCIAL ANALYSIS CONCEPTS

Private investment projects are judged in relation to whether they provide a return equal or greater than that required by investors. The financial evaluation or profitability analysis of a project is an integral part of the capital budgeting process of a private organization. Capital budgeting is the process of analyzing investment projects, estimating and evaluating their cash flows, and the selection of a project based upon an acceptance criterion (Van Horne, 1974).

The approach used to evaluate the profitability of a private toll road project in this research consists of the following steps (Hendrickson & Au, 1989):

1. Establish the project horizon (concession life)
2. Estimate the cash flow profile for the project
3. Specify the discount rate
4. Establish the criterion for accepting or rejecting a project
5. Perform a sensitivity or uncertainty analysis
6. Accept or reject the project on the basis of the established criterion

It must be emphasized that the analysis provides only a tool in the decision-making process. It is a means, not an end. Many assumptions and policies are introduced in the analysis by the decision-maker. The decision-making process is influenced by the subjective judgement of the decision-maker in as much as by the result of the analysis, which in turn will be as reliable as the data used to arrive at it.

Planning Horizon

The period of time over which the analysis looks ahead is called the *planning horizon*. For the purpose of this report, the planning horizon of a BOT toll road project is the facility life cycle comprising from project inception to the end of the concession life, which can vary from 15 to 50 years, depending upon the specific project or country legislation.

Cash Flow Profiles

The next step is to specify all the expected inputs and outputs in monetary terms, arriving at an anticipated figure of expenditures and revenues (cash flow profiles) over the n years or periods in the planning horizon. For the sake of simplicity of this explanation, interest periods of one year will be assumed, being $t = 0, 1, 2, \ldots, n$, with $t = 0$ representing the present time. The net annual cash flow (A_t), is defined as the annual revenue (R_t) in excess of the annual expenditure (E_t), at the end of year t. Thus, for $t = 0, 1, \ldots, n$,

$$A_t = R_t - E_t \qquad (4\text{-}1)$$

where A_t is positive, negative or zero, depending on the values of R_t and E_t, which are both defined as positive quantities.

Interest, Opportunity Costs and Inflation

A fundamental principle of financial decision making is the time value of money, which states that when choosing between two identical cash flow amounts, the cash flow that occurs earlier in time is more valuable. For example, a dollar today is worth more than a dollar next year, because a dollar invested today will earn interest and be worth more than a dollar by the end of the year. The interest rate is the difference between the value of current and future goods, the premium that must be paid for immediate, as opposed to deferred consumption. As long as current goods are more valuable than future goods, interest rates will be positive (Rao, 1992).

On the other hand, historically, the general economy has fluctuated in such a way as to experience inflation, which is a loss in the purchasing power of money over time. Lopez de

Ortigosa (1993) defines inflation as a generalized, irreversible, and persistent increase in the price of goods and services. It is a macroeconomic process that varies from country to country.

When money has been committed to a project, other investment opportunities that might have been undertaken by using the same funds must be foregone. The *opportunity cost of capital* is the relevant discount rate to be used for financial decision making. It is the rate of return forgone from the next best alternative, or the investor's required rate of return (RRR) for a capital investment. Determining the adequate RRR is a complex issue that warrants further discussion, but it essentially reflects the market interest rates for lending and borrowing, as well as the risk associated with a specific project.

Market interest rates take into account the combined effect of the time value of money and the inflationary expectations. The *real interest rate* is defined as the market interest rate *(nominal interest rate)* less the general rate of inflation. The greater the expected inflation rates, the higher the nominal RRR will need to be, since it reflects the real rate of return plus inflation. This concept is further explored at the end of the chapter.

Financial Evaluation Methods and Measures of Profitability

The aim of capital investment in the private sector is profit maximization within a particular time frame. A criterion or rule is needed to form a basis for the decision on whether a project should be adopted. According to Rao (1992), the best criterion is one that is consistent with the goal of maximizing profit. The best investment is one that adequately compensates its owner for the time value of money and for risk. A profit measure is the indicator of the desirability of a project from a private sector decision-maker standpoint.

According to Hendrickson and Au (1989), assuming that an organization has unlimited capacity for borrowing and lending funds at the RRR, the goal of profit maximization is best served by accepting all independent projects whose profit measure based on the specified RRR are nonnegative, or by selecting the project with the maximum nonnegative profit measure among a set of mutually exclusive proposals.

In this research two criterions or methods for financial evaluation are used: the net present value (NPV), and the internal rate of return (IRR). These methods are based on the concept of the discounted cash flow (DCF) model, which is one of the most widely used techniques for financial evaluation. The DCF model brings together all the cash flow profiles of a project over the planning horizon (adjusted for time value of money), and combines them into a measure of profitability, such as NPV or IRR. The application of the DCF model is very suitable for use with a computer spreadsheet program, hence the reason for it being selected to develop the feasibility evaluation model in this research. The following paragraphs explore these methods in more detail in a discussion adapted from Hendrickson and Au (1989).

Net Present Value

When an investment is made, the decision-maker looks forward to the gain over the planning horizon against what might be gained if the money was invested elsewhere. The RRR is selected to reflect this opportunity cost of capital, and it is used to discount the estimated future cash flows to the present. The profitability is measured by the net present value (NPV), which is the discounted value of the net return at the end of the planning horizon above what might have been gained by investing elsewhere at the RRR. In other words, it is the difference between the present value of the revenues and the present value of the expenditures of a project.

Let RPV_x be the present value of revenues of a project x, and EPV_x be the present value of expenditures for the same project. Then for a $RRR = i$ over a planning horizon of n years,

$$RPV_x = \sum_{t=0}^{n} R_{t,x}(1+i)^{-t} = \sum_{t=0}^{n} R_{t,x}(P \mid F, i, t) \quad (4\text{-}2)$$

$$EPV_x = \sum_{t=0}^{n} E_{t,x}(1+i)^{-t} = \sum_{t=0}^{n} E_{t,x}(P \mid F, i, t) \quad (4\text{-}3)$$

where the symbol $(P|F, i, t)$ is a discount factor equal to $(1 + i)^{-t}$ and reads: "to find the present value P, given the future value $F = 1$, discounted at an annual discount rate i over a period of t years." When the revenue or expenditure in year t is multiplied by this factor, the present value is obtained. Then the NPV of project x is calculated as:

$$NPV_x = RPV_x - EPV_x \quad (4\text{-}4)$$

or

$$NPV_x = \sum_{t=0}^{n} (R_{t,x} - E_{t,x})(P \mid F, i, t) = \sum_{t=0}^{n} A_{t,x}(P \mid F, i, t) \quad (4\text{-}5)$$

where $A_{t,x}$ is the cash flow profile for year t.

Under the assumption of unlimited funds, all independent projects having NPV greater than or equal to zero are acceptable. If the NPV is greater than zero, the proposed project will earn a return on investment greater than the RRR used as discount rate. That is, project x is acceptable as long as

$$NPV_x \geq 0 \quad (4\text{-}6)$$

For mutually exclusive projects ($x = 1, 2, \ldots, m$), a proposal j should be selected if it has the maximum nonnegative NPV among all m projects; that is,

$$NPV_j = max_{x \in m} \{NPV_x\} \quad (4\text{-}7)$$

provided that $NPVj \geq 0$.

It is important to note that the larger the RRR, the smaller the value of the NPV, therefore, the selection of an adequate RRR is as critical as the analysis process itself. A low RRR may favor a bad project, or a high RRR may exclude a beneficial project. This can be visualized in the diagram presented in the IRR criterion discussion below.

Internal Rate of Return

The internal rate of return (IRR) is a discounted rate of return measure derived directly from a project's cash flow profile, that is, the "yield" of the project. As mentioned earlier, it is the discount rate that equates the present value of the expected cash outflows with the present value of the inflows of the project over the planning horizon. In other words, the discount rate that equates the NPV of the cash flow profiles of the projects to zero. This method is usually applied by comparing the RRR to the IRR values for a project or a set of projects. The IRR rule is to accept a project if its IRR > RRR and to reject a project if its IRR ≤ RRR. As noted in the definition of the IRR,

$$NPV_x = RPV_x - EPV_x = 0 \tag{4-8}$$

or,

$$NPV_x = \frac{A_{1,x}}{(1+r)^1} + \frac{A_{2,x}}{(1+r)^2} + \cdots + \frac{A_{n,x}}{(1+r)^n} = \sum_{t=0}^{n} \frac{A_{t,x}}{(1+r)^t} = 0 \tag{4-9}$$

where r represents the internal rate of return. Figure 4.5 depicts the relationship between NPV and IRR for a hypothetical analysis. As the discount rate increases, the NPV of the project diminishes, and when the IRR = 22%, then NPV = 0,

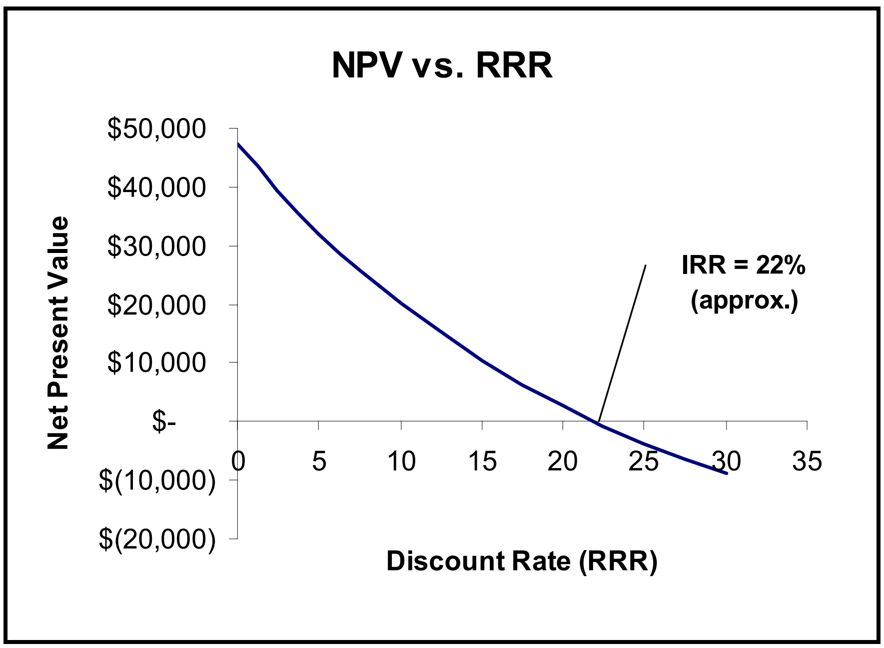


Figure 4.5 Graphical Representation of the Relationship between the Value of the RRR and the NPV

If a project consists of a single outflow (or consecutive cash outflows) at the beginning, and generates a stream of net inflows afterwards (the case of a toll road), a unique IRR indicates the return over cost per period from funds that remain invested in the project. However, a major difficulty in applying the IRR arises in the case of non-conventional projects with two or more sign reversals in the cash flow profile $A_{t,x}$ *(for* $t = 0, 1, 2, \ldots, n$*)*, where there may be multiple values of the IRR. For each sign reversal in the equation, there is a solution root for the IRR (Hendrickson & Au, 1989). When that happens, the method is generally not applicable either in determining the acceptance of independent projects or for selection of the best among a group of mutually exclusive projects, unless a set of well defined decision rules are introduced for incremental analysis. This case is very unlikely for a new toll road, except for the case that expansion at a future time is being considered in the current analysis. In the opinion of the author, for the sake of simplicity, considering expansion as a separate project is a better option than including it on the same analysis.

Besides, an implicit assumption in the IRR calculation is that the intermediate cash flows of the project are reinvested at the IRR. However, the IRR is not a market-determined rate of return. Therefore the assumption that the cash flows are reinvested at the IRR rather than at the opportunity cost of capital makes this a non-market-value-based method, that is, the IRR criterion is not necessarily consistent with the goal of profit maximization.

Special Issues in Project Selection Criteria

Hendrickson and Au, Rao and Van Horne (1989, 1992, and 1990) conclude that if a choice must be made between these two methods, the NPV method should be favored, because it is always consistent with the goal of profit maximization. The two methods generally do give the same advice about whether an investment is a good one. However, if the NPV is better than the IRR, why is it still helpful to use the IRR?

One reason for calculating the IRR besides the NPV is because many investors are more used to judging investments by their yield than by other measures. Another reason is that the NPV does not indicate whether a project is close to the margin of acceptability. Two projects may have the same NPV, one being a large project with an IRR only just above the discount rate, while the other is a very small project with a high IRR. This information is very useful if the organization is not sure about the value of its RRR. On the other hand, the IRR is of limited use if the decision-maker does not have a target RRR to compare it with (Little & Mirrlees, 1974).

Furthermore, when choosing between a small and a large project, it is possible that the small project would have the higher IRR but the smaller NPV. In this case, the clear choice is to borrow more and build the larger project in order to achieve the goal of maximizing profit. The important point here is that the IRR as a pure number does not give an indication of size. Sometimes it may be better to make a larger investment at a lower rate of return, than a small one at a higher rate (Little & Mirrlees, 1974).

The previous discussion assumed unlimited availability of funds. However, this is very unlikely in the real world, therefore it is important to mention that if investment funds are constrained in any way it becomes impossible to give any simple investment rule. The reason for this is that there is no rate of discount, given from outside the organization, which expresses the value of capital and is independent of its own investment opportunities (which will themselves govern in part its future investible funds). In this case, the organization needs to establish a discount rate that is a sufficient measure of the financial constraints it suffers, and yet it is not so high as to stop investments that would have been beneficial (Little & Mirrlees, 1974).

Assessment of the Required Rate of Return

There is neither a perfect methodology to determine a private investor's RRR nor consensus among researchers on a "correct" discount rate (Martin & Wurtzebach, 1998, 1991). Furthermore, the RRR for project analysis differs for different investors and for different industries, and even the same investor may have different RRRs for different projects within the same industry. Nevertheless, the following paragraphs present several concepts and measures that allow deriving a meaningful required rate of return.

According to several authors (Murray, Rao, Sytsma & Wurtzebach, 1997, 1992, 1998, 1991), the real RRR (after adjusting for inflation) has two core components. The first of these is the real return or "time preference," the premium the investor wants for deferred consumption. This is a base profit to compensate for investing money in the project and foregoing the use of money on an alternative venture, a risk-free return. For example, U.S. government obligations provide both, safety, and liquidity to investors, and adjusted for inflation, are used throughout financial literature as a benchmark for risk-free rates of return. A statistical analysis of the yield of the 30-year U.S. Treasury bond on a monthly basis is included in Appendix A. The analysis estimated an average nominal yield of 8.17 percent and a real average of 2.98 percent (3.4 percent after eliminating 47 negative values out of 385).

The second element is the risk premium, which is the return required by the investor to compensate for the risk of the capital not being recouped over the life of the investment. There are two types of risk for which the investor needs to be compensated: undiversifiable and diversifiable risks.

Undiversifiable risks are market risks, which are systematically dependent on the vagaries of the economy, out of the control of the investor and independent of the project materialization. These include issues such as domestic political and devaluation risks, tax changes, corruption, etc. (Murray & Rao, 1997, 1992). Market risks can be assessed by subtracting the risk free rate from the real average returns in the capital markets over long periods of time, literature putting this difference around 6 percent in the U.S. (Newnan, Rao & Wurtzebach 1996, 1992 and 1991). *Diversifiable* or project risks are those unique to the project, those that the investor will incur if and only if the project is undertaken, such as country specific risks (political, devaluation, war, corruption and the like), construction costs overruns, lower than expected revenues, etc.

Hence, the real RRR must be determined based upon these three elements, the risk-free rate plus undiversifiable and diversifiable risks. The nominal RRR is then obtained by adding an inflation component.

Depreciation, Interest and Tax Effects

The cash flow profile of a private investment project is affected by taxes. The cash flows only relevant to capital budgeting are the incremental cash flow after taxes, which are those periodic cash flows that occur if and only if an investment project is accepted (Rao, 1992). In a fiscal context *depreciation* is the amount allowed as a deduction due to capital expenses in computing taxable income in any year, resulting in a reduction in tax liabilities.

The depreciation allowance is a bookkeeping entry that does not imply a cash outflow. Instead it represents a systematic allocation of the cost of the facility over time. Land is assumed to hold its value over time and cannot be depreciated. It is an arbitrary length of time regulated by the taxing government. In fact, the estimated useful life used for tax purposes does not have anything to do with the actual useful life (Hendrickson & Au, 1989).

There are several methods for computing depreciation costs that can be used, depending on the particular government and tax regulations at the time. The various methods of computing depreciation have different effects on the streams of annual depreciation charges, thus in the stream of taxable income and taxes paid. The most common methods include the straight-line method, the sum-of-the-year's-digits method, the double declining balance method, or a combination of these. The subject of depreciation is further discussed in chapter 6.

According to Rao, (Rao, 1992), borrowing and lending, and interest or dividend payments are normally excluded from the concept of "cash flow" when evaluating the profitability of a new investment. Little and Mirrlees (1974) state that the exception to this rule is when the financial flows, or some part of them are tied to the project and thus cannot be considered apart, such as the case of a toll road. Therefore, the deductibility of interest on debt from taxable income may be considered for purposes of the analysis.

To consider tax effects in project evaluation, the most direct approach is to estimate the after-tax cash flow and then apply the evaluation method. Let after-tax cash flow in year t be Y_t. Then, for $t = 0, 1, 2, \ldots, n$,

$$Y_t = A_t - X_t (A_t - I_t - D_t) \qquad (4\text{-}10)$$

where A_t is the net revenue before tax in year t, I_t is the interest on debt paid in year t, D_t is the depreciation allowance in year t, and X_t is the marginal corporate income tax rate in year t (Hendrickson & Au, 1989).

Treatment of Inflation

Because any investment decision requires a forecast of future cash flows, the impact of inflation on these cash flows needs to be examined. Revenues and expenditures increase over time during inflationary periods. However, depreciation may not change with changes in inflation (depending on the particular country). Furthermore, the RRR that should be used to discount these cash flows also changes with inflation. As mentioned earlier, the greater the expected inflation rates, the higher the RRR will need to be, because the RRR is a nominal rate that reflects the real rate of return and inflation. Irving Fisher, an American economist developed the following relationship among nominal interest rates, real interest rates, and inflation (Rao, 1992):

$$(1 + R) = (1 + r)(1 + p) \qquad (4\text{-}11)$$

where R denotes the nominal rate of interest, r denotes the real rate of interest, and p is the expected rate of inflation.

Thus, inflation expectations affect the estimate of future cash flows as well as the discount rate. In a conceptual sense, the proper treatment of inflation in financial evaluation is straightforward (Rao, 1992). The analyst uses one of two approaches to evaluate an investment project:

1. *The constant currency approach.* Express the cash flows in terms of base year, or constant currency, and a discount rate excluding inflation should be used in computing the NPV. Interest rates should also be expressed as real rates, and the resulting IRR is a real rate.
2. *The inflated currency approach.* Express the cash flows in terms of then-current or inflated currency, and a discount rate including inflation should be used in computing the NPV. Interest rates should be expressed as nominal rates, and the resulting IRR is a nominal rate.

CHAPTER 5: PROJECT RISK ANALYSIS AND SIMULATION

Risk is an intrinsic component of any construction project. Because the financial evaluation of a toll road project requires forecasting, the factors involved in the calculation of revenues and expenditures are ultimately subject to diverse degrees of uncertainty or risk. The construction cost may be affected by several circumstances, changes in technology may affect the useful life of tolling equipment, the demand for transportation may be altered by changes in economic development, and a number of other factors can influence the forecasts. Making conservative traffic forecasts, including contingency amounts in construction budgets, and using higher rates of return for risky projects are ways of dealing with this problem, but in reality they do not draw out the uncertainties of a particular project. Furthermore, a conservative bias throughout an analysis may have an additive effect and lead to discouraging final results. Risk analysis is a method for dealing with uncertain situations that has been widely applied to investment evaluation and infrastructure projects (Jones, 1991).

This chapter is devoted to explore the concept of project evaluation under uncertainty, focusing on the risk analysis method used in the feasibility evaluation model for toll roads. First, the basic decision and risk analysis concepts are defined, discussing their methodology and the processes for risk identification and measurement. Then the project risk analysis process is reviewed in detail and the concept of risk from the project feasibility perspective is defined. The underlying principles of probability analysis and probability density function choice are explored. Finally, the simulation approach for project risk analysis is discussed and the use of the Monte Carlo computer simulation method is illustrated.

ANALYSIS OF DECISIONS UNDER UNCERTAINTY

The aim of a feasibility evaluation is to determine whether an investment should be undertaken or not. Practically every project investment decision is made under uncertainty. The decision-maker must choose a determined course of action from a number of choices, although the result of some, if not all, the possible courses of action will depend on events that cannot be accurately predicted. The value of each possible course of action generally depends on multiple factors, some relying on the expectation that potential events will occur, some others relying on the effects that will result if particular events do happen, and yet others on the costs or benefits of these effects. However, it is practically impossible to objectively consider all these factors simultaneously, hence the necessity to decompose the decision problem and analyze the implication of one set of factors at a time (Schalifer, 1969). This process is known as decision analysis. As mentioned earlier, risk analysis is a method for dealing with uncertainty, and hence it is a part of the decision analysis process.

The Decision Analysis Process

Decision analysis provides effective tools to organize a complex problem into a structure that can be analyzed. It helps to identify important sources of uncertainty and represent it in a systematic and useful way, leading to better decisions (Clemen, 1996). Nonetheless, decision analysis should be seen only as an information source, and not as a guarantee to obtaining better outcomes. Its purpose is to provide insight about the situation, uncertainty, objectives, and trade-offs, and probably yield a recommended strategy, not an absolute solution. The diagram in Figure 5.1 illustrates this process, and it is intended to provide a roadmap of the reasoning followed in the development of the feasibility evaluation model for toll roads.

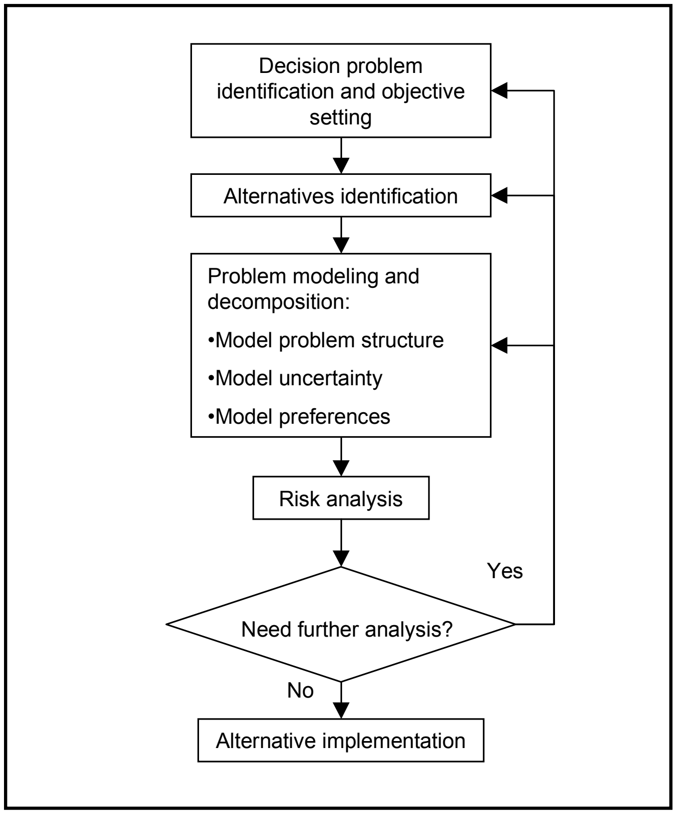


Figure 5.1 Decision Analysis Process or Roadmap for the Development of the Feasibility Evaluation Model (Clemen, 1996)

The first step in the process is to carefully identify the decision in hand (in this case it is whether to invest in a particular toll road project), and the objectives pursued by making that decision (in this case, maximizing profit). Once the decision problem and the objectives have been established, the potential alternatives can be created and explored.

The next step is the core of the decision analysis process, the decomposition of the problem. The first step in decomposing the problem is structuring the problem into smaller, more manageable parts in order to facilitate the identification and modeling of the problem elements. For the purposes of this report, influence diagrams are used to model the decision problem. Probability is then used to model the uncertainty inherent in the decision. These are mathematical and graphical models that can be subject to analysis and indicate a numerically favored alternative (Clemen, 1996).

Once the model has been built, risk analysis can be performed. Inherent to this process, is the sensitivity analysis, where a number of "what if" scenarios are explored and the sensitivity of the decision model to changes in the in one or more aspects of the model is determined. The probability models developed for uncertain factors are used in risk analysis to perform simulation routines, and obtain a probability model for the favored alternative. This is an iterative process in the sense that the decision-maker may return to the previous processes to refine the model or include factors that were not previously identified, identify new alternatives, etc.

Influence Diagrams and Decision Modeling

The decision modeling technique used for the purpose of this research is influence diagramming and it is further illustrated in the next chapter, where the feasibility evaluation model is developed. Influence diagrams are a relatively new technique to model the conditional probability relationship among random variables. The influence diagram provides a detailed representation of the relationships among these variables. This technique is used where the decision to be modeled is best represented as a sequence of related decisions. Influence diagrams are versatile in the sense that they may be used as a descriptive model or as a computational model, making it very suitable for use in a computer. Complex interactions, including both data and model uncertainty can be modeled with this technique.

RISK ANALYSIS

As mentioned earlier, risk analysis is an integral part of the decision analysis process. Risk analysis is the study of the relationship between an expected outcome and the probability of the actual results deviating from the expected and the development of adjustments to compensate for uncertainties in an estimate to achieve a target level of risk. CII (1988) also defines it as "*any method, qualitative and/or quantitative, used to assess the impacts of risk on decision situations*". The goal of risk analysis is to assist in the decision analysis process, by providing a better understanding of the possible outcomes that could result from particular course of action.

The concept of risk should be well understood before pursuing a risk analysis. The Construction Industry Institute (1988) has published the source document *Risk Management in Capital Projects*, which provides a comprehensive guide about the risk analysis process. This document served as a major source for the material presented in this chapter.

Risk Defined

The term risk in statistics is defined as a situation where there are two or more possible outcomes, and a probability associated with each outcome (Newnan, 1996). In the case of construction, Erikson (in CII, 1988) defines risk as "the exposure to possible economic loss or gain arising from involvement in the construction process." When the cash flow profiles of a toll road project are subject to uncertainty, it is said that the profitability of the investment is subject to risk. Throughout this report, the term project risk will refer to the variability in the project's measure of profitability, that is, its NPV and IRR.

The Ministry of Transportation of Colombia [Ministerio de Transporte de Colombia, 1994] classifies the risks of BOT toll roads as follows:

1. *Projects risks.* These risks arise from the project itself, and are related to the type of project and the complexity of its construction and operation. They essentially contemplate the probability of occurrence of events that considerably affect the budgeted construction cost and schedule, and the cash flows during the operation phase. CII (1988) further categorizes project risks into technical, schedule, and cost risks. These include factors such as technical complexity of the project, weather, productivity, change orders, etc., which ultimately are reflected in the project cost. These types of risks are high during the construction phase and decrease as the operations phase advances.
2. *Commercial Risks.* These risks refer to the level of usage of the project, and involve issues such as market conditions and price elasticity of demand for the traffic using the road.
3. *Financial risks.* These risks influence the project during both, the construction and operation phases. They refer to the risk of a sharp variation in the project cash flows due to abnormal

inflationary pressures or currency exchange rate changes. The larger the level of foreign currency used to finance the project, the larger the foreign exchange risk.

Risk Analysis Process

According to the CII, the risk analysis process consists of three phases: risk identification, measurement, and management, as shown in figure 5.2. Risk analysis is an iterative process, with loops between each phase. However, the Project Management Institute (PMI) simplifies risk analysis to the phases of risk identification and risk measurement (quantification) (PMI, 1996). Thus, the scope of this report is limited to the first two phases of CII's risk analysis concept. The subject of risk management warrants a thorough explanation, and is not covered in detail here, but the interested reader should refer to the bibliography for further orientation in the subject (CII, 1988).

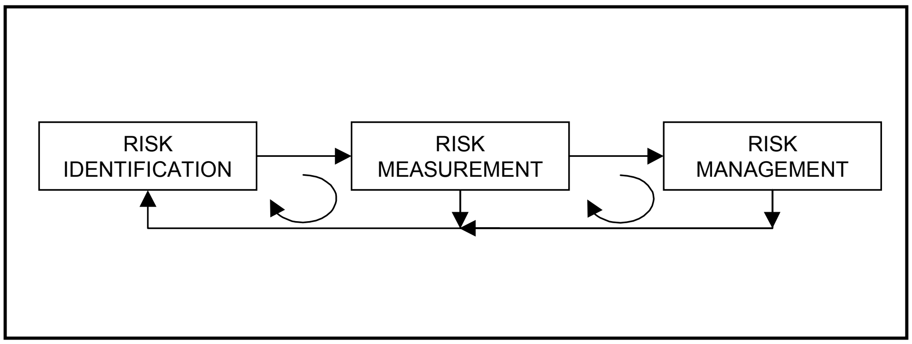


Figure 5.2 Risk Analysis Process (CII, 1988)

Risk Identification

The most important phase of a risk analysis process is the identification of risks. A risk that is not identified cannot be quantified, controlled, or transferred (CII, 1988). In this phase, the risks that are likely to affect the project, both positively and negatively, are identified and their characteristics documented. The end product of this phase is a comprehensive description of risk events and elements. The major risk concerns of the primary parties involved in the project (host government, sponsors, financiers, and contractors) must be addressed to identify all potential risks. Some of these risk elements may include initial construction cost, construction schedule, operation and maintenance costs, through traffic, toll prices, qualification of contractors, availability and cost of financing, and regional economic stability, etc.

This phase also involves understanding the particular characteristics and determining the sources of the identified risks in order to better describe them and move on to the measurement phase. There are two aspects that characterize risk, the frequency with which they occur, and their particular effect on project outcome. These characteristics yield two types of uncertainty to which attention must be paid, those uncertainties that occur very seldom but produce very severe losses, and those that that produce small losses but occur very frequently.

Sources of Risk

CII (1988) notes the following generic sources of risk in a construction project that apply to almost any project:

1. *The Project.* According to CII, the very nature of the project itself is the main source of risk. Risks vary with the amount of new technology, size, location, regulations, funding, and other factors that arise as the amount of data increases. Despite new management techniques and tools, and advanced information technology, there are still large uncertainties that increase project cost. The following are some vital project segments that involve risk:

   a) New technology. The greater the amount of new technology, the larger the risk. This is not very likely to be an important risk in a toll road.

   b) Size and location. Larger projects and constructing in unfamiliar (or confined) locations tend to create risks beyond those initially anticipated. For example, different new circumstances must be dealt when constructing a toll road in Mexico rather than in China or the U.S, or an intercity versus an interurban toll road.

   c) Regulations. If the duration of a project stretches through several years, the possibility of changes in regulations that may adversely affect the project must be considered. The project's risk posture must change to meet technology and increased public safety demands.

   d) Funding. The availability of financing and enough cash flow is a major concern of all project participants. This concern also extends to factors such as interest rates, internal rate of return and net present value.

   e) The concession agreement and other contracts. As the binding force among the parties, these documents require a great deal of attention from each party. The contracts are essentially a risk allocation tool. However, the contract itself may be the source of risk when it is not clearly drafted or when contract administration is not efficient. These legal documents must clearly define and assign the risks borne by each party.

2. *Management Actions.* The management and administration of the project is another major source of risk. These are some tasks that can increase or decrease the overall project risk:

   a) Cost and schedule estimates. Inaccurate estimates or schedules yield unrealistic goals and inefficient project planning.

   b) Human errors. These include omissions, poor judgement, lack of knowledge and also misunderstandings.

   c) Timely decisions. Lack of prompt management action in case of problems increases risks to all project participants.

3. *State of the world risks.* There are sources of risk that are outside the limits of the project and beyond the control of its participants. This category includes risks such as inflation, political and labor issues, marketplace factors, etc.

   a) Inflation and currency exchange rates. The general economy of a country definitely impacts the risk level of a toll road project, reaching aspects such as financing, construction costs, traffic demand, etc.

   b) Political issues. The political environment of the country where the project is to be built. These issues include risk of government appropriation of the project, retention of dividend remissions, political unrest, etc.

   c) Labor issues. Availability and reliability of a skilled labor force. Labor/Management relations in issues such as risk of labor strike, etc.

   d) Marketplace. The marketplace forces that determine the traffic demand that will exist through the toll road route are a critical risk concern.

Risk Identification Techniques

CII (1988) distinguishes historical data, experience, and insight as the primary basis for identifying risks. Although every road construction project is unique, similar risks do occur in every project, and hence can be identified from historical records. Nevertheless, in most circumstances and especially in the case of toll roads, mere historical information is not enough for careful risk identification. Experience with similar projects enables a project team to better analyze the known data and associate it with the characteristics of the current project, even when historical records are insufficient or not available.

According to CII, in the case that neither historical data nor previous experience is available, it is necessary to rely on insight. Even when data is available, the size and complexity of a major project make insight and subjective evaluations an essential element in the identification process. A subjective evaluation is built on a combination of knowledge for the project's elements and understanding those areas that are likely to contain major risks. In conclusion, the identification of risks depends to some extent on historical data, but for the most part on the skill and experience of all project participants.

Both, CII and PMI (CII & PMI, 1988, 1996) mention risk checklists as a tool to aid in risk identification. Checklists are catalogues that help project participants to think about previously unexplored risks. CII's source document contains examples of risk checklists, and Appendix B has a specific risk matrix for typical BOT projects, developed by Baker & McKenzie (1998).

Risk Measurement

Once the risks of the project have been identified, their magnitude must be measured. The previous section identified two primary types of risk, first those that occur frequently and have a moderate impact, but whose cumulative impact can be substantial and second, infrequent risks with a strong initial impact. Both of these strongly influence the feasibility of the project. Risks must be measured in order to establish whether the project is feasible or not, whether it should be further studied or abandoned, assess the level of detail deemed by the analysis, and the acceptable level of risk for the project (CII, 1988).

Risk measurement (quantification) can be described as the process of determining adequate measures of risk by assessing the likelihood of occurrence of all the outcomes associated with the risks identified, as well as the magnitude of such outcomes (CII, 1988). Palisade, a risk analysis software developer, defines it as the assessment of all the possible values that a risky variable or uncertainty could take and determining the relative probability of each value (Palisade, 1996).

Measures of Risk

The measures of risk are basically a mathematical description of the frequency and severity of the variability of the risk, summarized using a probability distribution function (PDF). Probability distribution functions are tools for displaying the uncertainty in a variable. There are a wide variety of forms and types of PDFs, each of which describes a range of possible values and their probability of occurrence. Most people are familiar with the normal distribution, the typical "bell curve", such as the one in Figure 5.3, which shows a hypothetical example of a PDF of the cost of concrete. There are several other useful PDFs, which include the lognormal, beta, uniform and triangular distributions. Almost any introductory probability and statistics text describes these functions in more detail. Throughout this report several of these PDFs are used to describe the variables included in the feasibility evaluation model, and they are discussed as presented.

The measures of risk represented as PDF must conform to the rules of traditional probability theory. These rules are summarized by CII (1988) as follows: "1) the sum of the probabilities for all possible events must sum to 1.0, 2) the probability of any event must be a number between zero and one, 3) the impossible event has a probability of zero, and 4) the probability of joint events is the product of the probability that one event occurs and the probability that the other occurs, given that the first has occurred." For example, given Figure 5.3, the probability that the cost of concrete will be \$50 per unit or less is 50 percent, or the other way around, that is 50 percent reliability in the estimate. On the other hand, if \$51 is the estimate, there is only 15 percent risk of being over the estimate, that is 85 percent reliability.

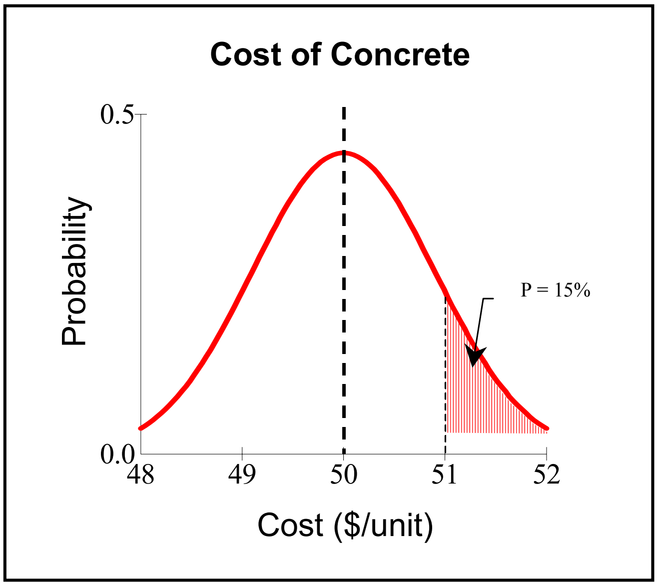


Figure 5.3 Example of a Probability Distribution Function for Cost of Concrete

However, as Palisade notes, most risk quantification is subjective (Palisade, 1996). Much information is needed about a variable to know the exact shape of the probability function and such precise information is seldom known, hence it has to be subjectively determined or assumed. To diminish the necessity for such detailed information, uncertain information can be described also in terms of particular summary parameters of the PDF.

The most common summary parameters of a PDF are the mean and the standard deviation. The mean (μ) is a measure of central tendency for the variable, and the standard deviation (σ) is a measure of the dispersion of the variable. For a given mean value, the larger the range of the variable, the larger the standard deviation. Hence, all other factors being equal, variables with large standard deviations are riskier than variables with small standard deviations (CII 1988). Figure 5.4 illustrates this concept on a normal PDF again for example of the cost of concrete. Even though both PDFs have a mean of \$50 per unit and 50 percent probability that the estimate will be on or below the \$50, the dashed PDF is tighter, that is, it has a smaller standard deviation, and hence higher reliability on the price of the estimate. In other words, the dashed PDF is less risky.

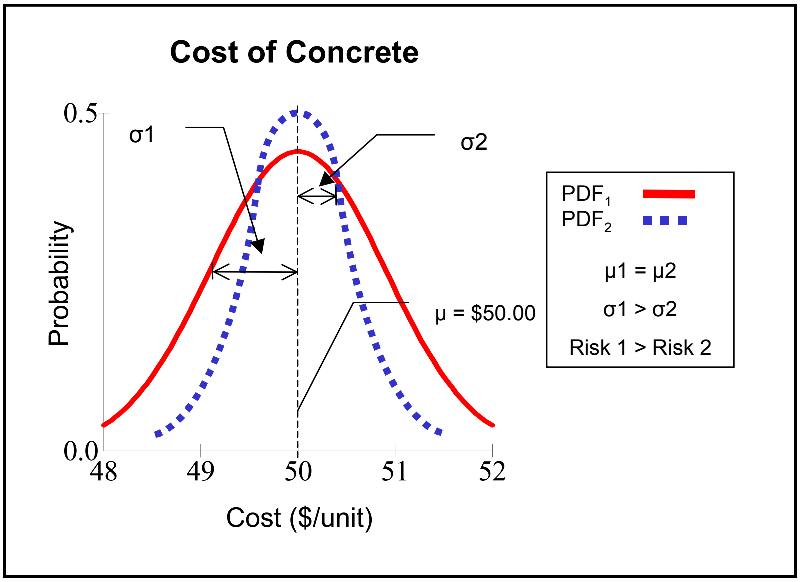


Figure 5.4 PDF Summary Parameters and Risk

The mean is also known in risk analysis as the *expected value* of a variable. It can be seen as the weighted average value of the random variable, where the weighting factors are the probabilities of occurrence (Park, 1997).

Other PDF parameters include the mode and the median, which are two other measures of central tendency, and the third and higher moments about the mean characterize the skewness and other conditions of a distribution function. A thorough description of these concepts is out of the scope of this report, but additional information can be also found in any introductory probability and statistics text.

<u>*Quantifying Objective Data*</u>

The collection of probability information is a key step in risk measurement. The characterization of a PDF based on objective data relies on the analysis of data from similar projects or situations and historical data on the variation of key factors. The analysis of this data is carried out with traditional statistical techniques, such as time series and regression analyses (Jones, 1991). Thanks to the availability of computer hardware and software, these techniques have become widely used and extensive literature is available on the topic, thus they are only briefly discussed next.

- *Time Series Analysis.* A time series is a set of observations of a variable generated sequentially in time. Time series analysis techniques, such as the *Box and Jenkins* model, characterize the variation of a process over time and the time interdependencies between the stochastic elements of this process, and identifying both, the deterministic and the stochastic components of the series (Jones, 1991). This technique requires the use of commercially available specialized statistics computer software.
- *Regression Analysis.* This method describes the deterministic components in a time series or a cross sectional data set with equations that relate a dependent variable to independent or explanatory variables (Jones, 1991). This method requires less effort than the time series analysis and is available in any commercial spreadsheet software.

Quantifying Subjective Judgement

Nonetheless, since most toll road projects are very recent and unique to some extent, historical information is often unavailable or untrustworthy. Most risk analysis literature agrees that the assessment of the information needed to develop a PDF, or to determine its parameters is for the most part subjective, that is, based on personal experience, judgement and the opinion of experts [CII, Jones, Palisade & Pouliquen, 1988, 1991, 1996, 1970]. Thus, subjective judgements must be summarized in the form of a PDF, creating what is called *subjective probabilities*. As Pouliquen (1970) states, subjective probabilities also follow all the rules of traditional probability theory.

CII, Clemen and Jones (1988, 1996 and 1991) cite several methods that can be used to transform subjective judgements into subjective probability distribution functions. A more detailed discussion of these methods can be found in the references, but a brief summary is presented:

- *Probability Encoding Methods*. These methods require the individual to assign an estimated probability to a value of a range of values, or to assign a lowest, a most likely, and a highest possible value and then choose a PDF form that he/she feels fits the particular situation the best (Jones, 1991).
- *Gamble Methods*. In this method the problem is stated in terms of betting gambles. The individual bets on a game of chance about the probability of the variable attaining a range of values (CII, 1988).
- *Delphi Method*. This method is aimed at obtaining a consensus from a panel of experts about an uncertain event while avoiding undesirable effects that may arise from group interaction. The process involves circulating a questionnaire, summarizing individual evaluations in an anonymous format, and repeating the process. The estimates obtained are supposed to converge after a few cycles (Jones, 1991).

Risk Measurement Techniques

There are a variety of methods that can be used to measure risk. The choice of one depends mostly on the objectives of the analysis to be performed. In profitability analyses, such as the financial evaluation of a toll road investment, the investor is trying to determine the combined effects of uncertainty in traffic, economic factors, cash flow needs, construction and maintenance costs, etc. For this type of analysis CII (1988) suggests among others, the use of sensitivity analyses and stochastic forms of common profitability analyses (NPV, IRR, etc.).

Sensitivity analysis is a formalized method of testing the effects of the variation in value of an individual variable at a time, on the project's overall profitability measure. It is a technique used to identify key variables that influence the profitability of the project and to judge their relative importance. Sometimes large changes in a random variable may not substantially affect the result, and small changes in others may have disproportionate consequences (Adler, 1987).

Monte Carlo simulation is a type of stochastic analysis that uses computer programs to repeatedly sample the PDF of the variables that influence the profitability of the project in order to determine the total variability in the overall profitability measure. This technique "performs" the project many times to estimate a PDF of the profitability measure (CII & PMI 1988, 1996).

Both sensitivity and Monte Carlo simulation analyses are further discussed in the following sections, as they form the core of the risk analysis element in the feasibility evaluation model developed for this research.

PROJECT RISK ANALYSIS AND THE SIMULATION APPROACH

Project risk analysis broadens the perspective of the decision-maker from a fixed set of assumptions, which are essentially uncertain, to a more comprehensive view of the potential actual outcomes. A broader view may lead to a reconfiguration of the project, assist in the development of new strategies of meeting project objectives or responding to difficulties (Jones, 1991), or in the worst case, to the definitive rejection of the project.

Park defines the term *project risk* as the variability in the project's profitability measure (such as its NPV or IRR), or in other words, as the project's potential for loss (Park, 1997). Thus total project risk can thus be represented by a figure such as the PDF of its calculated profitability measures.

The aim of project risk analysis is to produce a PDF of its profitability measure that serves as a tool to make a better investment decision. From this PDF, the decision-maker can extract such valuable information as the expected value (mean) of the profitability measure, the extent to which other profitability measures vary from, or are clustered around, the standard deviation, and the best- and worst-case values of the profitability measure (Park, 1997). Figure 5.5 provides an example of a PDF for the NPV of a project.

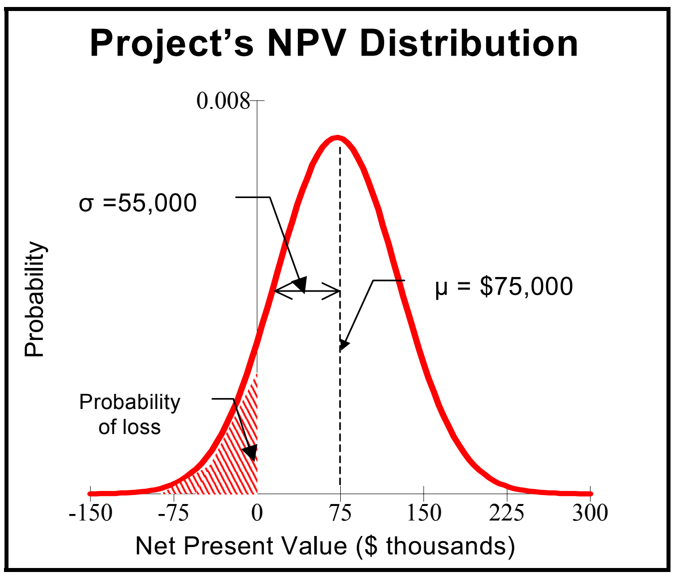


Figure 5.5 Example of the PDF of the NPV of a project

The investment decision can be improved by incorporating the variability information along with the expected value. As mentioned earlier, the standard deviation is a measure of the dispersion of the distribution (risk), hence it is desirable to minimize it. That is, the smaller the standard deviation, the less the potential for loss associated with the profitability measure. Therefore the ultimate investment choice depends on the decision-maker's preferences, or how greatly he/she is willing to accept the variability to obtain a higher expected value. That is, what is the level of risk he/she is willing to accept.

Project risk, that is the PDF of a pertinent project profitability measure, can be determined through *risk simulation*, which is, in the words of C. Vaughan Jones (1991), "*the most complete and comprehensive type of risk analysis*". Risk simulation has been extensively used to evaluate investments, including World Bank loans, petroleum investment decisions, plant expansion proposals, and construction schedule analysis (Jones, 1991).

The objective of risk simulation is to weigh several structures of risk factors by their probabilities and then summarize all the possible configurations and values of the risk factors into a risk profile (PDF) for the project under examination (Jones, 1991). The Monte Carlo simulation method is one of the most popular risk simulation techniques. The use of simulation is currently more accessible with the availability of affordable computer technology and simulation software. For the purpose of this research, the feasibility model was prepared with Microsoft Excel spreadsheet software and an add-in program called @Risk (Palisade, 1996).

Risk simulation operates with the probabilities (PDF) of the variables influencing the outcome of the problem being analyzed, in this case, the project profitability measure. These subjective probabilities are based, as mentioned earlier, on expert opinion and are supplemented by data about the objective frequencies of events, where available. The key to risk simulation resides in estimating these probabilities, which already exist, since people are willing to make decisions, such as whether or not to invest in a toll road project (Jones, 1991).

Steps in Project Risk Analysis and Simulation

Summarizing the work of several authors (Adler, Park, Rao & Vaughan 1987, 1997, 1992 and 1991), the simulation approach for project risk analysis can be defined as a process consisting of the following steps:

1. *Model the problem.* The model developed in the decision analysis process must be translated into an equation for determining cash flows, the equation for determining the profitability measure and other relevant data.
2. *Identify the major risk factors*. The process for risk identification has already been outlined. In order to identify the most important (sensitive) variables, a series of sensitivity analyses on the model is performed in this step. The elimination of non-sensitive variables will expedite the simulation process in the computer.
3. *Characterize the uncertainty*. The information about uncertainty associated with each sensitive variable or major risk factor, that is their likely probability distribution and expected values must be determined and input to the model.
4. *Run the simulation*. The performance of the investment is simulated with parameters sampled from the probability distributions developed for the various risk factors. This step is performed entirely by the computer. The computer first samples from the PDFs, forecasts each variable and then calculates the cash flows. After a specified iterations (usually around 1,000), the computer can provide the probability distribution of the profitability measure. The simulation concept is further explained below.
5. *Produce Risk Profile and Analyze Results*. The summary of the results of the analysis is a risk profile or PDF for the profitability measure. This PDF provides the mean profitability measure, the range of potential outcomes, and the probability that the measure will fall between a particular range.

Sensitivity Analysis

As mentioned earlier, sensitivity analysis examines how much a project's profitability measure or cash flows vary in response to specific changes in the input variables, treating one variable at a time. Sensitivity analysis provides an idea about the riskiness of a project by identifying its most critical variables.

For example, one of the known risks in a hypothetical toll road project is the initial average daily traffic (ADT). To perform a sensitivity analysis on initial ADT, we could measure the change in the project's expected cash flow profile to pessimistic (30% below) and optimistic (20% above) estimates of the initial ADT. Figure 5.6 depicts the results of this analysis.

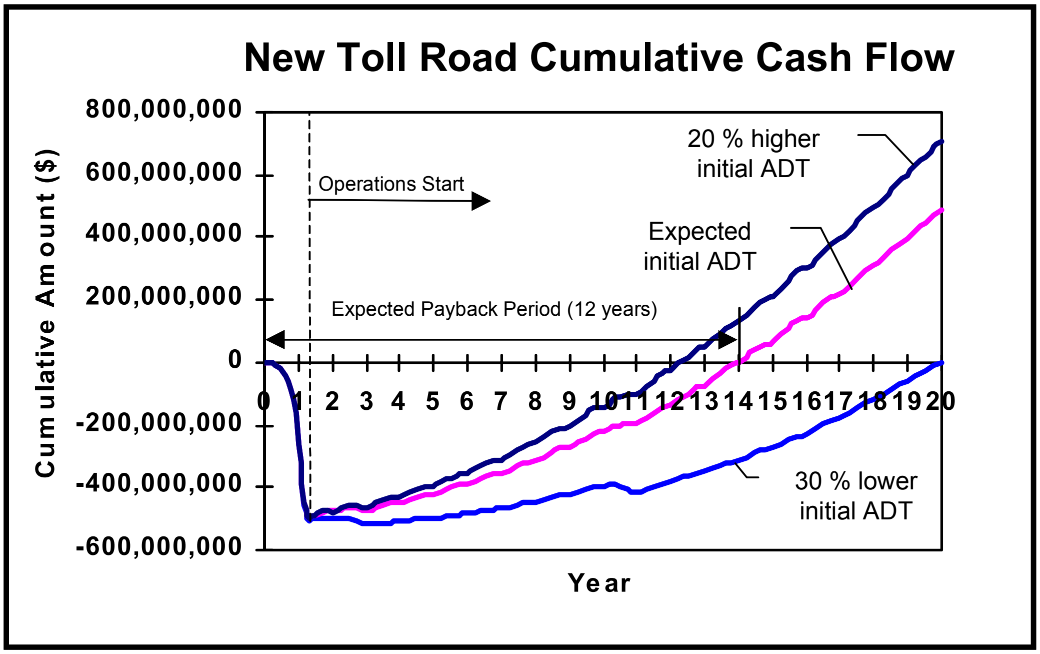


Figure 5.6 Toll Road Project Sensitivity Analysis to Initial ADT

The cumulative cash flow over a 20 year long concession period of the toll road shows how sensitive the project is to the initial ADT. If the actual initial ADT is equal to the expected, the payback period (time to recover the investment in nominal terms) of the facility is 14 years. The optimistic estimate for the initial ADT yields a payback period of 12 years, not very different from the expected estimate. However, for the pessimistic estimate the payback period is considerably longer, 20 years. The whole concession period would be just enough to cover the investment in nominal terms, not even compensating the investors for the time value of money.

Although sensitivity analysis indicates the sensitivity of the project to various factors and the range of possible outcomes, it is only an aid in the decision process and should not be used in isolation. There are other aspects of sensitivity analysis that must be explained further.

First, sensitivity analysis does not throw any light on the probabilities for the pessimistic, expected and optimistic estimates happening. Second, it assumes that the all variables being tested are independent. However, if the variables are correlated, they cannot be varied separately but must be varied jointly (Adler, 1987). Both of these shortcomings can be addressed with the use of computer simulation.

The purpose of sensitivity analysis in project risk simulation is to identify those key variables to which the overall profit measure is more sensitive, that is the major project risk factors, in order to characterize their particular uncertainty with a PDF and then proceed with the simulation process. The elimination of non-sensitive variables for the computer simulation process is intended to narrow the amount of variables for which a more detailed characterization of uncertainty must be done, and reduce the amount of computational effort needed to perform the simulation. Variables whose change does not significantly affect the project profitability measure do not need to be analyzed in a greater detail or included in the simulation, since their variation is not critical to the outcome. On the other hand, sensitive variables demand a more careful examination.

Monte Carlo Simulation

Unlike sensitivity analysis, the Monte Carlo simulation method cited earlier permits the examination of the impact of changes in all possible combinations of variables. The mathematical basis of the method dates to World War II and a Manhattan Project analysis of the diffusion of neutrons in fissionable material, developed by simulation methods with the code name Monte Carlo (Jones, 1991).

Monte Carlo varies and combines values for all the variables in a computer model by using random sampling techniques. This combination of variable probability distributions over a large number of iterations allows better envisioning of the possible effects (PDF and its parameters) of the project cash flow model and its profitability measures (CII, 1988).

The essence of the Monte Carlo technique is simple. For example, if a project has a 40 percent chance of having a NPV larger than say, US$100,000, that means that if there were a great number of similar projects, 40 percent of them would be expected to have a NPV larger than US$100,000. Conversely, if there were a great number of projects and 40 percent of them have a NPV larger than US$100,000, that would mean that the probability of a NPV larger than $100,000 is 40 percent. Thus, the simplest application of the Monte Carlo technique is to "invest" in a large number of projects with the characteristics of the one we are interested in and see how many of them have a NPV of less than zero, of zero, US$50,000, US$100,000, US$500,000, etc. The same analysis can be performed for the IRR or other profitability measure (see also Figure 5.8) (Pouliquen, 1970).

Random Sampling Technique

The underlying principle behind random sampling is straightforward. For example, take the example of the toll road project, in this case the sensitive or risk variable is construction cost. The starting point is to produce, with the help of a random number table or a computer, a random number between 0 and 1 called n. This number n will lead to the selection of the value of construction cost variable for one run of the project cash flow model and contribute to the development of the project's profitability measure PDF or risk profile. Assume that Figure 5.7 represents the probability distribution for construction cost. The figure shows the PDF, which shows the mean cost ($190 million U.S. dollars) and the standard deviation ($58 million), after which, the Cumulative Distribution Function (CDF) is developed. The CDF represents the probability that construction cost is at most the value of the x-axis. Then a value C is associated with n by reading from the probability axis to the CDF and down to the x-axis. The repetition of this sampling process with many random numbers guarantees that the repetitions of the cash flow model are computed with a random sample of the particular CDF of the selected variable (Jones, 1991).

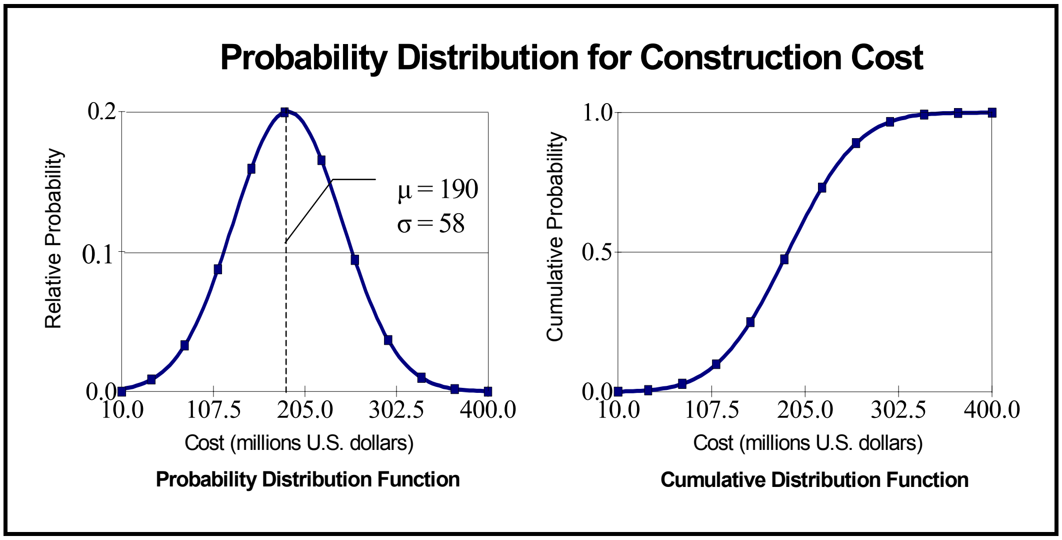


Figure 5.7 Probability Distribution for Toll Road Project Cost

According to several authors (Jones & Palisade, 1991, 1996), the number of samplings that must be made depends on the mathematical complexity of the model and the sampling procedure. A minimum of 1,000 iterations is recommended for the model to achieve stability in the results.

Computer Simulation

The current advance in microcomputer technology and simulation software remarkably facilitates the application of the Monte Carlo simulation technique. The computer software typically performs the simulation following the sampling principle previously discussed.

Once the probability information for the model variables to be simulated has been established, the data representing the known or assumed PDF for each input variable in the model is entered into the computer. For each variable simulated the computer calculates a sample value. This sample value is combined with like sample values for all the other specified variables. The combination of all these sample values represent one possible cash flow profile and one possible profitability measure. The sampling process is repeated the specified number of iterations. For each iteration statistics are recorded, resulting in a frequency distribution for the project profitability model (CII, 1988). The output result for this process would be similar to the PDF for NPV shown in Figure 5.5. Figure 5.8 depicts the same information from Figure 5.5, but in a CDF format, which is sometimes easier to interpret.

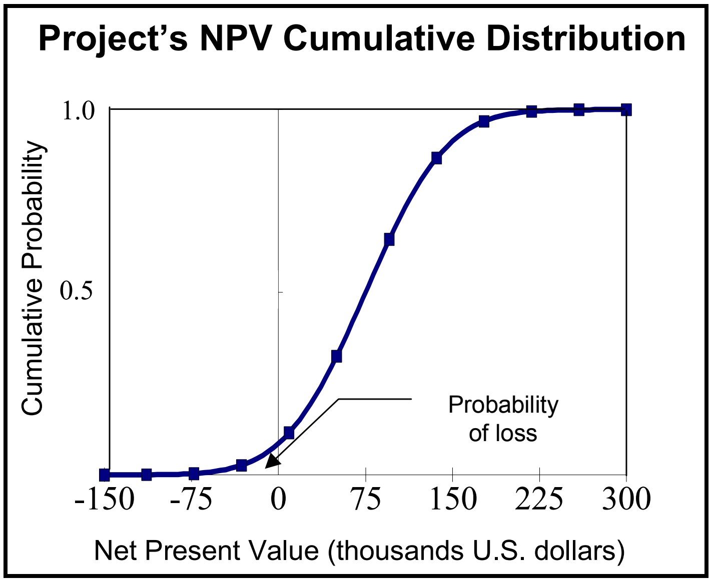


Figure 5.8 Example of Cumulative Distribution for a Project's NPV

CHAPTER 6: FINANCIAL FEASIBILITY EVALUATION MODEL FOR TOLL HIGHWAYS

This chapter deals with the development of the financial feasibility and risk analysis computer model for BOT toll highways, which is henceforward called Feasibility Evaluation Model for Toll Highways (FEMTH). The approach followed to develop the model was based on the decision analysis methodology discussed in the preceding chapter. Previous chapters illustrated the general setting under which toll road investments function, their role in the economy as a part of a region's strategic infrastructure network, and the profit implications that the private sector involvement has for the feasibility of these projects. This general background and the project feasibility and risk analysis concepts examined provide the framework under which the FEMTH is built.

BACKGROUND

As stated earlier, the standpoint of this research is from the private sector entrepreneur, that is, from the perspective of a commercial long-term capital investor. The objective of this research is to develop a decision making tool for toll road project investments. But what is the decision we need to make? The first step in a decision analysis process is to identify the decision in hand. In this case the decision is whether or not to bid for a toll highway project financed with private capital in, that is, to determine whether the investment will meet the investors' profitability criteria and at the same time be competitive enough to win the bid. In other words, the objective of the decision-maker is to make the most profitable investment.

The general framework under which the feasibility of a toll road project is evaluated was outlined in the preceding chapters and can be summarized in the following points:

- *Chapter 2*. A toll road is a commercial enterprise that is part of the transportation network of a region, which in turn is formulated according to the region's needs and its government(s) strategic economic plan. As a consequence of this macroeconomic integration, a toll road will be generally subject to competition with other "free" roads and transportation modes. As an integrated element of the economy, the economic up and downturns of the region definitively impact the facility over its lifecycle.
- *Chapter 3*. This chapter presented the context under which the private sector participates in the provision and financing of road infrastructure and the different players and factors involved in a BOT project. The role of international development and financial institutions, such as the World Bank, facilitating the participation of the cautious private investor was discussed as well. The overview of the recent experiences with BOT toll roads provided an insight on some of the issues that may arise in such projects.
- *Chapter 4*. This chapter described the concept of lifecycle evaluation of investment projects in the private sector, emphasizing the particular case of toll roads. The financing process for this type of project and the concepts and tools used for private financial feasibility analysis were discussed as well. The measures of profitability and procedures to determine the project's cash flows to be used in the FEMTH were also established in this chapter.
- *Chapter 5*. Finally this chapter described project risk analysis as a part of the decision analysis process. The concept of risk and the different sources of risk in a toll road project were explored and the measurement of these risks discussed. The use of the simulation

approach combined with the tools and concepts from Chapter 4 to perform project risk analysis was also illustrated in this chapter.

DECISION CONTEXT

Typically the inception process of a BOT toll road project can be described as follows. First, a transportation authority identifies the need for the construction of a new road in the transportation master plan or for upgrading an existing one. Based upon traffic demand, strategic priorities, budgetary constraints, and the existing legal framework the authority determines that a road is a good candidate to be constructed under the BOT concession scheme. After further traffic studies, carried out either by the agency or by an external consultant, and a preliminary budget of the capital costs of the project, including land and rights of way, the agency can decide to carry out the project and prepare the bidding process.

As mentioned in Chapter 3, in most cases, the concession award process for a BOT project differs from the typical public works process in the sense that instead of using the lowest construction cost as the award criteria, the project is awarded to the bidder offering the lowest competitive toll. Such a toll must cover all of the facility lifecycle costs (operation, maintenance and rehabilitation) plus the investor's required return.

In some other cases the government may set the toll structure for the project, and the award criteria may differ. The award criteria may be a weighed average of several components, such as a required government contribution for construction costs, a minimum revenue amount required for the initial years of operations, etc. (Credit Suisse/First Boston & Inverlink, 1997). This criterion basically places a limit on the government's liability and relies on the project's ability to support itself. Both criteria have the same end concept. The project is awarded to the proposal that offers the lowest required revenue for the project to cover for its lifecycle costs over the concession period and at the same time yields the investor's required return. In other words, the concession is awarded to the bidder that presents the most cost-effective lifecycle solution to the project.

This bidding criterion for a BOT concession poses a challenge for the potential investors. In order to obtain the bid, the proposal must contain the most competitive revenue support structure while still matching the return on investment of the project shareholders.

GENERIC BOT TOLL ROAD CONCESSION ISSUES

The approach to implement a BOT toll road project varies from country to country, and even from state to state within the same country. However, the fundamental elements remain the same. This section attempts to describe the most important bidding and concession contract issues of a generic BOT toll road project as well as some of the risk mitigation mechanisms frequently included in such contracts. Most of the material included in this section comes from the information memorandum of "El Vino – Tobiagrande – Puerto Salgar – San Alberto" toll road, published by Credit Suisse/First Boston and Inverlink (1997).

The governments currently implementing the BOT approach for road infrastructure construction seek to facilitate private international commercial participation through the use of risk and responsibility mechanisms commonly accepted in the international construction and capital investment arena (e.g. World Bank and other type of guarantees). The most common risks covered by such guarantees are traffic risk and currency convertibility risk. In some cases, the host government may mitigate construction cost risks by offering equity contributions for initial costs or coverage of cost overruns of special highway structures, such as bridges and tunnels.

Project Description

The bidding documents should include a detailed description of the project, including geographic location, the sections to be constructed or rehabilitated, operated and maintained, the type of terrain and climate, as well as its technical characteristics. The basic engineering data, such as level of service, the alignment and length of the sections, the number and characteristics of the intersections, bridges, and tunnels are also provided in the bidding package, leaving the detailed design to the potential concessionaire. Characteristics such as the number of lanes, and other geometric design concepts are usually included in the package, but the pavement type (rigid or flexible) and sections can be left to the bidders to play with it in their lifecycle cost analysis.

The bidding package should also contain an itemized preliminary cost estimate for the project divided into its several components such as open sky road, bridges and viaducts, conventional tunnels, specialty tunnels, environmental and public services work, etc. Most of these projects require the participation of international financing institutions and a substantial part of the funds is raised through foreign capital markets. In order to attract funds from international sources, generally the project cost estimates and cash flows are expressed in U.S. dollars or other solid international currency.

The package should also establish who assumes the responsibility for obtaining the rights of way, environmental licenses, construction permits, etc. In many cases, the government will assume the responsibility for purchasing the land and rights of way, carry out the land surveys, property filings, and appraisals.

Special Support and Risk Mitigation Mechanisms

This is one of the most important issues that should be covered in the bidding package. In general, the host government will try to mitigate the most significant concessionaire risks in order to make the project financially attractive and allocate each risk to the party that can most efficiently bear it. In most cases, the government will bear the political risks, share the traffic revenue risks with the concessionaire who would also bear most of the construction risks and the operations and maintenance risks. The table below is a sample of a toll road project risk and responsibilities allocation summary (Credit Suisse/First Boston & Inverlink, 1997):

Table 6.1 Toll Road Risk Allocation Summary (Credit Suisse/First Boston & Inverlink, 1997)

RISK	RESPONSIBILITY
Political and Regulatory	
Environmental Permits	Host Government
Right of Way Acquisition	Host Government
Construction and O&M	
Design and Build	Concessionaire
Construction Cost Financing	Shared
Construction Cost Overruns	
Tunnels	Shared
Excluding Tunnels	Concessionaire
Construction Delays	Shared
Operations and Maintenance	Concessionaire
Tolls, Traffic and Revenues	
Establish Toll Rates	Host Government
Traffic Revenue Risk	Shared
Non-compete Guarantee	Host Government
Toll Collection	Concessionaire
Other	
Currency Inconvertibility Risk	Shared
Force Majeure	
Political	Host Government
Natural	Concessionaire

Capital Cost and Funding Support

In situations where the expected revenue may not be enough for the project to be feasible, but the road remains a government priority, the host government may be willing to contribute with part of the capital costs of the project. Generally this can be done through special direct budgetary appropriations, which are guaranteed to be available to the concessionaire on agreed upon dates throughout the construction phase.

Cost Overruns of Non-Conventional Project Structures

Non-conventional structures of a highway project, such as long span or complex bridges and tunnels generally pose a much greater cost overrun risk than the rest of the highway, and special risk mitigation mechanisms are generally implemented to cover these risks. The host government may agree to share this risk by funding construction cost overruns on items of this type exceeding a specified percentage over their initial estimate. For example, by agreeing to fund cost overruns above 20% of the initial concessionaire's estimate.

Revenue and Currency Support Mechanisms

The revenue for the project depends almost entirely on the traffic it carries and the toll paid by the users, therefore it is the most critical issue for a toll road project. The toll price may or may not be set by the host government, and the traffic using the road will depend on a number of factors, including the toll price among others. The issue of toll and traffic demand is further discussed in the following chapter, where a toll-traffic estimation model developed as part of this research project is discussed. Usually, independent third party consulting firms hired by the host government will develop the traffic projections for the project in order to assure their reliability. However, the potential concessionaires should also develop their own traffic projections in order to corroborate the government estimates and refine their feasibility analyses.

In addition to independent traffic studies, the host government may incorporate into the concession structure other revenue support mechanisms for the early years of the project in order to mitigate the exposure of the concessionaire to traffic shortfalls. These mechanisms may be provided in the form of cash commitments by the host government in order to meet certain revenue levels at the project. These revenue levels are specified in the concessionaire's bid and are called the *minimum revenue required*. In case the revenues fall below the pre-specified amounts, the government may provide funds to meet the minimum revenue requirements, but only up to a certain cap, hence sharing the risk with the concessionaire. This type of revenue support protects the concessionaire from a number of risks, including traffic, regulatory, and currency rate volatility, since the minimum revenue required is calculated in U.S. dollars or the currency specified in the bid documents.

On the other hand, the concession contract may require the concessionaire to accrue the revenues in excess of the minimum revenue required as a reserve, which would be the first recourse in case of a revenue shortfall in subsequent periods before tapping into the support mechanism.

Permitting and Right of Way Commitments

In the case that the host government has committed to provide the construction and environmental licenses and the rights of way, the concessionaire needs to assure to have these delivered on time to start construction. The concession contract may specify a penalty to be paid by the government in case of delay in the delivery of these permits.

Guarantees

As noted in Chapter 3, guarantees and other mechanisms from international development institutions, such as the World Bank, are used in order to assure the host government's compliance with its concession contract obligations.

Standby loans from the World Bank may be used in order to avoid the typical disbursement delays of a government budgetary process. Funds from such loans would be disbursed immediately to the concessionaire in the event of occurrence of the previously mentioned cost overruns or that the revenue support mechanism is called upon.

Other World Bank instruments called "partial risk guarantees" may also be included in the concession. With such guarantees, the World Bank commits to step-in financially for any government payment defaults under the concession contract, to the extent necessary for the project to meet senior debt service obligations. Some of the host government commitments covered by partial risk guarantees may include periodic toll adjustments due to inflation, compensation for events of political force majeure, and changes in law that may affect the project's ability to service its debt.

Bidding Terms and Conditions

The bidding package should also include information describing the bidding process and its schedule. Generally the bidding process will include a pre-qualification phase before the final terms and conditions of the project are released. Some of the major milestones included are the initiation of the bid process, data room and information period, deadline for the pre-qualification process, release of the final terms and conditions, the final bid submission date, and the award and signing of the concession contract. Figure 6.1 depicts a sample schedule of a toll road bidding process.

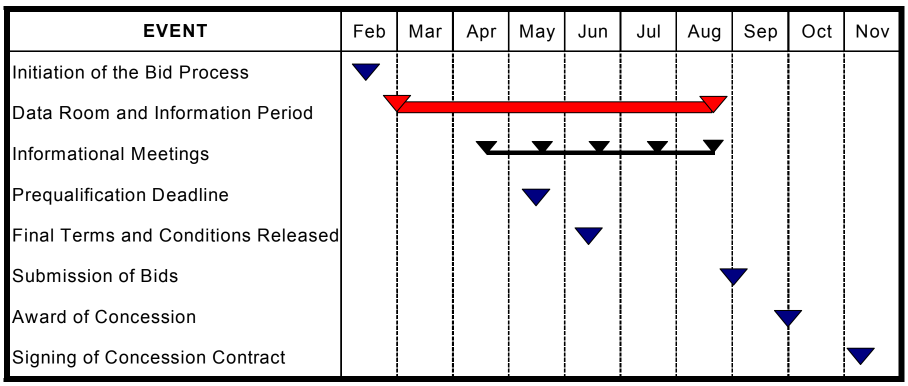


Fig. 6.1 Bidding Process Sample Schedule (Credit Suisse/First Boston & Inverlink, 1997)

Pre-qualification

During the pre-qualification phase, the project teams bidding must demonstrate compliance with specific technical, financial, and legal requirements.

The technical requirements refer to issues such as demonstration of satisfactory performance and experience in design, construction, and maintenance of similar projects, including the non-conventional structures already mentioned.

The financial requirements refer to the bidder's financial capability to execute the work. The project team must demonstrate experience in raising funds for similar projects at least from one of its members and to have a collective minimum net worth of a certain percentage of the total project cost.

The legal requirements refer to the demonstration of the legal existence of the bidders or if such is the case, of its different members in the case of joint ventures created for the specific purpose of the project.

Data Room and Information Period

During this period the host government opens a special office dedicated exclusively to the attention of the project called "data room". The potential bidders must pay a fee in order to gain access to the project's bid documents. The same fee may also provide pre-qualified bidders with the right to obtain the final version of the concession specifications once the pre-qualification phase has been closed. The purpose of the data room is to provide more detailed information regarding engineering and legal aspects of the project and to clarify the information provided in the bidding documents. The informational meetings serve to have feedback among the project participants.

Bid Submission and Award Criteria

The bid submission date and the concession award criteria must be clearly specified in the bidding package. As noted previously, the award criteria in this type of project is the proposal that offers the most cost-effective solution to the project lifecycle costs during the concession period. This concept can be expressed in terms of the lowest competitive toll or in terms of a weighed average of several bidding components. An example of the latter is shown in Table 6.2, which outlines the various bidding components and their relative weight for purposes of concession award.

Table 6.2 Concession Award Criterion Summary (Credit Suisse/First Boston & Inverlink, 1997)

BID COMPONENT	TYPE	WEIGHT
Non-Conventional Structures Cost	Present Value	0.13
Government Contributions	Present Value	0.45
Minimum Revenue Required	Present Value	0.20
Liquidity Facility Amount	Present Value	0.20
Total Required Revenue	Actual Amount	0.02
		1.00

The example shown in the table corresponds to a scheme where the host government has set the toll rates and has specified a number of guarantees and support mechanisms such as those mentioned earlier. These bid components are discussed below to demonstrate how this award criterion concurs with the idea of the most cost-effective solution to the project.

1. *Non-conventional structures cost*. In the case that the host government has offered to cover cost overruns on such structures (long span bridges and tunnels), the bidders are required to present a detailed breakdown of their construction unit costs. These costs are multiplied by the unit quantities in the bidding documents to determine a single structure construction cost. In the event of cost overruns on the account of the government, the government will pay for units of overrun at the unit costs offered in the bid. Assigning a certain weight to this component assures the government that it will pay the most competitive price for unforeseen cost overruns.
2. *Government contributions*. In the case of projects where the host government offers to contribute to the capital costs of the project, the inclusion of this component in the award criterion encourages the minimization of these contributions. The minimization of the government's contribution in turn encourages the development of a more cost-effective lifecycle solution, which relies more on the project itself than on external contributions.
3. *Minimum revenue required*. In the cases where the host government has specified the toll structure and guaranteed a periodic projected traffic, the award criteria may include a minimum required revenue component. The minimum revenue required by the bidder must

be less or equal to the projected traffic for that period multiplied by the applicable tariff rate. The government would guarantee this amount to the concessionaire for a specified number of years at the beginning of the operational phase. This mechanism also encourages the cost-effectiveness of the bids by favoring those with the least required revenue.

4. *Liquidity facility amount*. The previous mechanism by itself would allocate all of the revenue risk to the host government. In order to share this risk more efficiently with the concessionaire, a liquidity facility amount is established in the concession contract. Through this mechanism, the bidders are required to specify a maximum liquidity support value for each period. If revenues fall below the minimum revenue required, then the government will be only required to provide liquidity support for revenues up to the maximum liquidity support value specified for the period. The concessionaire, sharing the revenue risk with the government, would absorb the risk for amounts above the liquidity facility amount.
5. *Total required revenue*. This concept refers to the maximum amount of cumulative revenue that the concessionaire would seek to receive from the project. If this element is included in the concession contract, once this amount is achieved, the concession will terminate. This mechanism allows for the government to share in the potential upside of the project. It is important to mention that if revenues far exceed the expected amounts, the concessionaire will receive its return on investment earlier, thus increasing the project's rate of return. Conversely, if the total required revenue has not been achieved by the end of the concession period, the government may either buy out the concession or allow the concession period to be extended.

The Concession Contract

Both, the bidding package and the concession contract included with it are the legal documents, which will govern the allocation of rights and responsibilities for the project throughout its lifecycle. The concession contract has three primary functions:

- Management of the construction, operations, and maintenance of the road
- Implementation and management of the risk and responsibility allocations introduced in the bidding documents
- Management of the eventual return of the road to the host government

The most important elements of the concession contract include the definitions of the work required, the duration of the concession, the returns available to the concessionaire, and the use and availability of support mechanisms for the project operations and dispute resolution.

The duration of the concession period varies from project to project, depending on its size, financing scheme, and the legislation of the particular jurisdiction where it is located (country, state or province). Over this period, the concessionaire is responsible for the construction, operations, and maintenance of the road. Generally, the concession periods last between 20 to 50 years, for the most part being around 30 years (Cervantes & Rubio, Levy, OECD, 1992, 1996, 1987). An exception is the case of the Mexican toll road program (subject of the following chapter) on its first phase, where the concessions were awarded to the bidder requesting the shortest concession period, resulting in concession periods as short as eight years. This scheme developed a number of problems that eventually led to the failure of the program, and the concession periods were extended up to 30 years.

The concession can be divided into three contractual phases that allow for the identification of the rights and responsibilities of each party during each phase. These phases are pre-construction, construction, and operations and maintenance.

Pre-Construction Phase

This is the period between the signing of the concession contract and the start of actual construction of the road. During this phase the concessionaire can close its financing and complete the design, while the rights of way, and environmental and construction permits must be secured by the party responsible for them. The duration of this phase is specified in the contract along with the applicable penalties for delays caused by any of the parties.

Construction Phase

Toll roads are usually schedule driven projects. The duration of the construction period is specified in the contract, and in general, the earlier the project is completed and the revenue stream starts the better for the concessionaire. Penalties for delays caused by the host government in this phase must be included in the contract, since delays caused by the concessionaire would work against it. Nonetheless the contract may also specify delay penalties for the concessionaire.

As in every highway project, the construction work must meet the technical specifications as laid out in the bidding documents. The host government may also require the concessionaire to pay for an independent engineer or "supervisor," which may or may not be appointed by the government, to monitor the construction process.

Operations and Maintenance Phase

Once the construction phase has been completed, the concession enters the operations and maintenance phase. The duration of this phase is set in the contract but can be shortened or lengthened depending upon the total revenue levels achieved by the project (see Total Revenue Required above). During this phase the concessionaire is responsible for maintaining and operating the road to meet the standards specified in the bidding documents. The concessionaire must turn the road back to the government meeting the same standards of service at the end of this period.

The duration of the overall concession period is set in such a way that the duration of the operations and maintenance phase is set to a *long term investment* duration, such as 20, 30, 40 or 50 years, in order to meet the requirements of the long term capital markets. Thus, the overall concession period may be set to an odd number, such as 23 or 34 years for an operations and maintenance period of 20 or 30 years.

DEVELOPMENT OF THE CONCEPTUAL MODEL

Once the decision, fundamental objectives, uncertainties, and consequences have been identified, and the decision context has been understood, the next step in the decision analysis process is to create a conceptual model of the decision. The FEMTH was created by structuring the elements of the decision situation into a logical framework, in this case, influence diagrams. Influence diagrams provide simple graphical representations of decision situations, where the elements appear as different shapes. These shapes are then linked with arrows in specific ways to show the relationships among the elements.

Influence Diagram

An influence diagram is a snapshot of the decision situation at a particular time, which must account for all the decision elements that play a part in the decision. In an influence diagram, rectangles represent *decisions*, and ovals represent uncertainties or *state variables*. The rectangles with rounded corners represent *calculated variables* or *constant values* and have a variety of uses, but the most important is to represent *consequences*. The three shapes are referred to as *nodes*: decision nodes, uncertainty nodes, and consequences or calculation nodes. Uncertainty nodes mean that although the decision-maker is not completely sure of what will happen, he or she has some idea of the likelihood of the different possible outcomes. Nodes are put together in a diagram, connected by arrows. The node at the beginning of an arrow is called a *predecessor* and the node at the end of the arrow is called a *successor*. The arrows can represent either relevance or sequence between the decision elements linked. A properly constructed influence diagram has no cycles, that is, regardless of the starting point in the diagram, there is no path following the arrows that leads back to the starting point (Clemen, 1996).

The approach to structure an influence diagram is first to put together a simple version of the diagram and then add details as necessary until the diagram captures all of the relevant aspects of the problem.

For the purpose of this research, the decision context has already been set for choosing whether or not to invest in a toll highway project, with the fundamental objective of making a profitable investment, one that meets the investor's profitability criteria (NPV or IRR) as established in Chapter 4. Hence this objective feeds into an overall consequence node, the project's Net Present Value (or IRR), which is henceforward called the *objective function*.

All the decision elements, other than the investment decision, that affect the objective function had to be identified and added to the diagram. The diagram is said to be appropriate or *requisite,* when it contains everything that the decision-maker considers important in making the decision. Identifying all its basic elements was achieved by working through the problem several times and refining the model on each pass based on the background information available, until all of the important concerns were fully incorporated. The final version of the influence diagram for the project investment decision is shown in Figure 6.2. The influence diagram served as the basis to develop the FEMTH, and its elements are discussed in the following paragraphs.

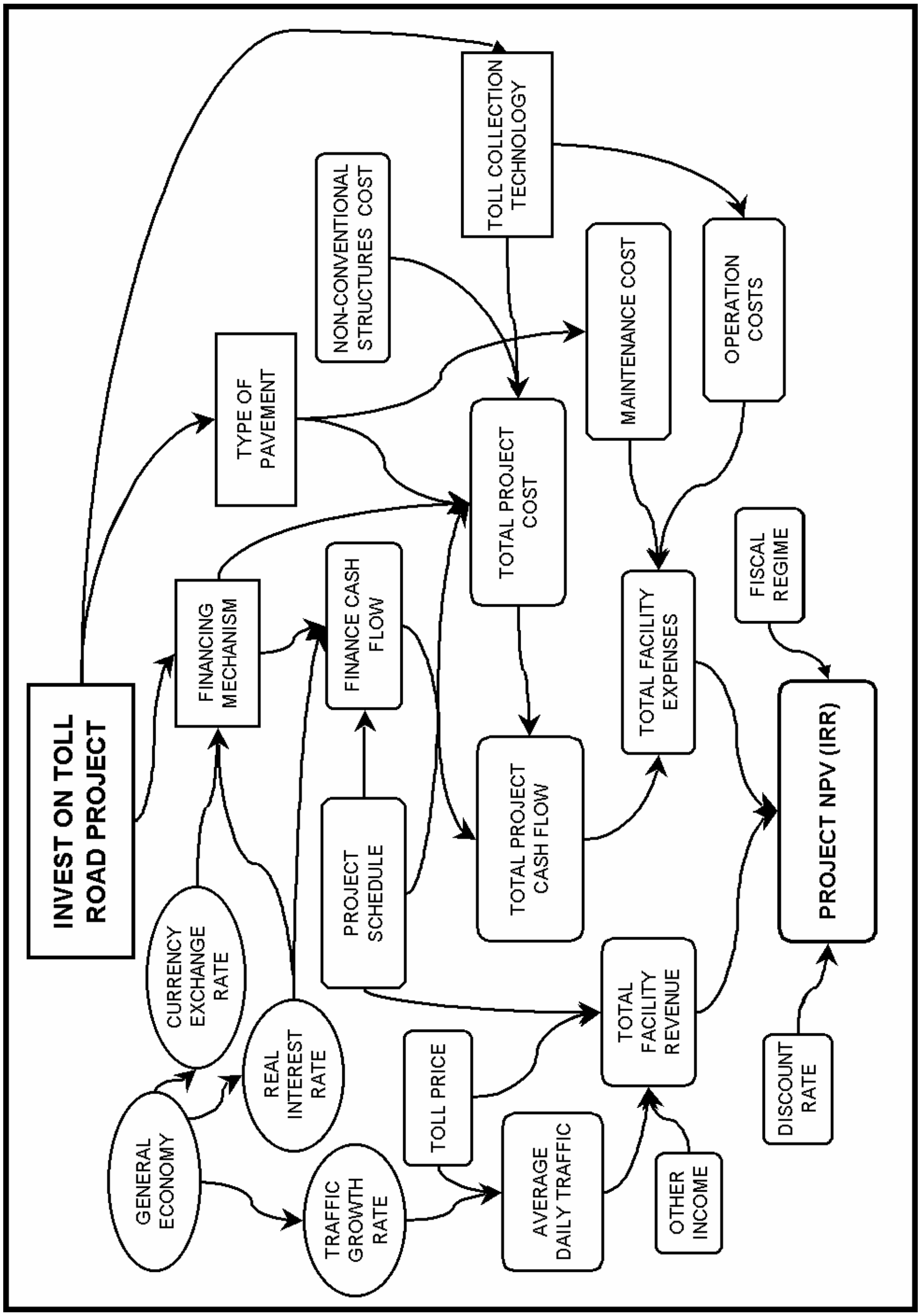


Fig. 6.2 Influence Diagram for the FEMTH

Elements of the Conceptual Model

The FEMTH influence diagram graphically depicts the decision problem, whether to invest in a toll road project, the decisions embedded within this one, and the state variables or uncertainties that affect these decisions. It also depicts the constant variables and the calculated variables that result from the interaction between state variables and decisions, and finally the objective function that serves to evaluate the decision, the profitability measure (NPV or IRR). The influence diagram illustrates the interactions among all these elements, allowing the assessment of the information needed to make the decision. The elements in the influence diagram can be grouped as follows:

Decision

The big bold rectangle at the top of the diagram, the decision is whether to invest in the toll road project.

Embedded Decisions

There are three embedded decisions that have to be made as a consequence of deciding to invest in the project.

1. ***Financing Mechanism***. Refers to those issues affecting the choice of financing structure of the project, including those discussed in Chapter 4, such as debt/equity, type of financing instrument used, foreign or local capital markets, guarantees, etc.
2. ***Type of Pavement***. The type of pavement (rigid or flexible) used in the facility. The lifecycle cost of each one is different and has a direct incidence in the initial construction cost and the maintenance cost.
3. ***Toll Collection Method***. The choice of toll collection method, manual, mechanical, or electronic for each booth impacts both, initial construction and operation costs.

State Variables.

There are four state variables in the diagram that indicate uncertainty.

1. ***General Economy***. The economic and political conditions prevailing in the country or region where the project is located and includes issues such as foreign trade, balance of payments, GNP growth, inflation, employment, etc.
2. ***Currency Exchange Rate***. This is the value of the local currency in the host country as compared to major international currencies. Its value is directly linked to the general economy.
3. ***Real Interest Rate***. The real interest rate on borrowed funds. It is a function of the prevailing commercial interest rates and inflation; hence, it is also directly affected by the status of the general economy.
4. ***Traffic Growth Rate***. The rate at which the traffic will grow over the life of the facility. It is a function of a variety of factors, such as economic development, price of gasoline, etc.

Calculated Variables

There are fourteen calculated variables or constant values that result from the decision and state variables.

1. ***Project Schedule***. This is the duration of the project design and construction phases, finishing at the start of project operations.
2. ***Cost of Non-Conventional Structures***. The cost of special structures such as long span bridges and complex tunneling jobs.

3. ***Total Project Cost***. The total amount of project direct costs, including design, construction, and right of way in case that it is not furnished by the government.
4. ***Finance Cash Flow***. The amount and timing of the funds flowing from the project investors and creditors during project design and construction stages.
5. ***Total Project Cash Flow***. The total amount of funds needed to cover for total project cost plus the interest charged on borrowed funds.
6. ***Maintenance Costs***. These are the costs for maintaining the facility over the concession period, including cleaning, patching, rehabilitation, etc.
7. ***Operation Costs***. These are the costs for operating and administrating the facility, ranging from toll collection to office work, emergency services, etc.
8. ***Total Costs***. This is the sum of the total costs for the project financing, design, construction, operations and maintenance over the concession period.
9. ***Toll Price***. This is the toll charged to each type of vehicle for using the facility. It is a function of a number of factors, such as regulations, traffic demand, road damage, etc. It can be pre-specified by the host government (constant), or calculated by the concessionaire in its bid (variable).
10. ***Average Daily Traffic (ADT)***. This is the calculated amount and type of vehicles that will use the facility on a daily average over the life of the concession.
11. ***Other Income***. The use of the right of way for commercial purposes, such as leasing it for fiber optics, electricity, oil, gas stations, traveler services, etc.
12. ***Total Facility Revenue***. The total revenue that the concession will produce over its life from toll income and other revenue sources.
13. ***Fiscal Regime***. The legal regime under which the project company will be taxed over its life (income taxes, value added taxes, depreciation, etc.).
14. ***Discount Rate***. The discount rate that the decision maker will use to discount the project cash flows over the concession period and calculate its NPV.

Objective Function

The bold rounded square at the bottom is the objective function, the NPV (or IRR) of the project. The objective function of the project serves as the basis for making the decision. Based upon the project's NPV or IRR the decision-maker will decide whether or not go ahead with the project.

The interaction among all these elements is illustrated in a very straightforward manner by the influence diagram. For example, once it has been decided to invest in the project a *pavement type* (rigid or flexible) must be selected. This decision influences both the *total project cost* as well as the *maintenance cost* for the facility. A flexible pavement may have a lower initial construction cost, but it may cost significantly more to maintain over its lifecycle than a rigid pavement, which may have a higher initial cost. *Maintenance cost* then influences *total facility expenses*, which in turn feeds into the profitability measure. Another example is the *general economy*. A stable political environment and healthy governmental finances, fosters economic growth, employment and commerce, increasing the amount of goods and services consumed by society. These goods need to be transported and people require mobility, increasing the *traffic growth rate*, and thus increasing the number of vehicles using the facility (*ADT*). The ADT is also affected by the *toll* charged to use the facility due to the price elasticity of demand. The ADT in turn directly influences the *total facility revenue* and thus the profitability measure.

DECISION MODEL DETAILING

Once the overall structure of the decision has been defined, the next step was to detail and define all elements of the decision model. This was basically accomplished by expanding on the elements of the influence diagram, and identifying the sub-elements that comprised them. All of the decision elements were then grouped into different categories according to their domain. This section looks in detail at all of the model elements and variables in order to advance to the next step, the development of a computer model for the decision.

The model elements and variables are grouped into six different categories as follows:

1. Traffic and toll related
2. Engineering and construction related
3. Facility operation related
4. Fiscal related
5. Economic environment
6. Financial

Traffic and Tolls

These are the variables related to projected use of the facility over its lifecycle and the tolls to be charged to the users. These are the most important elements in the decision, since they represent the main source of revenue, thus for repayment of the project. As Roth states, traffic forecasting is not an exact science (Roth, 1996), and it its often subject to a high degree of uncertainty. The toll-traffic study carried out by Orozco (1997), as part of this research project, demonstrates that these two elements are closely related. This study, which is further discussed in the following chapter, provides with a methodology to predict the approximate amount of traffic that will use a toll facility. The following are the elements that fall in this category:

Average Daily Traffic (ADT)

The initial ADT is the number and type of vehicles that on a daily average use the facility. For the purpose of this research, vehicles have been classified into three different types: cars, buses, and trucks. The percentage of each type of vehicle using a facility is called the *ADT distribution*.

The initial ADT of a toll facility depends on a number of factors, which are thoroughly discussed in Orozco's study, and summarized later on in this report. As a toll road is priced as a service, due to the price elasticity of demand, the most important of the factors affecting the "traffic demand" is the toll charged to the user, which is discussed below.

ADT Growth Rate

The traffic growth rate refers to the yearly rate at which the ADT is expected to grow over the facility lifecycle. The factors determining the traffic growth rate are rather complex, as they depend on macroeconomic factors, such as GNP, consumer expenditure, prices of fuel, etc., therefore this variable must be carefully determined for the specific project being analyzed.

Toll Structure

Toll structure refers to the toll amount to be paid by each type of vehicle, cars, buses, and trucks with cars generally paying the lowest toll and freight trucks paying the highest. As noted earlier, the ADT and the toll structure are closely related, and they represent the main source of revenue for the facility.

Engineering and Construction

These elements are those related to the design and construction phases of the project and those that directly influence initial project hard costs and its schedule.

Design

The percentage of the project design completed at the time of carrying out the cost estimate and the feasibility analysis is crucial to determine the variability of the initial cost estimate. The host government may provide the basic design data, but the detailed engineering generally has to be carried out by the concessionaire. As the design effort is commensurate with the project's complexity, its cost is generally expressed as a percentage of the total construction cost. According to a Mexican transportation official, for feasibility purposes a 10 percent of the total construction cost can be used as a proxy for total design cost (Aldrete & Orozco, 1996). McConville (1996) suggests the use of an 11 percent for complicated facilities.

Construction Cost

This concept encompasses all of the project hard costs, and it is given as a dollar amount. These are the costs for the pavement structure, bridges, and tunnels; toll charging facilities, equipment, toll booths, administrative building, emergency medical facilities, etc.

The costs of road construction depend on a number of factors, including terrain, pavement type and thickness, number of lanes, number and spans of bridges and tunnels, etc. There are two major types of pavement structures: rigid pavements (Portland cement concrete) and flexible pavements (asphalt concrete). The pavement type used will not only affect the initial construction cost, but also the maintenance cost of the facility over its lifecycle, as discussed below.

- *Pavement Type Selection*

Pavement type selection is a complex engineering problem that involves an assessment of many types of factors, including traffic, soils, weather, materials, construction, maintenance, and environment. The selection process is facilitated by comparing cost estimates for alternate pavement designs, including not only the initial cost but also the subsequent cost to maintain the level of service desired over the project lifecycle.

Rigid pavements generally have a higher initial cost than flexible pavements, but they have an average life span of 30 years, as compared to the 15 years average life of flexible pavements. Rigid pavements also have been found to carry more than three times their design traffic and to behave better under heavy loading conditions (American Concrete Pavement Association [ACPA], 1998). In other words, rigid pavements offer a better performance. Performance is understood as the degree to which the road fulfills its purpose, as measured by the accumulated quality and length of service that it provides to its users. A common scale to measure road performance is the 0 to 5 scale of the Present Serviceability Index (PSI) for pavements (Hudson, 1996).

According to Cole (1997), the lifecycle cost analysis for selection of pavement type must be done with comparable sections and taking into account their rehabilitation timing (performance) over the analysis period, in our case, the concession life. Cole defines comparable sections as those with the same structural capacity, similar traffic-carrying capacity over the analysis period, and which provide a reasonably similar level of service. Figure 6.3 shows an example of two hypothetically equivalent sections of the two different pavement types along with a hypothetical performance curve that illustrates their rehabilitation timing (performance).

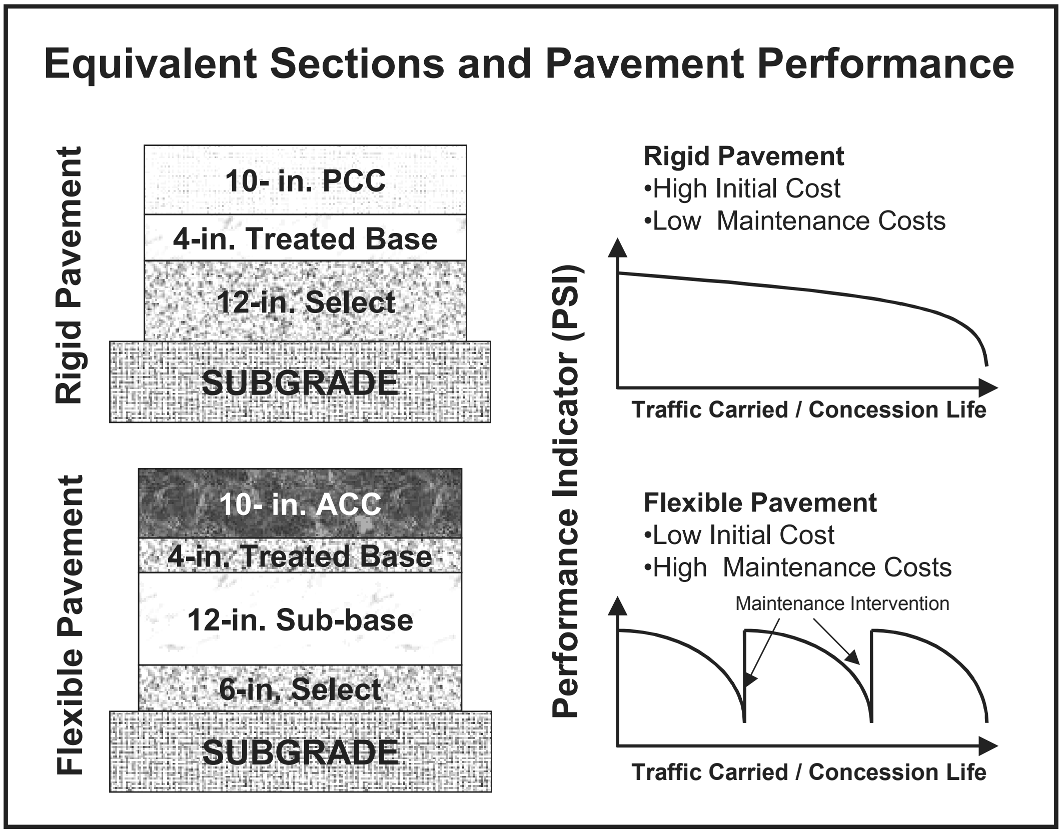


Fig. 6.3 Equivalent Sections and Pavement Performance (ACPA, 1997)

- *Construction costs in the FEMTH*

For the purposes of the FEMTH, these costs are divided into *road construction* (or conventional structures) cost and *special structures* cost. The former includes all of the above mentioned costs, except for non-conventional construction items, such as long span bridges and tunnels, which are included in the latter.

The reason for this construction cost breakdown is to give the decision-maker the chance to estimate these two types of construction separately, given the uncertainty that the existence of special structures may bring into the initial estimate. Conventional highway construction costs are rather standard and can be estimated more accurately at the project feasibility stage, from similar projects, than the cost of non-conventional structures. That is, the cost deviation from the initial estimate is more likely to be larger for non-conventional structures than it is for conventional highway construction. The advantage of splitting these costs will become more evident as risk analysis is introduced into the FEMTH.

Project Schedule

Project schedule refers to the time period between the signing of the concession contract, or the beginning of the detailed design phase, and the start of project operations, including the construction period. The time units used for the FEMTH are months.

As previously noted, toll road projects are usually schedule driven projects. The earlier the project enters in operations, the earlier the revenue stream starts, thus saving in financial costs and increasing the rate of return on the project.

Project expenditures (thus project cost) and schedule are closely related as mentioned in Chapter 4. The rate at which money is spent at the design stage is very low, increasing gradually and reaching its peak at the construction stage, at the end of which it starts declining. This relationship between project cost and schedule becomes very useful in the development of the computer model.

Construction Supervision Cost

This is the cost of the external engineer or supervisor mentioned earlier, in *the concession contract* section, which monitors the construction process. For our purpose, the cost of the services rendered by the external supervisor is given as a percentage of the construction cost carried out in a given period. A paper from Cervantes and Rubio (1992) cites a supervision cost of 3 percent for Mexico, but this number varies from project to project and it is likely to be negotiated. Although usually the host government appoints the supervisor, it is the concessionaire who pays for its cost.

Right of Way

This variable refers to the cost of the land and rights of way for the road. Generally the host government covers these costs as part of the concession agreement, thus the concessionaire should not include them in his/her analysis. In other cases the host government applies a tax or commission on the facility's toll income to help to amortize these costs (Cervantes & Rubio, 1992). On the other hand, this cost should definitely be included in the analysis in those cases where the host government will not be providing it.

The cost of land for the right of way will vary through different locations, depending on the degree of development of the region, the environment, etc. Land for the right of way should be priced before including the development impact of the road, which will bring its price up. For preliminary feasibility analysis purposes, Carlos Orozco suggests the use of a 10% of the project's construction costs (Aldrete & Orozco, 1996).

Facility Operation

These are the variables that affect the toll road during the operations stage. These are the costs of the ongoing operations of the facility as well as the revenues linked to the facility that the concessionaire may obtain from activities other than charging tolls to the road users.

General Administration or Overhead Costs

This variable encompasses all those expenses arising from managing the concession enterprise, the concessionaire's overhead. These costs include administrative personnel and office materials, facilities management, incident management, etc. Highway patrol costs are not included in this category because they tend to vary depending upon the administrative arrangement with the host government. A study carried out by Gittings (1982) estimated these costs to be around 22.5 percent (varying between 18 and 25 percent) of the total annual operating and maintenance costs.

Toll Collection Costs

The cost of collecting the tolls will depend on the number of employees, location, number of booths, and the type of toll collection system used. There are three basic systems for toll collection, manual, automatic coin machine, and electronic toll collection (ETC). The first two are still the most used methods for toll collection. They require a driver to stop and pay (to an operator or inserting coins) before continuing his/her journey, resulting in congestion at toll plazas and time lost. ETC is based in the technology called automatic vehicle identification (AVI), which is the process of identifying a vehicle by a unique identification code as it passes a sensor without requiring any action from by the driver or observer. It combines an on-board transponder with roadside receivers to automate vehicle identification and charge the toll amount to the user account. This technology has become quite inexpensive over the last few years, and its use is constantly increasing as agencies and users become more familiar with it. The study by Venable (1994) describes this technology in detail and serves as a reference to this section.

- *Capital Costs*

Manual and automatic systems require each expressway lane to expand to three approach lanes, which then expand to six tollbooths to ensure that the capacity of the road itself is not restricted by the capacity of the tollbooth. Tollbooths are land (right of way), labor (toll operators), and time (user) intensive. ETC systems, on the other hand, do not require lane expansion, they improve the efficiency of revenue collection by alleviating congestion at toll plazas, increasing tollbooth capacity, reducing toll collection costs, enhancing audit control, and reducing driver frustration and time lost (Venable, 1994). ETC systems result in overall toll collection cost reduction. Besides toll plaza cost savings (construction and right of way), the equipment cost for ETC is lower than for the other systems.

For the purpose of the FEMTH, the capital cost of the toll collection equipment must be included in the facility construction cost estimate. As a reference the table below presents the equipment costs in US dollars for the three different systems (Venable, 1994):

Table 6.3 Toll Collection Equipment Cost (Venable, 1994)

System	Equipment Cost
Manual	$58,500 per lane
Automatic Coin Machine	$58,000 per lane
Electronic Toll Collection	$15,400 per lane
Transponder	$15 - $50 per piece
ETC Plaza Computer	$124,400 per plaza
ETC Central Computers	$296,800 per system

As the number of lanes increases, central and plaza system costs are spread over a larger number of lanes, decreasing the total cost per lane. Due to the type of technology involved, toll collection equipment capital costs are not likely to vary much from project to project.

- *Collection Costs*

The study by Venable identifies the following major operating cost items for toll collection, operator salaries, facility operation and maintenance, and revenue processing fees. Venable states that the cost per transaction ranges from $0.05 to $0.10, depending on the system size and rate of use. She also estimates the cost of manual toll collection at US $0.086 per transaction, including equipment, maintenance, and auditing costs. The same study indicates that if half of the toll transactions are processed in automatic (coin and ETC) lanes, the overall average cost per transaction is reduced to about $0.056 (Venable, 1994).

Maintenance Costs

As soon as the road is constructed, it starts to deteriorate as a result of adverse weather conditions and the application of loads to its surface, requiring continuous maintenance. The costs of road maintenance, are also known as M,R&R (maintenance, rehabilitation and reconstruction), and include routine activities, which are continuous, and rehabilitation and reconstruction activities, which are periodic. The costs of maintaining roads vary with many factors and also with one another. Timely and effective maintenance increases road life. Some of these costs (loading damage) occur only as a result of use and vary with traffic, while others are incurred irrespective of traffic (weather). Table 6.4 lists the typical road routine and pavement maintenance expenditures (from Hudson & Roth, 1996):

Table 6.4 Road Maintenance Expenditures (after Hudson & Roth, 1996)

Routine Maintenance
Pavement and shoulder
Rigid pavements. Cleaning and rehabilitation of joints, slab replacements, patching, and thin asphalt overlays.
Flexible Pavements. Localized patching, crack sealing, surface treatments, and thin asphalt overlays.
Reserve and drainage. Vegetation control, drainage cleaning and repair, etc.
Appurtenances. Signs, lighting, pavement markings, barriers, etc.
Structures. Minor repairs to bridges, tunnels, etc.
Snow and hazard control. Removal of snow, ice, debris, and hazardous materials.
Emergency work. Landslides, washouts, catastrophic damage, etc.
Major Maintenance
Pavement
Rigid Pavements. Hot mix asphalt overlays, concrete overlays, and reconstruction.
Flexible Pavements. Hot mix asphalt overlays, concrete overlays, surface milling and recycling and reconstruction.
Structures Maintenance. Major repairs to bridges and tunnels.

As mentioned earlier, the type of pavement (rigid or flexible) selected for road construction will directly affect its M,R&R costs. The timing and amount of the maintenance expenditures will be different in each case. The concept of pavement performance previously introduced serves to illustrate this difference.

According to Hudson (1996), serviceability is the ability of a specific section of pavement to serve traffic in its existing condition, and the Present Serviceability Index (PSI) measures it. Plotting a time series of PSI measurements over the facility lifecycle, as seen in Figure 6.4, can represent pavement performance.

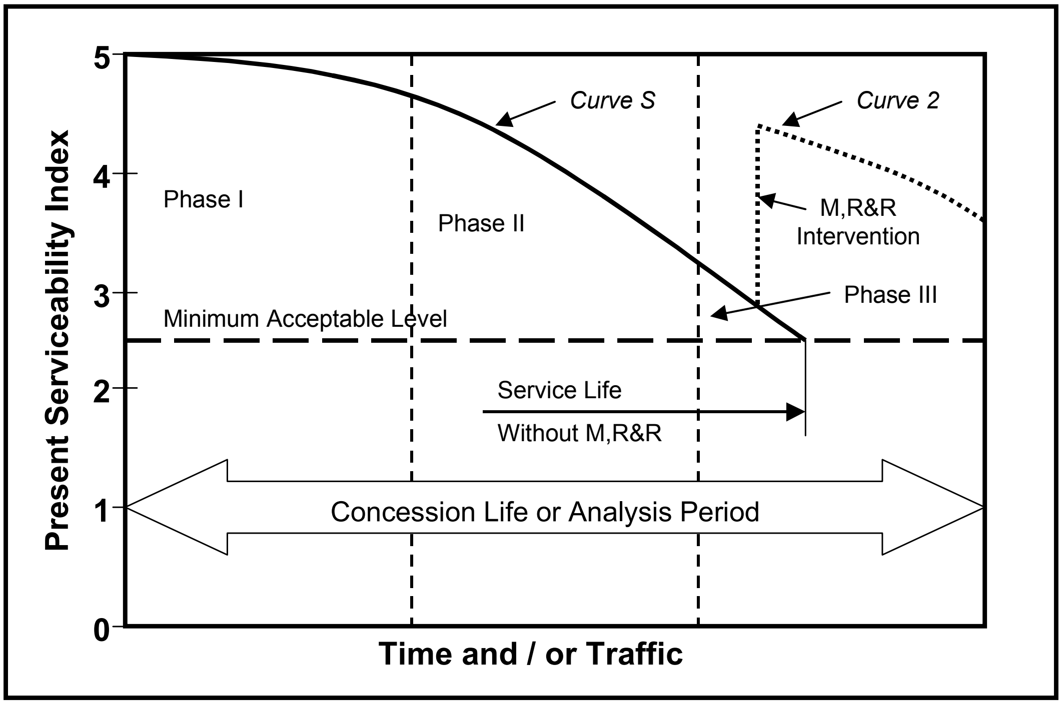


Fig. 6.4 Conceptual Illustration of Performance Curve (After Hudson, 1996)

The area under the curve represents accumulated service or performance of the road. A good performing facility should provide a high level of service and should remain in relatively good and acceptable condition for most of its service life. As mentioned earlier in this chapter, different pavement types perform differently in both the timing and the amount of M,R&R intervention (hence the cost) needed to bring their PSI to a high level, and in general, rigid pavements perform better than flexible pavements.

C*urve S* in the figure defines a typical pavement performance. According to Hudson, it is generally assumed that routine maintenance does not have any significant effect on serviceability and only a major M,R&R action improves the road condition, as shown by *Curve 2*. The performance curve can be characterized by three distinct phases of the facility life in the absence of any major M,R&R treatment (Hudson, 1996).

Phase I starts immediately after construction, or after a major M,R&R as in the case of Curve 2. A smaller slope and longer period indicates good performance, and the concessionaire would like to see this period being the same as the concession life, ideally with minimum maintenance. A sharp increase in the slope of the curve or rate of deterioration indicates the start of phase II. Lack of appropriate maintenance will accelerate in a relatively shorter period to the minimum acceptable level, initiating phase III. If deterioration is allowed to continue to the end of this phase, reconstruction or replacement may be the only effective option at that time (Hudson, 1996).

In the case of concessioned toll roads, the concession agreement requires the concessionaire to maintain the highway at very high levels of service, a PSI of 4 or above (Credit Suisse/First Boston & Interlink, 1997). Therefore, the concessionaire should seek to extend phase I of the performance curve over the concession period by following the M,R&R policy mentioned by Hudson of repair, rehabilitation, restoration, and renovation of the pavement to improve its condition and extend its life. Pavement performance prediction is key to the accurate estimation of the M,R&R strategy, and a number of pavement performance prediction models have been developed over the last decades (Hudson, 1996). However, because all pavement structures are different, in terms of both local conditions and operation policies, accurate prediction models can only be developed using detailed historical performance data about material properties, loads, environment, etc. Therefore at the project feasibility stage it is very difficult to attempt to make an accurate prediction of the cost of the maintenance strategy along the life of the facility.

For the purpose of the FEMTH, an annual estimate of the M,R&R costs had to be determined, allocating these costs uniformly over the life of the concession. Although these costs do not occur uniformly and in fact, they increase with traffic and time, it is assumed that the amount allocated each year for maintenance may go to a M,R&R fund from which the funds are drawn when needed. A paper by Carlos Orozco estimates that the annual costs of maintaining an expressway at a high PSI are about 2.5 percent of the project's initial roadway construction cost in Mexico, and about 5 percent in the U.S. (excluding special structures) (Orozco, C., 1996). A study by Gittings (1982) on U.S. toll roads supports this figure, indicating an approximate annual maintenance cost of 5.2 percent of construction cost. Another paper by Cervantes and Rubio estimates the annual maintenance costs of a concessioned highway in Mexico at approximately 3.5 percent of the total initial construction cost (Cervantes & Rubio, 1992). From these references, we can establish an annual M,R&R expense that varies between 2.5 and 5.2 percent of the initial conventional roadway construction cost.

Other Revenue Activities

This variable represents all the income that the concessionaire may obtain as a result of other activities out of toll charging. The concessionaire may be allowed to profit from leasing the right of way for a number of services, activities, or purposes. Some of these include fiber optics, utilities, gas and liquid pipelines, and convenience stores, restaurants, and service stations. This income will vary from project to project, and it would be very difficult to estimate a number for this variable.

These revenue activities are not likely to impact as strongly the feasibility of a project when compared to the toll traffic revenue. Nonetheless, if this variable is well managed, these activities can provide added value to the project in terms of attractiveness to potential investors, with several business opportunities, and to toll traffic customers with a better service.

Fiscal or Tax

These variables refer to the fiscal regime governing the project company, which will be specific to the location of the project. State and federal taxes as well as depreciation policies vary from country to country. In general, it can be assumed that the project company will be taxed as any private corporation, although there may be special tax breaks and incentives implemented to attract potential investors and facilitate private participation. Corporate taxes and depreciation policies are easier to figure out than the potential tax breaks and incentives. For this reason these tax incentives are excluded from the FEMTH, knowing that their existence would work in favor of the overall project feasibility. The following paragraphs overview the most common fiscal regimes that would apply to a private toll road corporation.

Corporate Income Taxes

This research identified two types of corporate income taxes that could apply to a toll highway corporation, the *regular income tax* and the *presumptive income tax*. As in any corporation, the concessionaire's regular income taxes will be calculated by subtracting its business expenses, exempt income, and deductions from its revenues. The presumptive income tax is usually calculated as a percentage of the book value of the corporation's fixed assets. Presumptive income taxes usually apply in those cases where the corporation declares losses at the end of the fiscal year. Starting businesses usually have a grace period of a number of years (3 in Mexico) before they are required to pay presumptive income taxes. Toll highway corporations are likely to experience fiscal losses during the first years of operation.

The tax rates applicable to the concessionaire will also vary from country to country, and even from state to state, in case that besides the federal income tax there is a state income tax. For example, in the U.S. the marginal federal tax rate on regular income for private corporations is 34 percent. The same rate is applied in Mexico, while a 35 percent is applied in Colombia. The U.S. does not have a tax on presumptive income, while in Mexico the rate for this tax is 2 percent and in Colombia is 1.5 percent (Secretaría de Hacienda y Crédito Público [SHCP] & Credit Suisse/First Boston & Interlink, 1997).

A corporation incurring a fiscal loss may offset this loss against taxable income in previous (loss carrybackward) and future years (loss carryforward) for a limited number of years. For example, in the U.S. tax losses can be carried backward for the prior three years and forward as far as fifteen years (Rao, 1992). In Mexico, losses can be carried forward up to ten years (SHCP, 1997), while in Colombia losses can be carried forward just for a maximum of five years (Credit Suisse/First Boston & Interlink, 1997).

Other Taxes

Other taxes identified in this research that can be applied to a toll road corporation include: a value added tax (VAT), a percentage chargeable on sales and expenses, a worker's profit sharing tax that depends on the corporation's profits after taxes. In some cases there is a tax or commission levied directly on toll revenues.

The VAT applies to most business related costs, although this and the tax rate vary from country to country. For example, the U.S. does not have a VAT. Instead it has a sales tax, which varies from state to state and only applies to the final consumer of a product (it does not apply to services, like a toll road). In Mexico the VAT rate varies for some items but is in general 15 percent of the cost of the good or service (including interest paid on debt). There are some exemptions to this tax, like direct labor costs (SHCP, 1997). In Colombia the VAT rate is 16 percent, and the exemptions include direct labor costs, interest payments, and tolls collected on roads (Credit Suisse/First Boston & Inverlink, 1997).

Worker's profit sharing taxes are levied when at the end of the fiscal year the corporation declares profits, and only then. When the corporation declares losses, this tax is not levied. In Mexico, by law, corporations are required to pay to their workers 10 percent of after tax net income (SHCP, 1997).

In 1992 the Mexican government through the Ministry of Transportation (SCT) charged a commission or tax of 0.5 percent on the gross income generated by the tolls charged to the users (Arias, 1990). This commission was used to help the government to cover for the cost of the right of way.

Depreciation

Depreciation is according to Rao (1992), the allocation of the historic cost of an asset over its estimated economic life. In a toll highway facility there are many physical components with different service lives (Hudson, 1996). Pavements generally deteriorate over 18 to 30 years, while the toll collection equipment may become obsolete over 10 years. Structures may last over 50 years, and rights of way may not deteriorate at all. Although depreciation is an accounting expense that does not involve the disbursement of cash, it affects the amount of cash paid out in the form of taxes, and therefore it is very important to the concessionaire. Depreciation on fixed assets is a deductible expense for tax purposes according to the rules set out in the specific tax legislation of the country where the project is located.

There are two types of methods that are commonly used to depreciate assets: straight-line and accelerated methods. Straight-line depreciation is the simplest method, and it is used in the FEMTH to determine the depreciation expense. It spreads the historic cost of an asset evenly over its economic life. Usually tax legislation indicates the asset lives for tax depreciation purposes. For example, in the U.S. the service life of non-residential property is 31.5 years (Wurtzebach, 1985). In Mexico and Colombia it is 20 years (SHCP, Credit Suisse/First Boston & Interlink, 1997). However, in the case of a toll highway this is likely to be a special tax case. Its service life for tax purposes could vary around the shortest of the duration of the concession and the service life of the pavement structure (between 20 to 30 years), since pavement is the largest cost item of the facility.

Economic Environment

These are macroeconomic variables that are non-project specific, hence they are out of the control of the concessionaire and are the most uncertain as well. These variables depend for the most part on the state of the economic and political environment of the particular country where the project is located, and practically influence every other element in the project. These variables deal with inflation, foreign exchange, interest rates, and political risks.

All of these macroeconomic elements are closely interrelated and it would be very difficult to provide a thorough explanation of their interaction in this report. Foreign exchange is a very complex variable, which is linked to a number of other factors, such as the country's economic policy, inflation, balance of payments, etc. These issues become very critical when the financing for the project is obtained abroad in a foreign currency, the debt has to be serviced in the same currency, and the toll income in the facility is in local currency. The availability of currency to make the payments and the exchange rate at which the concessionaire can obtain it becomes a major risk for the project's feasibility. This can be further complicated if the tolls are not linked to inflation. It is in these cases where the guarantees and agreements mentioned earlier, among international development banks, host governments, financiers, and concessionaires are used to mitigate these risks.

Forecasting with acceptable accuracy foreign exchange and inflation rates in developing countries over such a long period as the life of a concession is a very complex issue and probably impossible. The following paragraphs provide the reasoning followed to consider them in the FEMTH without further complicating the development of the model.

Foreign Exchange and Inflation

This variable refers to changes in the exchange rates between the host country's currency and foreign currencies; especially those used to finance the project. Exchange rates are influenced by many factors, with inflation rates, interest rates, balance of payments surpluses or deficits, and the level of international reserves among the most important (Rao, 1992). The increase in foreign currency exchange rates is also known as *devaluation* of the local currency, and it is more noticeable in less developed countries. A devaluation boosts the prices of goods and services in the local country, especially those that rely heavily in imported inputs which are priced in foreign currency, leading to a generalized inflationary process, and a recession in the economic activity.

The importance of this issue resides in the fact that while the project's toll income is priced in local currency, its debt obligations (or part of them) have to be paid in the foreign currency, usually U.S. dollars. As a result of devaluation, the concessionaire will need more local currency units to pay for the same foreign currency obligation or higher domestic interest rates. At the same time the concessionaire's local currency net income stream does not change or may even decline due to a decrease in traffic and price increases in its operating inputs.

Both host governments and institutional lenders have to address the devaluation problem with a number of risk mitigation and hedging strategies. Bond and Carter (1994) suggest that host governments may agree to link toll prices to the project's debt service cost (exchange and interest rates) or to an inflation index in case that the tolls are regulated.

It would be very difficult, if not impossible, to accurately forecast inflation rates or the timing and currency exchange rates over such a long period as a toll highway concession in a feasibility evaluation model and would merely introduce more uncertainties into the evaluation. However this issue still needs to be acknowledged and addressed in some way. In order to determine the best or most practical approach to address this variable, Pedraza (Aldrete, 1997) suggested to avoid the exchange rate issue by using constant U.S. dollars to develop all the cash flows over the life of the project. The rationale behind this approach is discussed in the following paragraphs.

The first argument for this approach refers to the facility revenue stream and is based in the concept that inflation and currency exchange rates are closely interrelated. One definition of inflation by Martin Brofenbrenner says *"Inflation is a fall in the external value of the money as measured by foreign exchange rates… or indicated by excess demand for gold and foreign exchange at official rates"* (Lopez de Ortigosa, 1994). Rao (1992) further explains this concept in his discussion about the *purchasing power parity* and the *interest rate parity* theories for exchange rates.

After devaluation and over a reasonably short period, as a result of price increases, toll income will recover from exchange rate adjustments. Immediately after devaluation, real toll income will fall, but over time nominal toll income will increase as a result of price increases, recovering the facility's real toll income levels at some point in time. Although the lag between the devaluation and the time when real toll income is recovered creates cash flow problems in the short run, over the long-term analysis of the concession period, these temporary cash problems will not have a strong impact on the feasibility of the project.

To illustrate this, the case of the Mexican peso and the U.S. dollar was analyzed on a monthly basis, from January 1980 to February 1998. First a dollar adjusted exchange rate index (AERI) was created based on the nominal pesos exchange rate for constant U.S. dollars with base in January 1984. Adjusting the value of the dollar by the U.S. consumer price index (CPI), the nominal amount of pesos paid for one January 1984 dollar over the dates mentioned earlier was used to obtain an exchange rate index based in January of 1994. Once the AERI was obtained, it was plotted against the Mexican CPI based in January of 1994, from January 1980 to February 1998. The detailed data for this analysis is included in Appendix C. Figures 6.5 and 6.6 depict the plot of both indexes, the first on a decimal scale and the second in a logarithmic scale to better illustrate the behavior of the indexes on the first years of the analysis (BDINEGI & BOGFRB, 1998)[1].

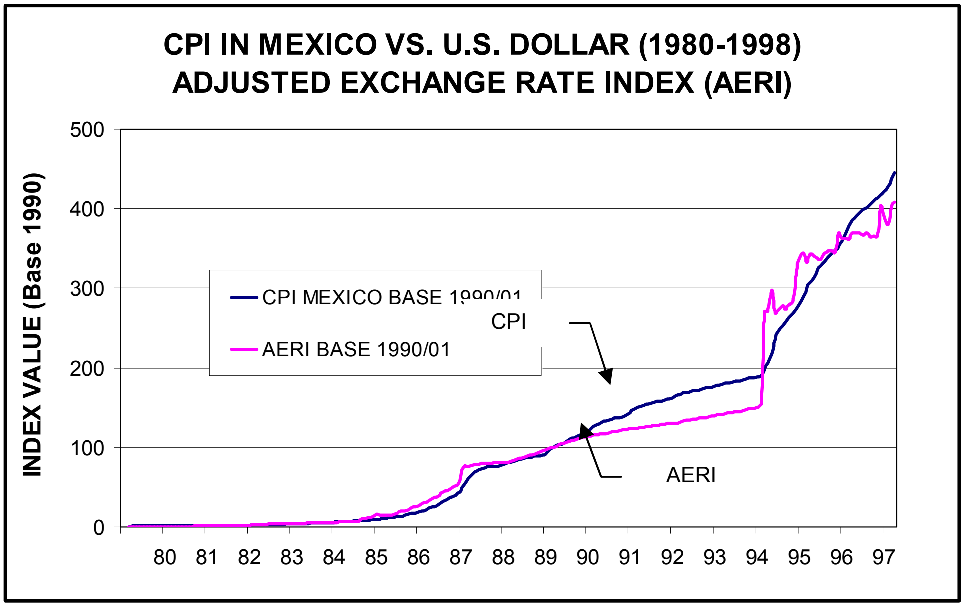


Fig. 6.5 Exchange Rates and Inflation in Mexico (1980-1998) (Exhibit I)

[1] Banco de Información Económica del Instituto Nacional de Estadística, Geografía e Informática [BDINEGI] & Board of Governors of the Federal Reserve System [BOGFRB].

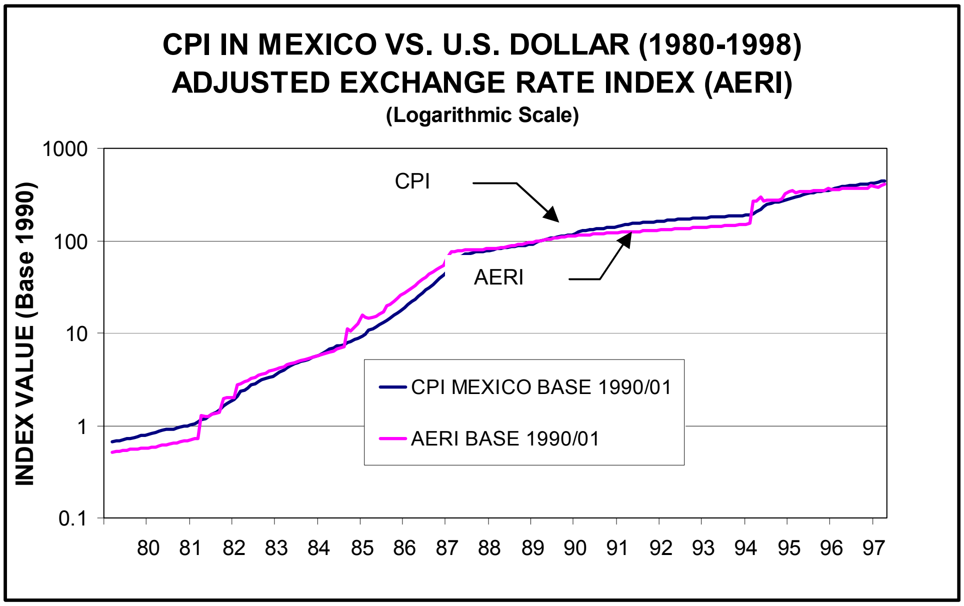


Fig. 6.6 Exchange Rates and Inflation in Mexico (1980-1998) (Exhibit II)

Both figures show clearly how foreign exchange rates and inflation follow each other. It could also be argued that the value of the income lost at the time of a devaluation balances out with the overvaluation of the local currency at other points in time, when inflation is high and the foreign exchange rates remain low. A more thorough analysis of this issue is out of the scope of this report. Right now, this idea serves to justify the use of U.S. dollars for the development of the FEMTH in order to avoid the additional uncertainty that would bring in the inclusion of exchange rate forecasts, and would not add much value to the final results of the analysis.

The second argument that serves us to justify the use of constant U.S. dollars refers to the facility expenditure stream. At the present time most of the inputs to the project construction and operation (except labor) have reasonably similar international prices. Highway construction is a materials and machinery intensive and not labor intensive process. With the increasing use of semi-automatic and automatic toll charging, operation of the tollbooths is becoming less and less labor intensive. General administration has a small share of total operation cost, and personnel salary differences at the managerial level are less marked internationally. Thus, the share of project expenditures that would not be directly linked to the currency exchange rate is fairly small, making it reasonable to estimate the project cash flows in a more stable currency, like the U.S. dollar.

Interest Rates and Inflation

This variable refers to the interest rate to be paid for the funds borrowed for the project. The relationship between interest rates and inflation has already been explained in Chapter 4. In capital markets priorities for funds allocation are determined on the basis of a pricing structure expressed in terms of interest rates and required rates of return (RRR). These rates are determined by the supply of, and demand for, funds within particular categories of risk and maturity of investment. As Fisher's equation demonstrates, interest and required return rates are significantly affected by the inflation rate in the general economy, and an *inflation premium* is built into both rates to reflect the capital's loss of purchasing power over the term of the investment (Wurtzebach, 1991).

For example, the prime lending rate is defined as the rate that U.S. banks charge to their most creditworthy customers, and serves as a benchmark to most bank loans (Rao, 1992). Figure 6.7 depicts the prime interest rate from January 1966 to February 1998 (BOGFRB, 1998), plotted in both nominal and real terms. The gap between each curve represents the inflation premium for each observation. The real interest rate was obtained using Fisher's equation and the monthly data for the prime rate and the U.S. CPI. The source data for this analysis is also included in Appendix A.

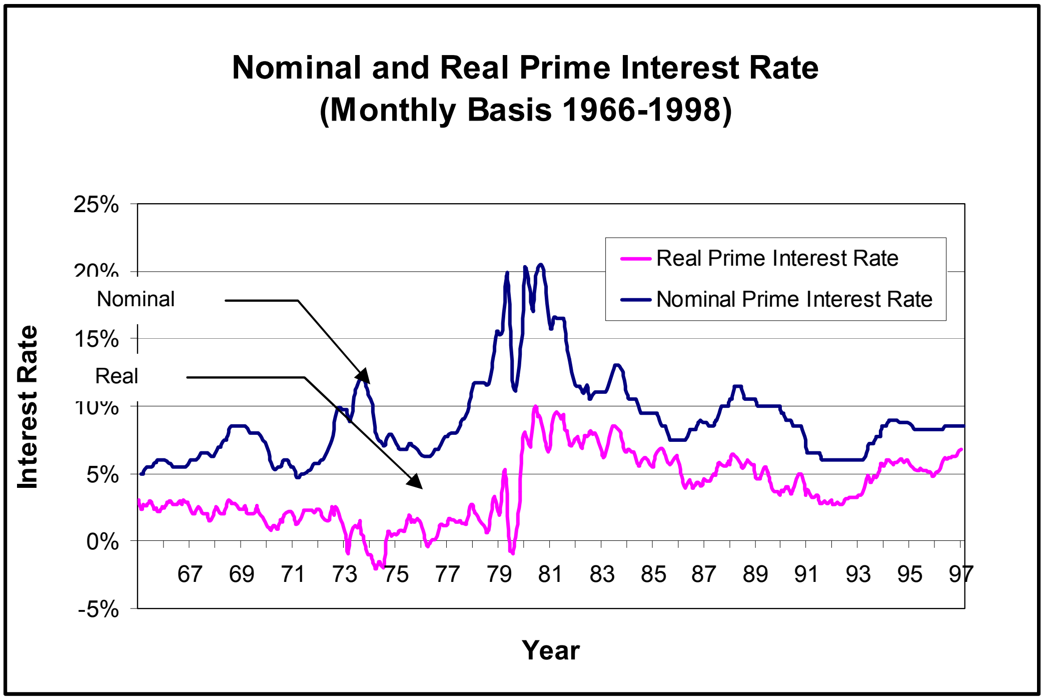


Fig. 6.7 Nominal and Real Prime Interest Rates in the U.S. (1966-1998)

The approach followed to deal with inflation in the FEMTH will be the one mentioned in Chapter 4, the constant currency approach. Thus, by tying this approach with the one convened to treat the exchange rate problem, the cash flow profiles of the FEMTH are developed in terms of constant U.S. dollars. Consequently, the rates used to carry out the financial analysis (both interest and discount rates) are real rates, calculated with Fisher's equation introduced in Chapter 4. Therefore, the results yielded by the model are expressed in real rates and constant or base year U.S. currency.

Political Risk

Political risks were briefly discussed in Chapter 5. This is an economic environment variable, which is highly uncertain, very hard to measure, and totally out of the control of the concessionaire. As mentioned earlier, these risks include expropriation, changes in the regulatory regime that affect the project, failure of the host government to meet contractual obligations, or even events such as war or civil unrest. The importance of this variable depends on the specific country and project itself, the perceived volatility of the economic and political environment, and the priorities of the investors (Bond & Carter, 1994).

The traditional way to account for this type of variable in a discounted cash flow model like the FEMTH would be by incorporating a project specific risk premium into the required rate of return. Such an approach is entirely subjective and goes beyond the scope of this study. However, there are a number of other instruments currently used to hedge from or mitigate this type of risk in infrastructure projects, such as the previously mentioned guarantees, insurance and other agreements. The study by Bond and Carter (1994) discusses this issue in greater detail.

Project Financing

These are the variables that deal with the funding scheme of the project and in one or another way affect the cash flows overt the life of the project. Chapter 4 discussed different potential scenarios for project funding and the financing risk vs. cost of funds difference between the construction and operation phases. Ideally, the best strategy would be complementary bank-bond financing with bank financing during the early years of the project followed by refinancing with longer term bonds once the project is completed. However, at the feasibility analysis stage of the project it is difficult to anticipate the costs and timing of bond issuance, since project feasibility has not been proven. Considering this and the case studies used for this research, which were for the most part financed through commercial bank loans (Cervantes & SCT 1992, 1996), the bank loan scenario was selected for the development of the FEMTH.

Capital Structure

The capital structure of the project, as mentioned in Chapter 4, in terms of the concessionaire's capital (equity) and the funds borrowed (debt) used to finance the project. As mentioned earlier, in toll road projects the amount of equity fluctuates generally around 20 to 30 percent of the total project cost due to the large amounts of capital required and the particularly risky nature. The choice of a specific capital structure depends on a number of factors, including taxes, cost of financing, project risk, etc. A thorough discussion on capital structure decision making can be found in most financial management texts. For the purposes of the FEMTH, the project's capital structure may be based upon the previously mentioned values.

Interest Rate

The approach to deal with this variable was already discussed in the previous section. The financial cost of capital or interest rate carried by the project debt over such a long term (beyond 20 years) is a highly uncertain and volatile variable. Loan interest rates are usually a floating variable that is tied to the prime lending rate, the rate for commercial paper, or the London Inter-Bank Offered Rate (LIBOR). Although the prime lending rate was defined as the rate charged to the most creditworthy customers, a number of large, healthy companies pay 1 or 2 percentage points below this rate. On the other hand, small businesses are usually charged at least 1.5 to 2 percent above the prime rate (Rao, 1992). The LIBOR is a rate set based on the rates charged by one European financial institution on loans to another, and loans to multinational companies are quoted in terms of the LIBOR plus a percentage for the risk premium based on the borrower's creditworthiness.

Figure 6.7 depicted the values of the prime rate (nominal and real) over the period 1966-1998 on a monthly basis. The average value for this rate during this period was a nominal of about 9 percent, with an average real of 3.77 percent (3.99 percent after eliminating negative values). The same analysis was performed on the LIBOR rate (1971-1998) to obtain an average nominal rate of 6.89 percent and the real of 2.27 percent (2.69 percent after eliminating negatives). Thus if a multinational firm pays 1.5 percentage points below prime or 1 point above LIBOR, the real rate paid would be the same (3.27% vs. 3.27%), corroborating the notion that the cost of capital is very similar in the capital markets. The detailed data for these analyses is included in Appendix A.

Debt Origination Cost

This variable refers to the additional costs of originating the loan or issuing the debt. The investment institution that will backup the project or serve as intermediary between the investors and the concessionaire generally reviews the concessionaire's feasibility analyses and proposals and evaluates their appropriateness against the backdrop of current market conditions. The investment institution also performs intensive due diligence, an investigation of all the aspects of the concessionaire (or its members) business, finances, management, projections etc. These procedures have costs associated with them besides, which consist of the *investment institution spread* (or fee) and *administrative costs*. The spread and the administrative costs are usually expressed as a percentage of the amount borrowed. According to Rao (1992) the spread costs fall below 2 percent and administrative costs below 1 percent, which coincides with the total of 3 percent origination costs mentioned by Cervantes and Rubio for a toll road project in Mexico [1992].

Discount Rate

One of the most important and sensitive variables in the FEMTH is the discount rate used to arrive at the NPV of the project cash flows. It is also the hurdle rate against which the project's IRR is compared or the required rate of return (RRR) discussed in Chapter 4. The RRR is in essence a yardstick for the minimum level of performance of the investment. As defined in Chapter 4, the real RRR must be determined based upon three elements, the risk-free rate plus undiversifiable and diversifiable risks.

The assessment of the diversifiable or project unique risk component is one of the primary objectives of the risk analysis process in the FEMTH. Thus in order to avoid double counting these risks, the RRR should not be affected by this factor when performing risk analysis using Monte Carlo simulation. This approach is related to the *state preference* or *certainty equivalent* capital market theory cited by Rao and Wurtzebach (1992, 1991), which adjusts the expected cash flows to their certainty equivalent and discounts at a risk free rate, which is essentially what the simulation process does.

However, there are certain subjective risks whose impact on the expected project cash flows would be very difficult to quantify numerically, such as some country specific risks, and still the most practical way to take them into account is by adding a risk premium to the RRR. These issues are out of the scope of this report; yet there are a number of international organizations that publish data that may help to determine the degree of political risk for specific countries, such as the International Finance Corporation, Amnesty International, etc. (Bond & Carter, 1994).

Thus, the approach to determine the RRR or discount rate to be used in the FEMTH would be as follows. The first component, the risk-free rate would be the average interest rate yielded by the U.S. Treasury 30-year bonds (around 2.98 percent), since its maturity approximately coincides with the project investment period and the reference currency being used. The undiversifiable risk component would then be the average real return in the capital markets less the risk-free rate (using an average of 6 percent). The diversifiable risk component will not be added at this point for the reasons previously discussed, but the analyst should bear these risks in mind. These numbers add up to a 9 percent risk-free plus diversifiable RRR.

For comparison purposes, let us mention the rates of return for similar projects throughout the world. According to Quinet (1990), the rate of return (real) obtained in the financial analyses of private toll roads is 10 percent, and Szymansky (1997) suggested the use of a 7.5 percent real discount rate for a NPV analysis of the Eurotunnel. Thus, for the purposes of the FEMTH, a 9 percent or the particular investor's average cost of capital is suggested as a lower boundary for the RRR, which is equal to that suggested by Hirshleiffer for private utility investments, at 9 percent (in Wohl, 1984). Furthermore, in the same way as its components, this rate is not static. It is dynamic by nature, and thus the analyst must also consider the effects of its variation on the results of the analysis.

Cash Flows and Debt Amortization Scheme

This concept refers to the particular scheme that will be considered to repay the project's outstanding debt. As stated earlier, toll road projects are generally highly leveraged projects, that is, they are mainly financed through borrowed funds. As a general rule, once taxes have been paid, debt holders have the first claim on the project's assets and only after they have been paid, equity holders can receive their profit.

Typically, infrastructure projects, and specifically toll roads do not have revenues during the construction stage and their income is limited during the first years of operation. The financing plan and debt structure must be designed to fit the revenue scheme associated with the project in order to make it feasible, resulting in "level," or "deferred" debt service payments. Thus, under normal conditions initial interest payments are capitalized in bank loans (deferred) or the issuance of bonds (level), that is, there is an initial grace period in which there are no interest payments.

In the FEMTH a bank loan with a deferred debt service mechanism is assumed as the debt financing mechanism. Besides eliminating the uncertainties associated with a bond issue, this mechanism also allows for uncertainty in construction costs, revenues, toll adjustments, and stochastic variation in traffic growth. Hence the debt amortization scheme must be planned according to the projected cash flows, giving priority to debt repayment. Likewise, by repaying debt first, the project is freed from additional financing costs and investment recovery is accelerated. However, this scheme further emphasizes the schedule driven nature of toll road projects, since interest is capitalized during the construction period and delays demand high penalties. Both international development and private investment banking institutions support this financing scheme (Jones & World Bank, 1998, 1991).

Development of the Computer Model

The influence diagram in Figure 6.2 consists for the most part of rounded rectangles, that is, constants, intermediate calculations, and consequences. Although these three different roles may seem confusing, the basic idea is the same in each case; for any variable represented by a rounded rectangle, as soon as its inputs are known, the value of the variable can be calculated. In the case of constants, there are no inputs and therefore there is no calculation to do.

The information needed to arrive to the objective function, the profitability measure that serves to evaluate project feasibility, revolves around accounting information, which is easily handled with the use of a computer spreadsheet, such as Microsoft Excel. As Clemen states (1996), "A spreadsheet environment is ideal for working with accounting data and building financial models for the possible outcomes and consequences in a decision situation." In a spreadsheet it is possible to construct the decision model and create subsidiary models to provide the inputs to the elements in the influence diagram, develop cash flows profiles, obtain expected values, and finally calculate the model's profitability measure.

The conceptual model of the FEMTH was structured as a Microsoft Excel spreadsheet template. The integrated functions and programming capabilities of Excel were used to create a model that only requires the user to input the basic data in a straightforward manner to calculate the model's objective function. Two toll road case studies, one presented by Arias (1990) and one presented by Cervantes and Rubio (1992) were initially used as a basis to prepare the structure of the spreadsheet model. The detailed code of the spreadsheet template is included in Appendix D.

In essence, the computer model consists of three elements, an *input form*, a *discounted cash flow calculation structure*, and a *cumulative cash flow profile and results* screen. In the input form the user enters the expected values and other information needed to calculate the model's variables. This information includes data about traffic and planned tolls, design and construction costs, operation and maintenance costs, financial and fiscal information, etc. Based upon this information, the discounted cash flow structure calculates the cash flow profiles for the project over its lifecycle and yields its profitability measure. Then, the cumulative cash flow profile and results screen displays a cumulative cash flow graph for the project's life and the objective function results.

Input Form

The input form is the primary interface between the user and the FEMTH. The basic project data is entered here for the model to calculate the project's objective function. The model calculates the objective function in terms of both, the NPV of the project, and the IRR, and displays the results for the then current input values. The format for all the inputs follows the logic from the previous discussions, and the values are calculated in base year constant dollars using real interest rates.

At this point it is important to clarify that the ADT diverted to the toll road is determined by using the toll-traffic demand model discussed earlier, which is based upon the Mexican toll road network case. In order to apply the FEMTH to other economic region, the toll-traffic model would need to be modified to reflect the characteristics of the particular case. However, as one of the objectives of this research was to create a generic model, there are two versions of the input form. The only difference between these versions is in the data section called *traffic and tolls*. In both versions, this section produces the same information, which is later used in the discounted cash flow structure. The other two elements of the FEMTH remain the same with either input form version.

The first form, the *case study* or *input* form, shown below in Figure 6.8, specifically applies the toll-traffic demand model to determine the basic traffic data. The second, the *generic* form, is more general and has some shortcomings. It does not include any methodology to determine the traffic data, which is instead, totally input by the user, making the results obtained with it more general as well. Both forms consist of seven major sections, six for data input and one for output of preliminary results. These sections are discussed below, including the two different *traffic and tolls* sections. The cells in white color are cells that require input from the user and the model calculates the darker cells.

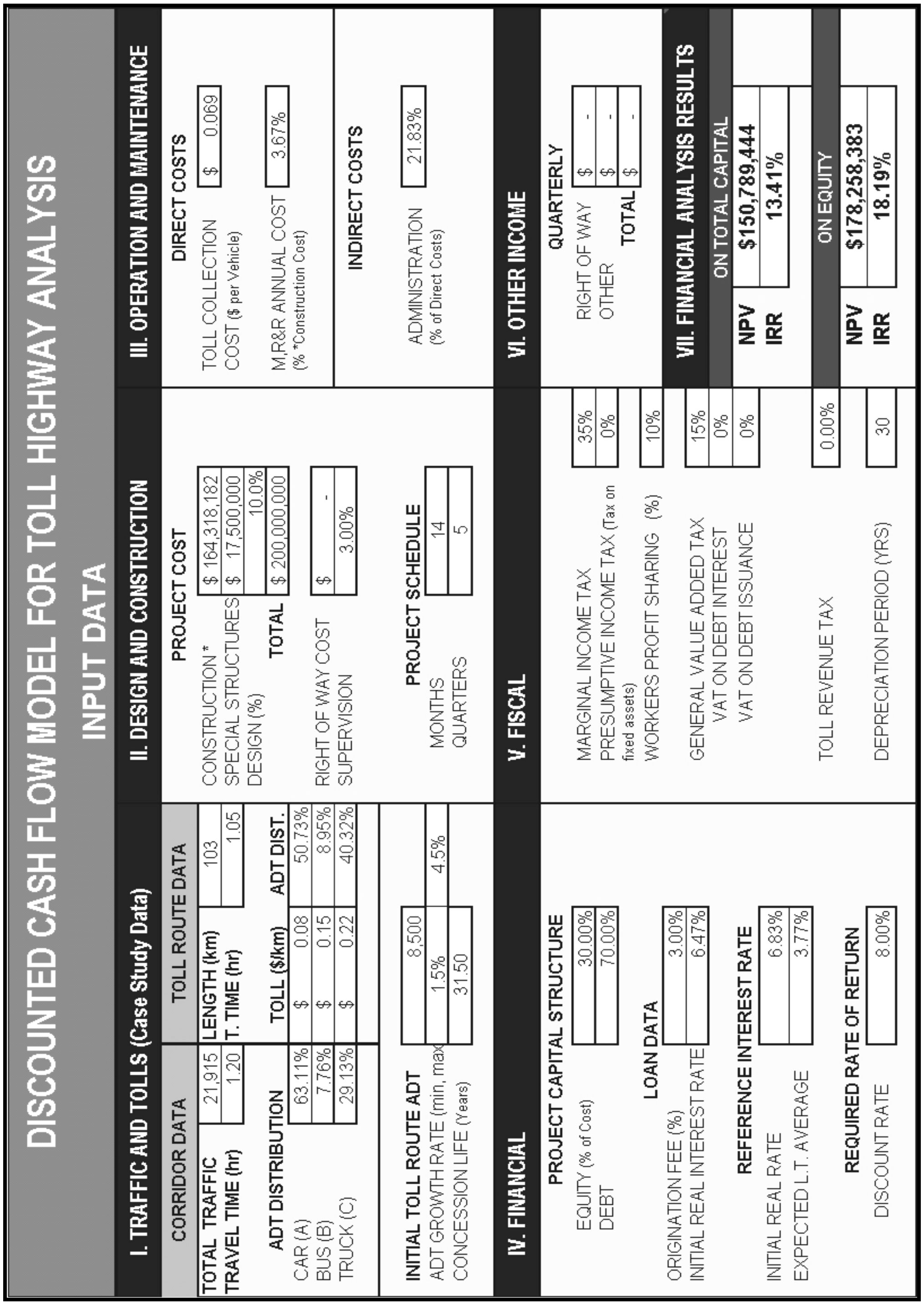


Fig. 6.8 FEMTH Input Form

Traffic and Tolls Data Section

The data input and calculated in this section is the basic traffic and toll information of the project. The *traffic and tolls* section of the case study input form, illustrated in Figure 6.8, is divided into two main subsections: the corridor data and the toll route data. The model assumes that a “free” road already serves the same corridor as the projected toll road. The traffic that will divert to the new toll facility is then calculated using the toll-traffic demand model (Orozco, 1997), which is discussed in detail in the next chapter.

The information about the corridor data includes the total average daily traffic (ADT), the ADT distribution (in percentage) in three categories, car (A), bus (B) and truck (C), and the total travel time. All the information is from point to point for the same stretch as the toll road. The toll route data includes the total length in kilometers, the expected travel time from point to point, and the toll fare in dollars per kilometer for each of the three vehicle types.

Based upon this data the model calculates and displays the expected ADT and the ADT distribution for the toll road. Finally the user must input the maximum and minimum expected traffic growth rates over the analysis and the duration of the concession period.

Figure 6.9 below illustrates the *traffic and tolls* section of the generic input form. The data in this section includes the ADT in absolute numbers, the ADT distribution in the three vehicle categories, and the total toll fare for each category. Finally this section also includes the maximum and a minimum expected traffic growth rate and the duration of the concession period.

I. TRAFFIC AND TOLLS (Generic)

INITIAL ADT		8,500

DISTRIBUTION		**TOLLS**
CAR (A)	50.73%	$ 8.24
BUS (B)	8.95%	$ 15.45
TRUCK (C)	40.32%	$ 22.66

ADT GROWTH RATE (Min	1.50%	4.50%
CONCESSION LIFE (Years)	31.50	

Fig. 6.9 Traffic and Tolls Section (Generic Form)

Design and Construction Data Section

The inputs in this section are divided into project cost and project schedule items. The first item is the cost of conventional road construction in dollars. Next, the cost of special structures such as tunnels and long span bridges, also in dollars, and then, the cost of design expressed as a percentage of the construction cost. This division of construction cost elements will become useful later on for the risk analysis routines. The next inputs are the cost of right of way in dollars, in case that the user wants to include it in the analysis, and the cost of construction supervision as a percentage of total construction cost.

Finally, the project schedule data is simply the overall expected duration of the project design and construction stages in months. Since the cash flows in the spreadsheet are calculated quarterly, the computer then calculates the cell labeled “*QUARTERS*,” which is simply the number of months divided by three and then rounded off.

Operation and Maintenance Data Section

This section is divided into two cost input groups: direct and indirect costs. Direct costs are those that arise from the actual use of the facility for its end purpose, costs that the traffic going through the facility and the existence of the road structure itself originate. First in this group is the cost of collecting tolls in an average dollar cost per transaction basis. The next input is the average yearly M,R&R cost, as a percentage of the initial conventional cost.

Indirect costs are those that arise from the operation of the highway as an enterprise, that is, the administrative costs. This input is expressed as a percentage of the total direct operation cost.

Financial Data Section

There are four data input groups in this section. First are the project's capital structure data, equity, and debt expressed as a percentage of the initial total project cost.

Next are the loan data, which includes the fee for debt origination as a percentage of the amount borrowed and the expected interest rate specifically for the first quarter of the project. The information from the *reference interest rate* subsection is used to model subsequent interest rates during the simulation process. This data is concerned with the interest rate that determines the rate charged on the project's debt, i.e. prime rate, LIBOR, etc. The input *initial reference rate* is the prevailing reference rate expected for the first quarter of the project. The expected *long-term average* (or the mode) of the reference rate is the last item in this group (e.g. 3.77 percent for the prime rate, 2.27 percent for LIBOR, etc.). The example in the figure would be paying around 0.37 percent below the prime rate.

Finally, the last item in this section is the RRR specified by the user, which will be used in the NPV analysis.

Fiscal Data Section

This section serves to enter the information related to the fiscal regime in the particular country where the concessionaire is operating. All the taxes are expressed as a percentage, and not all of the taxes listed in this section may apply to every case analyzed, and the cell needs to be left blank. The corporate income tax is probably common to every country. On the other hand, the presumptive income and profit sharing taxes are not that common. The general Value Added Taxes (VAT) is more common. However, it is not very common that interest payments and debt issuance fees are taxed with a VAT. The toll revenue tax is very rare and is included in the input screen due to the precedent of the Mexican case. Finally, the user is asked to enter the period of time over which the facility will be depreciated for tax purposes, using a straight-line depreciation method.

Other Income Data and Financial Analysis Results Sections

The purpose of the section labeled "*OTHER INCOME*" is to allow the user to consider other income sources in the analysis, including right of way rental, or services provided along the road, such as gas and service stations, etc. There are two cells to input a quarterly dollar amount, which are added by the computer in the colored cell labeled "*TOTAL*."

Finally, the Financial Analysis Results section displays the results of the NPV and IRR analyses calculated by the spreadsheet with the data input from the previous sections, expressed as a dollar amount and as a percentage respectively.

Discounted Cash Flow Structure

In order to arrive to the model's measures of profitability, that is, the project's after tax NPV and IRR, its cash flow profiles need to be organized, discounted, and analyzed. Based upon all the information discussed earlier, the main calculation structure of the model was constructed in the body of the spreadsheet. The structure is subdivided into six different sections where the project's cash flows are calculated and organized. The programming capabilities and built-in functions of Excel were then used to automate the discounted cash flow analysis process and respond to the information furnished by the user in the input screen. As a result of this, there is no need to modify the spreadsheet structure every time that the user wants to analyze a different project. Thus, the user can vary all of the project inputs at will without affecting the accuracy of the calculations.

The project cash flows are analyzed on a quarterly basis, due to the length term nature of the concession periods, and following an *end of period* convention. That is, cash flows are estimated and assumed to occur at the end of the quarter. Only the cash flows for the design and construction stages are first analyzed on a monthly basis and then summarized into quarters. Also, because toll road concession periods seldom go beyond fifty years, the model is designed to analyze any project up to sixty years of concession life, from the design to the operations stages. The following paragraphs describe the model's structure and the methodology followed to generate the net cash flows after taxes for the project, which in turn lead to the project's expected NPV and IRR.

The discounted cash flow model is then divided into the following sections:

1. Monthly schedule of project execution expenditures
2. Quarterly schedule of expenditures for project execution and maintenance
3. Toll income and capital investment
4. Flow of funds analysis
5. Income statement
6. Analysis of net cash flows after taxes

Schedules of Project Execution and Maintenance Expenditures

At the feasibility stage it is very unlikely that an accurate schedule of design and construction activities will be available to estimate the cash flows for the project execution stage. Despite this fact, the first attempt to estimate this information for the FEMTH was to link a project scheduling software package to the spreadsheet software. This approach was abandoned due to the fact that the processing speed performance of the computer was severely hampered. The accuracy gained through this procedure did not compensate the complexity and amount of work involved with linking the scheduling software and detailing the project schedule at the activity level with information still highly uncertain. Thus, an alternative approach had to be developed to estimate the amount and timing of the cash flows during the project design and construction stages.

As shown in the Influence and Expenditures Curve for the project lifecycle in Figure 4.1, the typical cumulative expenditures vs. time diagram of a project takes the shape of a letter *S*. At the beginning of the project, when planning, design, mobilization, and organization take place, expenditures accumulate slowly. Later, when most of the equipment, labor, and materials are on the project, costs accumulate almost at a constant rate. Toward the end of the execution stage, work is completed and cost accumulation decelerates. This diagram is thus known as the project's *S-Curve* (PMI, 1996). According to Navon (1996), most mathematical models developed to forecast construction project cash flows are based on this formulation.

Murmis (1997) developed a mathematical model to build type *S* curves with normal distribution. The model applies a curve with the shape of a normal distribution of probabilities under conditions that force the accumulated curve to pass by fixed points at 0T/0P (0% time, 0% progress), 10T/5P, and 100T/100P. According to Murmis, the term progress is used in its most general definition, and his model is generic and can be used for physical progress, economic progress, requests for payment, etc. In addition, he affirms that highway projects follow the same type of progress *S-Curve*. Murmis' model is further illustrated in Appendix E. This model is also very flexible, and it lends itself very well for spreadsheet programming. Consequently, this model was used to describe the cash flows for the project design and construction stages in the FEMTH computer model.

In Murmis' model, project time and progress (total schedule duration and expenditures in this case) are recorded as percentages of their totals. Accordingly, 100% of time corresponds to total schedule duration, and 100% progress corresponds to total project cost. For each percentage point of schedule duration there is a corresponding percentage point of project expenditures with the fixed points cited in the previous paragraph for a total of 100 points. The model was then built into the FEMTH spreadsheet template and used to estimate the amount and timing of project expenditures. The Expenditures vs. Time S-Curve yielded by this model is depicted in Figure 6.10 below.

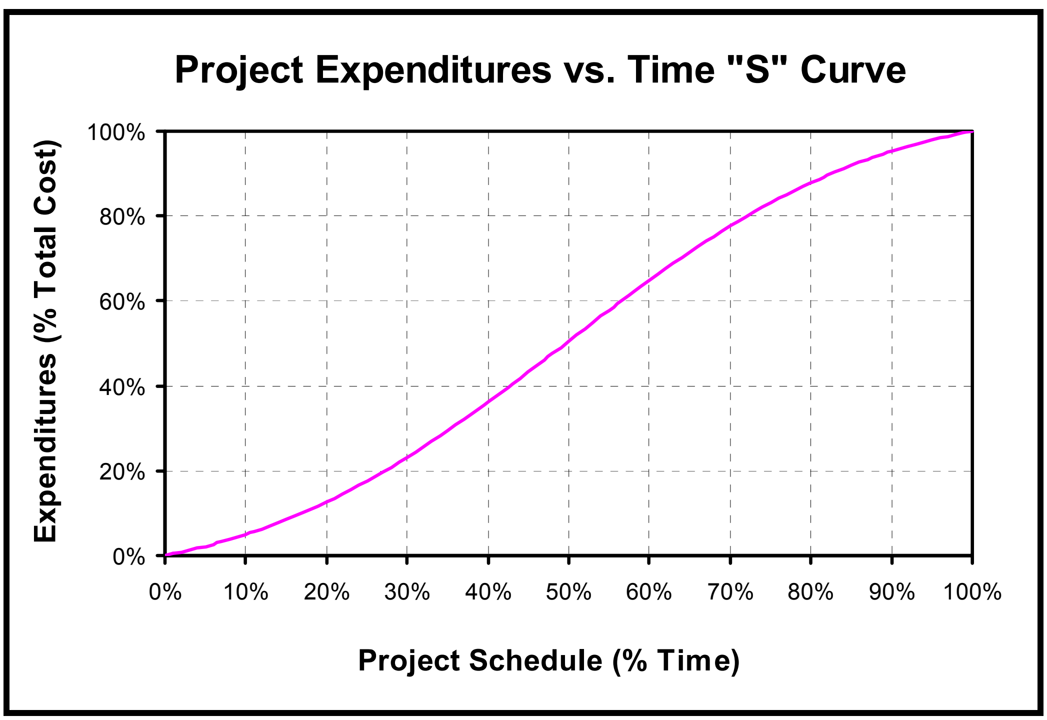


Fig. 6.10 The Expenditures vs. Time Project S-Curve (Murmis, 1997)

At this point, the methodology used in the FEMTH to generate the cash flows of the design and execution stages is better explained with an example. Let us take the hypothetical project used to illustrate the input screen, which is expected to cost U.S.$200 million, and to be completed in fourteen months, including design and construction. First, the FEMTH tabulates cells for the number of months specified. In order to determine the expenditures for month 1, the computer calculates the percentage of project schedule progress (1/14 = 7.14 percent). Then, the lower and upper integers for this number (7 percent and 8 percent) are found in the S-Curve model and their corresponding expenditure percentages retrieved (3.24 percent and 3.80 percent). These percentages are then interpolated to find the value corresponding to 7.14 percent, which is 3.32 percent.

The cumulative expenditure until that period is then determined multiplying the total project cost by the percentage of expenditure progress, U.S.$200,000,000 times 3.32 percent, for a total of U.S.$6,640,000. The monthly expenditure for that period is obtained by subtracting the previous month total cumulative expenses from the current calculation. Because this is the first month, both numbers are equal. The same procedure is carried out for each month. The resulting monthly schedule of project expenditures is shown in Table 6.5 below.

Table 6.5 Monthly Schedule of Expenditures for Project Execution

MONTHLY SCHEDULE OF PROJECT EXPENDITURES

(Thousand U.S. dollars)

MONTH	1	2	3	4	5	6
% SCHEDULE TIME	7.14%	14.29%	21.43%	28.57%	35.71%	42.86%
% TOTAL EXPENDITURES	3.32%	7.93%	13.99%	21.51%	30.35%	40.19%
MONTHLY EXPENDITURE	$ 6,640	$ 9,229	$ 12,106	$ 15,040	$ 17,691	$ 19,669
CUMULATIVE	$ 6,640	$ 15,869	$ 27,974	$ 43,014	$ 60,706	$ 80,374

7	8	9	10	11	12	13	14
50.00%	57.14%	64.29%	71.43%	78.57%	85.71%	92.86%	100.00%
50.54%	60.86%	70.58%	79.25%	86.58%	92.42%	96.84%	100.00%
$ 20,706	$ 20,643	$ 19,440	$ 17,346	$ 14,643	$ 11,697	$ 8,837	$ 6,314
$ 101,080	$ 121,723	$ 141,163	$ 158,509	$ 173,151	$ 184,849	$ 193,686	$ 200,000

The fact that the S-Curve approach is based upon percentages makes it very suitable for use in a generic model such as the FEMTH. It gives the model the flexibility of calculating data for any project, since there is no need to modify the structure for each case, and there are no constraints in terms of cost and schedule as long as the parameters are reasonable and realistic. This flexibility also becomes very useful in the risk analysis stage, when the parameters for a single project are varied a number of times, and it would become impractical to modify the structure of the model for each iteration.

Finally, the monthly expenditures are summarized into quarters in the quarterly schedule of expenditures for project execution and maintenance, which calculates the quarterly expenditure amounts for this concept.

As discussed earlier in this chapter, annual maintenance expenditures are calculated as a percentage of the cost of conventional construction. The model is programmed to start assigning quarterly maintenance costs once the operations stage has started, that is, once project execution has been completed and until the end of the concession period. Table 6.6 below illustrates the *quarterly schedule of expenditures for project execution and maintenance* section for the first eleven quarters of the example project life, which assumes an annual maintenance cost equal to 3.67 percent of conventional construction initial cost.

Table 6.6 Schedule of Expenditures for Project Execution and Maintenance

SCHEDULE OF EXPENDITURES FOR PROJECT EXECUTION AND MAINTENANCE (Thousand U.S. dollars)											
PROJECT LIFE YEAR	1				2				3		
Quarter/Life	1	2	3	4	1	2	3	4	1	2	3
Quarter/year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
QUARTERLY CAPITAL EXPENDITURES	$ 27,974	$ 52,400	$ 60,789	$ 43,686	$ 15,151	$ -	$ -	$ -	$ -	$ -	$ -
QUARTERLY MAINTENANCE EXPENDITURE	$ -	$ -	$ -	$ -	$ -	$ 1,506	$ 1,506	$ 1,506	$ 1,506	$ 1,506	$ 1,506

In this case, the project execution stage occurs during the first five quarters of the concession period. The quarterly maintenance cost is then equal to U.S.$164.3 million times 0.92 percent (3.67% divided by 4), U.S.$1.5 million per quarter. Thus, maintenance expenditures begin in *quarter 3* and continue throughout the life of the concession.

Cash flows in the FEMTH are organized in years of the concession life or "*N*" (*years 1, 2, 3, . . . N-1, N*), then subdivided into quarters, which are first enumerated relative to the concession life or "n" (*quarters 1, 2, 3, . . . n-1, n*) where *n = N*4*. Quarters are also numbered relative to their particular year (e.g. *quarters 1, 2, 3, and 4 of year 2*). This convention is used to develop all the project cash flows throughout the model.

Toll Income and Capital Investment

In this section the model calculates the quarterly total capital expenditures and total gross income of the facility, including both categories discussed earlier: tolls and other sources.

The subsection labeled traffic volume calculates the total number of vehicles of each class that use the facility during each quarter. The initial ADT from the input screen is assigned to *time zero*, at the beginning of the first quarter of the analysis. The ADT for the end of each quarter is obtained by compounding the initial ADT by the quarterly growth rate (annual rate divided by 4). To obtain the total traffic volume at the end of each quarter, the ADT is then multiplied by 90 days, and the volume for each category is simply obtained from the ADT distribution.

In the subsection labeled gross income the model serves to calculate the facility's quarterly total gross income, assuming that revenues do not start until the project execution phase has finished and the highway initiates operations. Total gross income is the sum of total toll income plus total income from other sources. Total toll income is obtained by multiplying the total volume of traffic from each quarter times an average toll per vehicle. This number is calculated based upon the relative weight of each vehicle type in the ADT distribution and its particular toll fare as follows:

$$T_{avg} = \%A\ T_A + \%B\ T_B + \%C\ T_C \qquad (6\text{-}1)$$

where T_{avg} is the average toll per vehicle, *%A, %B, and %C,* are the share of each vehicle category in the ADT distribution, and $T_{A,}$ $T_{B,}$ T_C are the tolls for each category.

Finally, the subsection labeled capital expenditures calculates the total quarterly capital expenditures or hard costs of the project. It consists of the expenditures for project execution plus the cost of the right of way. The purchase of the right of way is assumed to occur in the first quarter, since it must be secured as soon as possible in order to continue with the project.

Table 6.7 Toll Income and Capital Investment

TOLL INCOME AND CAPITAL INVESTMENT

PROJECT LIFE	YEAR	1				2			
	Quarter/Life	1	2	3	4	1	2	3	4
	Quarter/year	1	2	3	4	5	6	7	8
TRAFFIC VOLUME									
AVERAGE DAILY TRAFFIC		**8,564**	**8,628**	**8,693**	**8,758**	**8,824**	**8,890**	**8,957**	**9,024**
TOTAL VOLUME OF VEHICLES		**770,767**	**776,548**	**782,372**	**788,240**	**794,151**	**800,108**	**806,108**	**812,154**
CAR (A)		390,992	393,925	396,879	399,856	402,855	405,876	408,920	411,987
BUS (B)		68,990	69,508	70,029	70,554	71,083	71,616	72,154	72,695
TRUCK (C)		310,784	313,115	315,464	317,830	320,213	322,615	325,035	327,472
GROSS INCOME									
TOTAL GROSS INCOME		$ -	$ -	$ -	$ -	$ -	$ 11,761,348	$ 11,849,559	$ 11,938,430
TOTAL TOLL INCOME		-	-	-	-	-	11,761,348	11,849,559	11,938,430
BY CATEGORY									
CAR (A)		-	-	-	-	-	3,344,420	3,369,503	3,394,774
BUS (B)		-	-	-	-	-	1,106,474	1,114,773	1,123,134
TRUCK (C)		-	-	-	-	-	7,310,454	7,365,283	7,420,522
OTHER SOURCES		-	-	-	-	-	-	-	-
CAPITAL EXPENDITURES									
TOTAL		$ 27,974,286	$ 52,400,000	$ 60,788,571	$ 43,685,714	$ 15,151,429	$ -	$ -	$ -
PROJECT EXECUTION		27,974,286	52,400,000	60,788,571	43,685,714	15,151,429	-	-	-
RIGHT OF WAY		-	-	-	-	-	-	-	-

Funds Flow Analysis

The purpose of this section is to calculate the quarterly amount of funds to be borrowed, the outstanding debt, the amount of interest charged, and the funds available for principal repayment. Table 6.8 below illustrates the logic followed to arrive at these figures. In general terms the process consists of determining the difference between the actual revenues and expenses of the project on each quarter. This amount are the funds outside the road's own operating activities actually needed to carry out the project on that specific quarter (*total funds required*), and which must be financed through equity, debt, or the project's working capital reserve. Based upon this figure and the financial information input by the user, the program calculates the rest of the data.

First, the total revenues per quarter are calculated. Total revenues for each quarter basically consist of the gross income calculated in the *toll income and capital investment* section, which is affected by its corresponding VAT, plus the VAT[2] paid in the previous quarter for intermediate goods and services consumed by the project. These intermediate goods and services include all capital expenditures for project execution, supervision, and all of the operation stage expenses, as well as interest and origination fees if applicable. Thus, in quarter 1, there are no revenues, and in quarter 2 the only revenue is the VAT paid in quarter 1 for project execution and supervision. It is not until quarter 6 that revenues include gross income plus the previously paid VAT.

Next, the total expenses per quarter are calculated. Total expenses consist of all the intermediate goods and services, including interest and origination fees, affected by their corresponding VAT (where applicable), the VAT received from tolls, and other taxes payable. The VAT received from tolls is considered an expense that is later offset by the VAT paid on goods and services, as discussed earlier. The interest charge expense is calculated from the quarterly interest rate and the project's outstanding debt. The difference between revenues and expenses represents the quarterly cash deficit or surplus to the project resulting from its own existence and its operations.

During the execution phase and in some cases during the first quarters of the operations stage, the project is likely to experience cash deficits, but as traffic starts to build up and revenues grow, the project will experience surpluses. These cash deficits are covered through equity and debt capital. The quarterly equity contribution is calculated as the specified equity share percentage of the total capital expenditures for the same quarter. The remaining deficit, which includes capitalized interest, is then covered through debt capital. Besides, since taxes (other than the VAT and fees levied on tolls) are calculated and assumed to be paid yearly, the project is also very likely to experience a cash deficit from operations on the fourth quarter of each year. These deficits are handled in a different manner, as explained in the next paragraph.

Cash surpluses, on the other hand, are assumed to be entirely used to repay outstanding debt until it has been liquidated. Once debt has been repaid, cash surpluses represent a return on equity. In order to cover for future cash deficits, such as end of year deficits, the model creates a *working capital fund* with funds from the quarterly surpluses. From the quarterly cash surplus the model subtracts a percentage that goes into the working capital fund, while the rest becomes the line *available to stockholders*. At the end of the concession period specified by the user, the remaining working capital fund becomes available to the project's stockholders. The percentage of the quarterly surplus that is allocated as working capital was determined arbitrarily using a

[2] The concessionaire is allowed to deduct the taxes paid on intermediate purchases from the taxes collected from its operating activities in determining its tax liability. For a discussion on administration of the VAT see (Hyman, 1993).

proxy to the income tax payable. The yearly income tax is prorated into the first three quarters of the year. Thus, the percentage subtracted quarterly from the surplus is equal to 75 percent of the income tax rate.

In the subsection labeled "*total capital needs*" the model calculates the amount of funds to be borrowed, the origination fees, and the outstanding debt as follows. Quarterly cash deficits are the *total funds required* for that specific quarter and the quarterly equity contribution is calculated as discussed earlier. The difference between these two is the capital that needs to be borrowed and the origination fee is estimated as a percentage of this amount. Cash surpluses are the funds *available before principal repayment*.

Outstanding debt is the cumulative amount borrowed less cash surpluses and interest charges are calculated as a percentage of this amount. The arithmetic these procedures are better illustrated in Table 6.8 below, which depicts the first 8 quarters of operation of the hypothetical example. The computer model is programmed to follow all the logic explained here, in such a way that the user does not need to change its structure.

Table 6.8 Funds Flow Analysis

FUNDS FLOW ANALYSIS

PROJECT LIFE	YEAR	1				2			
	Quarter/Life	1	2	3	4	1	2	3	4
	Quarter/year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
TOTAL REVENUES		$ -	$ 4,322,027	$ 8,095,800	$ 9,391,834	$ 6,749,443	$ 15,866,446	$ 13,912,300	$ 14,014,578
GROSS INCOME (VAT INCLUDED))		-	-	-	-	-	13,525,551	13,626,992	13,729,195
TOTAL VAT PAID IN PREVIOUS PERIOD FOR:		-	4,322,027	8,095,800	9,391,834	6,749,443	2,340,896	285,308	285,383
CAPITAL EXPENDITURES		-	4,196,143	7,860,000	9,118,286	6,552,857	2,272,714	-	-
SUPERVISION		-	125,884	235,800	273,549	196,586	68,181	-	-
OPERATION		-	-	-	-	-	-	8,241	8,303
MAJOR MAINTENANCE		-	-	-	-	-	-	225,938	225,938
GENERAL ADMINISTRATION		-	-	-	-	-	-	51,129	51,142
INTEREST PAID ON DEBT		-	-	-	-	-	-	-	-
DEBT ORIGINATION FEE		-	-	-	-	-	-	-	-
TOTAL EXPENSES		$ 33,135,541	$ 63,142,206	$ 74,141,199	$ 54,528,321	$ 20,536,936	$ 5,881,195	$ 5,453,627	$ 6,876,147
CAPITAL EXPENDITURES (VAT INC)		32,170,429	60,260,000	69,906,857	50,238,571	17,424,143	-	-	-
SUPERVISION (VAT INC)		965,113	1,807,800	2,097,206	1,507,157	522,724	-	-	-
VAT RECEIVED FROM GROSS INCOME		-	-	-	-	-	1,764,202	1,777,434	1,790,765
GOVERNMENT FEE ON TOLLS		-	-	-	-	-	-	-	-
OPERATION (VAT INC)		-	-	-	-	-	63,182	63,656	64,133
MAINTENANCE (VAT INC)		-	-	-	-	-	1,732,188	1,732,188	1,732,188
ADMINISTRATION (VAT INC)		-	-	-	-	-	391,989	392,092	392,197
INTEREST PAID ON DEBT (VAT INC.)		-	332,108	844,131	1,348,328	1,629,146	1,652,372	1,488,258	1,358,123
DEBT ORIGINATION FEE (VAT INC)		-	742,298	1,293,005	1,434,265	960,923	277,262	-	-
TAXES PAYABLE		-	-	-	-	-	-	-	1,538,742
TOTAL REVENUES - EXPENSES		$ (33,135,541)	$ (58,820,179)	$ (66,045,399)	$ (45,136,487)	$ (13,787,493)	$ 9,985,252	$ 8,458,673	$ 7,138,431
CUMULATIVE		(33,135,541)	(91,955,720)	(158,001,119)	(203,137,606)	(216,925,099)	(206,939,848)	(198,481,175)	(191,342,744)
TOTAL CAPITAL NEEDS									
TOTAL FUNDS REQUIRED		$ 33,135,541	$ 58,820,179	$ 66,045,399	$ 45,136,487	$ 13,787,493	$ -	$ -	$ -
FROM STOCKHOLDERS EQUITY		$ 8,392,286	$ 15,720,000	$ 18,236,571	$ 13,105,714	$ 4,545,429	$ -	$ -	$ -
FROM DEBT (FUNDS BORROWED)		$ 24,743,256	$ 43,100,179	$ 47,808,828	$ 32,030,773	$ 9,242,065	$ -	$ -	$ -
* ORIGINATION FEE		$ 742,298	$ 1,293,005	$ 1,434,265	$ 960,923	$ 277,262	$ -	$ -	$ -
AVAILABLE BEFORE PRINCIPAL REPAYMENT		$ -	$ -	$ -	$ -	$ -	$ 9,985,252	$ 8,458,673	$ 7,138,431
OUTSTANDING DEBT		$ 24,743,256	$ 67,843,435	$ 115,652,262	$ 147,683,035	$ 156,925,099	$ 146,939,848	$ 138,481,175	$ 131,342,744
AVAILABLE AFTER PRINCIPAL REPAYMENT		-	-	-	-	-	-	-	-
LESS: TO WORKING CAPITAL	26%	-	-	-	-	-	-	-	-
CUMULATIVE WORKING CAPITAL FUND		-	-	-	-	-	-	-	-
AVAILABLE TO STOCKHOLDERS		-	-	-	-	-	-	-	-

Income Statement

This section of the model essentially prepares a pro-forma income statement and its purpose is to estimate the project's yearly tax liability and from this figure calculate its net operating profit/loss after taxes. This section is divided into three parts, production and operation activities, financial activities, and taxes.

The first part, production and operation activities, includes all the activities related to the operation of the concession and calculates the figure for the project's net operating income (NOI), that is, gross income minus operating expenses. The depreciation expense for tax purposes is calculated following the straight-line method and supervision during the project execution stage and the government fees on tolls, if existing, are also considered operation expenses.

In the second part, financial activities, interest expenses, and debt origination fees are subtracted from the NOI, yielding the figures for the quarterly net profit/loss before taxes and the yearly taxable profit/loss. The model calculates the yearly taxable profits/losses by adding the quarterly figures, keeping track of the cumulative losses, and taking into account the loss carryforward provisions for tax purposes discussed earlier.

Finally, the third part of the income statement calculates the project's yearly income tax and profit sharing liabilities, and yields the quarterly net profit/loss after taxes. Taxes are then assessed on the last quarter of each year, and based upon the yearly taxable profit/loss. The model estimates the presumptive income tax or tax on fixed assets, only on those years with no taxable profit and considering a grace period in the initial years as explained earlier. Since the VAT liability was already taken into account in the funds flow analysis section, the flows calculated in this section do not include VAT payments.

The quarterly net profit/loss after taxes is calculated by subtracting the yearly tax liability from the quarterly net profit/loss after taxes. As taxes are assessed yearly, the figures for net profit/loss for the first three-quarters of each year are the same before and after taxes. This section is illustrated in Table 6.9 below for the first eight quarters of the analysis. Again, all the logic explained here is embedded in the model.

Table 6.9 Income Statement

INCOME STATEMENT

PROJECT LIFE								
YEAR	1				2			
Quarter/Life	1	2	3	4	1	2	3	4
Quarter/year	1	2	3	4	5	6	7	8
PART 1: EXECUTION AND OPERATION ACTIVITIES								
GROSS INCOME	$ -	$ -	$ -	$ -	$ -	$ 11,761,348	$ 11,849,559	$ 11,938,430
LESS: OPERATING EXPENSES	839,229	1,572,000	1,823,657	1,310,571	454,543	3,568,717	3,569,219	3,569,725
OPERATION	-	-	-	-	-	54,941	55,353	55,768
MAINTENANCE	-	-	-	-	-	1,506,250	1,506,250	1,506,250
GENERAL ADMINISTRATION	-	-	-	-	-	340,860	340,950	341,041
SUPERVISION	839,229	1,572,000	1,823,657	1,310,571	454,543	-	-	-
DEPRECIATION	-	-	-	-	-	1,666,667	1,666,667	1,666,667
GOVERNMENT FEE ON TOLLS	-	-	-	-	-	-	-	-
NET OPERATING INCOME (NOI)	$ (839,229)	$ (1,572,000)	$ (1,823,657)	$ (1,310,571)	$ (454,543)	$ 8,192,631	$ 8,280,339	$ 8,368,705
PART 2: FINANCIAL ACTIVITIES								
LESS: FINANCIAL EXPENSES	-	1,074,406	2,203,612	2,986,570	2,943,151	2,383,538	1,972,252	1,858,719
INTEREST EXPENSES	-	332,108	910,607	1,552,305	1,982,228	2,106,276	1,972,252	1,858,719
DEBT ORIGINATION FEE	-	742,298	1,293,005	1,434,265	960,923	277,262	-	-
NET PROFIT/LOSS BEFORE TAXES	$ (839,229)	$ (2,646,406)	$ (4,027,269)	$ (4,297,141)	$ (3,397,694)	$ 5,809,093	$ 6,308,087	$ 6,509,986
YEARLY NET PROFIT/LOSS				(11,810,045)				15,229,472
CUMULATIVE LOSS (YEARLY)				(11,810,045)				-
TAXABLE PROFIT				$ -				$ 3,419,427
PART 3: TAXES								
LESS: TAXES	-	-	-	-	-	-	-	1,538,742
INCOME TAX	-	-	-	-	-	-	-	1,196,800
TAX ON FIXED ASSETS				-				-
WORKERS PROFIT SHARING	-	-	-	-	-	-	-	341,943
NET PROFIT/LOSS AFTER TAXES	$ (839,229)	$ (2,646,406)	$ (4,027,269)	$ (4,297,141)	$ (3,397,694)	$ 5,809,093	$ 6,308,087	$ 4,971,244

Analysis of Net Cash Flows after Taxes

This final section of the spreadsheet structure serves to calculate the final input to the objective function of the FEMTH. The analysis of cash flows looks at the project from two different perspectives. The first looks at the total flows of the project or the return on total capital invested, and the second looks only at the flows to the equity holders, that is, to the return on equity capital invested.

The analysis of cash flows calculates the quarterly net cash flows of the project by adding (subtracting) the quarterly figures for capital expenditures plus the net income (loss), and finally adding the corresponding depreciation amount from the *income statement* section. Depreciation is not an actual cash flow, but it is referred to as an expense, to offset income tax liability in the income statement.

Likewise, the quarterly net cash flows to equity are calculated by adding (subtracting) the quarterly equity contribution to capital expenditures plus the amount *available to stockholders*, both found in the *funds flow analysis* section.

Finally, using the integrated financial functions of the spreadsheet, the model discounts both series of cash flows over the concession period specified to obtain the model's objective function or project profitability measures, the NPV and the IRR. The values for the NPV and the IRR are calculated in terms of both, the overall project investment (return on investment) and the equity capital investment (return on equity). When the NPV and IRR figures for the return on equity are higher than those for the return on total investment are, the equity capital is said to be positively "leveraged" with the funds borrowed.

Table 6.10 Analysis of Cash Flows after Taxes

ANALYSIS OF PROJECT NET CASH FLOWS AFTER TAXES

PROJECT LIFE	YEAR	1				2			
	Quarter/Life	1	2	3	4	1	2	3	4
	Quarter/year	1	2	3	4	5	6	7	8
PROJECT CASH FLOWS									
CAPITAL EXPENDITURES		(27,974,286)	(52,400,000)	(60,788,571)	(43,685,714)	(15,151,429)	-	-	-
PLUS: NET INCOME (LOSS)		(839,229)	(2,646,406)	(4,027,269)	(4,297,141)	(3,397,694)	5,809,093	6,308,087	4,971,244
PLUS: DEPRECIATION		-	-	-	-	-	1,666,667	1,666,667	1,666,667
NET CASH FLOWS AFTER TAXES		$ (28,813,514)	$ (55,046,406)	$ (64,815,840)	$ (47,982,856)	$ (18,549,122)	$ 7,475,760	$ 7,974,753	$ 6,637,911
CUMULATIVE NET CASH FLOW		(28,813,514)	(83,859,920)	(148,675,761)	(196,658,616)	(215,207,739)	(207,731,979)	(199,757,226)	(193,119,315)
EQUITY CASH FLOWS									
EQUITY INVESTMENT		(8,392,286)	(15,720,000)	(18,236,571)	(13,105,714)	(4,545,429)	-	-	-
PLUS: AVAILABLE TO STOCKHOLDERS		-	-	-	-	-	-	-	-
NET EQUITY CASH FLOW		$ (8,392,286)	$ (15,720,000)	$ (18,236,571)	$ (13,105,714)	$ (4,545,429)	$ -	$ -	$ -
CUMULATIVE EQUITY CASH FLOW		(8,392,286)	(24,112,286)	(42,348,857)	(55,454,571)	(60,000,000)	(60,000,000)	(60,000,000)	(60,000,000)

FINANCIAL ANALYSIS OF NET CASH FLOWS AFTER TAXES		
ON TOTAL PROJECT CASH FLOWS		
NET PRESENT VALUE AT	8.00%	$150,789,444
INTERNAL RATE OF RETURN		13.41%
ON EQUITY CASH FLOWS		
NET PRESENT VALUE AT	8.00%	$178,258,383
INTERNAL RATE OF RETURN		18.19%

Cumulative Cash Flow Profile and Analysis Results Screen

The last component of the spreadsheet model is the screen that displays the results of the financial analysis and plots the cumulative profile of the project's cash flows. The screen is designed to provide the user with an easy to interpret graphical and numerical snapshot of the project analyses.

The results presented in this screen include both the NPV and the IRR analyses for the two cash flow profiles being analyzed, the project cash flows, and the equity cash flows. The information displayed in this screen also includes part of the information entered by the user in the input screen, the initial ADT, traffic growth rate and interest rate, the expected duration of the project execution schedule and the discount rate used for the NPV analysis.

Figure 6.11 below provides a full size view of the result screen for the example that has been discussed throughout this chapter. The plot for the cumulative cash flow profile graphs the cumulative cash flows against time over the concession life for both the project, denoted by the thicker line and for the equity capital invested.

There are three sections of interest in this plot, which are also illustrated in detail in Figure 6.17 below. Section I comprises the whole execution phase. At the end of this phase, the cumulative cash flow lines reach their lowest point. The execution phase is characterized by the cumulative negative cash flows that result from the project disbursements and the capitalized interest on borrowed funds.

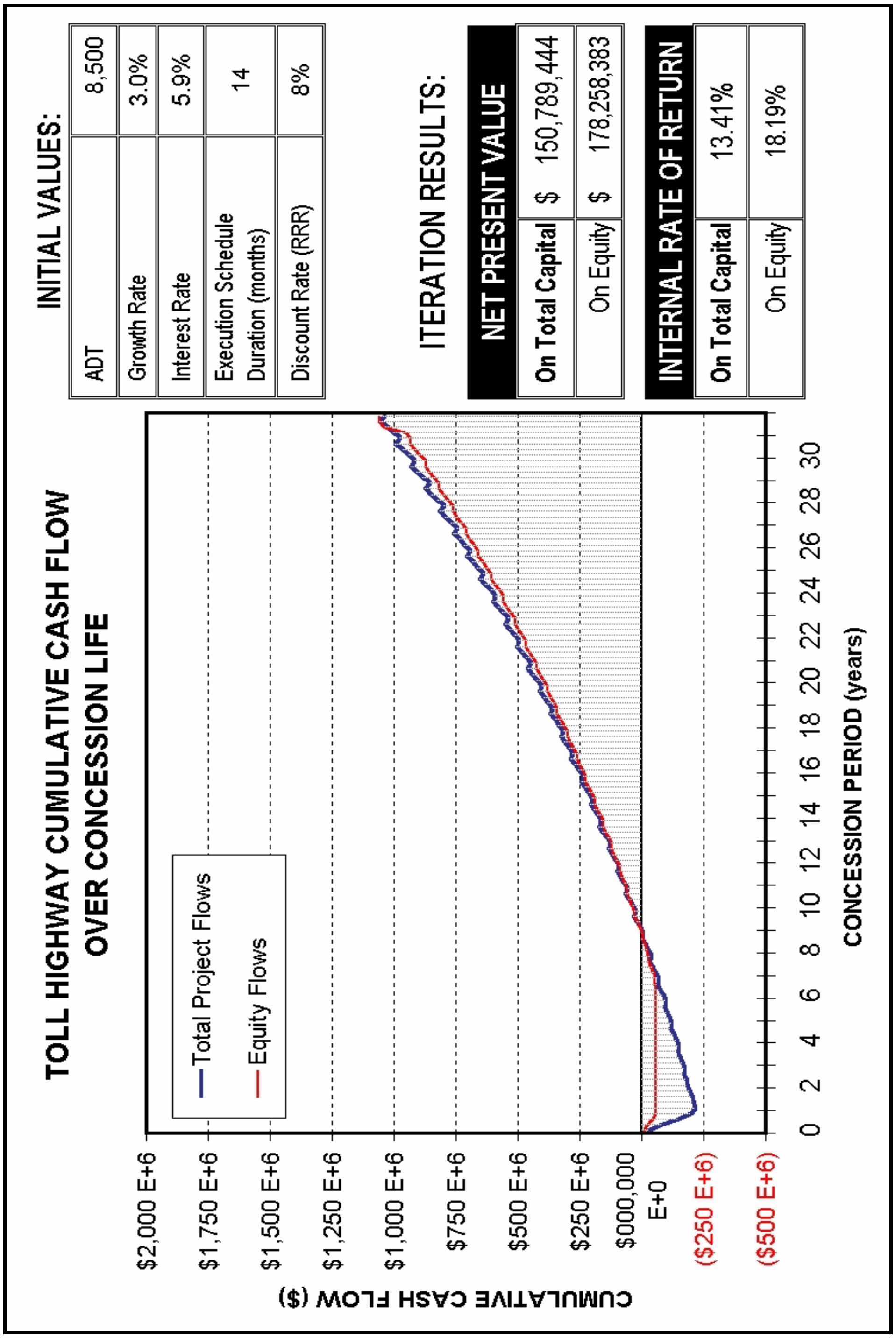


Fig. 6.11 FEMTH Results Screen

Section II encompasses from the beginning of operations, when revenues start to build up, until the cash flow lines reach the point where the cumulative cash flow is zero. In this section the equity cash flow line remains flat, since the all the available surplus funds are used to repay debt. On the other hand, the project cash flow line goes upward until it merges back with the equity cash flow line. At this point, outstanding debt has been paid off, and the two lines follow the trend upward until they reach the horizontal axis, when the whole capital invested is "recovered" in nominal terms. Section III comprises from this point until the end of the concession period. In Figure 6.12 the equity flows line and the project flows line start diverging at the beginning of the section and merge back abruptly at the end of the section. The gap between the two lines represents the cumulative cash flow fund mentioned earlier, which is available to the stockholders in a single payment at the end of the concession period.

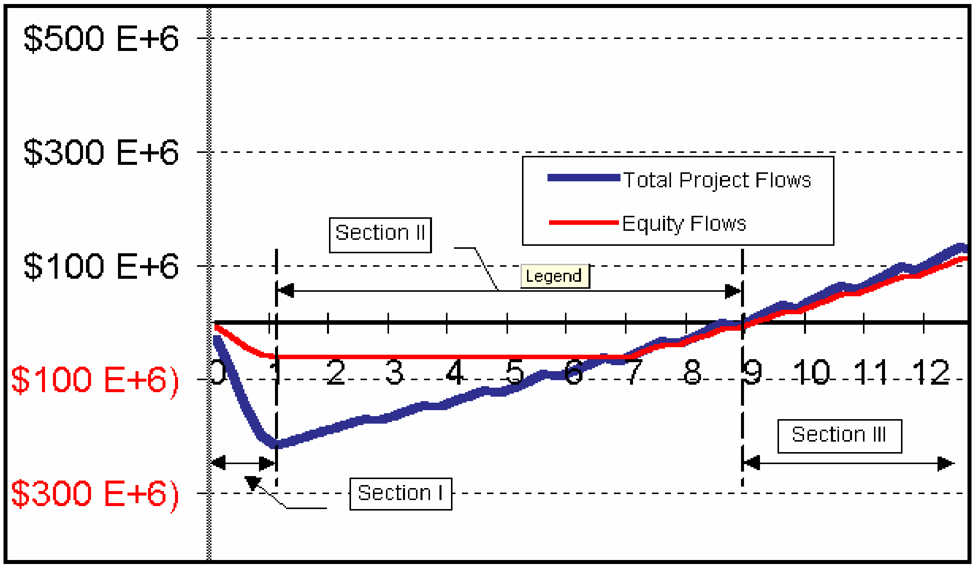


Fig. 6.12 The FEMTH Results Screen (Detail)

Implementation of Risk Analysis in the FEMTH

The last task in the development of the FEMTH is the incorporation of Monte Carlo simulation into the computer model to perform risk analysis and obtain the project risk profile of the model's profitability measures. This section represents the essence of this research. At this point, the computer model has only automated the regular project evaluation process and theory discussed in Chapter 4. Traditional sensitivity analyses can be already executed easily with the model in its present condition. Many organizations carry out project financial evaluation endeavors with similar spreadsheet models (Cervantes & Rubio, 1992), which use single point estimates of the model's variables to predict a single result, or at the most perform traditional sensitivity analyses. Thus, outside the automation routines for the calculation parameters that were programmed into the computer model, the FEMTH at this point is just a set of mathematical equations that, for given values of certain inputs, enables the user to determine the value of the desired outputs.

However, the aim of this report is to incorporate into the FEMTH the concept of project risk analysis using the simulation approach, as discussed in Chapter 5. The integration of this feature into the FEMTH provides the decision-maker with a more effective tool for project evaluation, which broadens his/her perspective from a fixed set of assumptions to a more comprehensive view of the potential outcomes. This is the most important contribution of this research, a comprehensive risk analysis model for toll road project investments.

The simulation approach to risk analysis was already discussed in Chapter 5. It was defined as a process consisting of five steps. The first step, *modeling the problem*, was already carried out in the previous sections. The second and third steps, *identifying the major risk factors* and *characterizing uncertainty* are accomplished in this section, leaving the model ready for the last two steps, *run the simulation* and then *produce the risk profile and analyze the results*.

Risk Analysis and Simulation using @RISK

Although spreadsheet programs in general can be used to perform simulations for several common probability distributions, this approach has severe disadvantages. Remember the sampling process from Chapter 5. Once the desired sample values are obtained, the results need to be stored and when this process is finished, the results must be plotted and statistically analyzed. Despite the analytical and graphics power of modern spreadsheet programs, performing simulation for a complex model like the FEMTH in Excel may turn cumbersome.

Hence, in order to incorporate simulation capabilities into the computer FEMTH, and to characterize the uncertainty on its variables, the spreadsheet model was complemented with a powerful Monte Carlo simulation software package called @RISK (Palisade, 1996). Since @RISK is a spreadsheet *add-in*, it links directly to Excel to add Monte Carlo simulation capabilities, thereby providing the user the full functionality of the spreadsheet.

The following are some of the most important features of @RISK (version for Microsoft Excel) (Palisade, 1996):

1. The user can define the values of uncertain variables in the model as probability distributions using @RISK functions. For example, entering

   = RiskNormal(14,2)

   as the value of project schedule duration will generate an observation from a normal random variable with mean of 14 months and standard deviation of 2 months. @RISK contains more than thirty different probability distribution functions, which can be added to any number of variables and formulas. Since these functions are only invoked during the simulation process, during normal Excel operations the variables show a single value, allowing the user to work with the spreadsheet as usual.
2. @RISK allows choosing any variables in the model as output variables and specifying the number of iterations in each simulation as well as the number of simulations to be run.
3. Variables with dependency relationships in the model can be linked.
4. @RISK keeps statistics for the chosen variables and produces high-resolution graphics to present the output distributions resulting from the simulations, such as histograms and cumulative distribution curves.
5. @RISK also has sensitivity and scenario analyses capabilities. The program collects simulation data iteration by iteration for both input and output variables. After completing the simulation process based upon this set of data the program performs sensitivity analysis identifying those inputs, which are significant in determining the value of the output variable. The program also performs a scenario analysis, which identifies combinations of input values that lead to output target values.
6. Allows the animation of sampling and recalculation of the spreadsheet, assisting in the visualization of the simulation process.
7. Finally, the sampling techniques and language used by @RISK provide the fastest possible simulations, reducing the processing time required, which was one of the drawbacks mentioned Chapter 5.

Therefore, by incorporating @RISK to the FEMTH the second step in the simulation approach to risk analysis, *identifying the major risk factors*, is accomplished. The next natural step in the development of the FEMTH then, is to characterize the uncertainty for the model's input variables.

Characterizing Uncertainty

There are 37 input variables in the FEMTH's input screen. These variables are the basic elements of the model, each one with a different degree of uncertainty. Some of these variables are not likely to change over the analysis period, or may have a limited variability, such as the financial structure, the concession period, etc. Other variables are stochastic or uncertain, as their value will change over the life of the project, such as interest rates, traffic growth rate, operation costs, etc. Thus based upon their particular characteristics, the variables were classified as non-stochastic (or quasi-fixed) and stochastic variables.

This section attempts to identify and suggest probability distribution functions (PDF's) that best describe the nature of the uncertainty of the stochastic variables, based upon the assumptions and theory discussed in this report. Thus, the PDF's suggested here should only serve as a guide to the user, who is encouraged to adapt the knowledge presented here to his/her individual preferences and experience. This is what analysis of decisions under uncertainty is all about.

In the case of variables for which historical or empirical data was available, their PDF was modeled with help of the @RISK companion software packages, BestFit© and RiskView©. BestFit is a program that fits existing data to its best-fit probability distribution. The program tests the data and fits it against 28 different widely known PDF's, providing the user with the function characteristics and statistical parameters, ready for use with @RISK. On the other hand, RiskView helps on the selection of a distribution function by previewing different PDF's and parameters before introducing them to @RISK. RiskView also includes a tool that extracts data points from a PDF drawn by the user, and then finds a distribution that is the best fit to that curve.

Non-Stochastic Variables

From the 37 initial variables of the model, 23 were classified as non-stochastic or with limited variability. Certainly, the degree of uncertainty of a variable increases the further out in time it affects the project. Some of the variables assumed and listed here as non-stochastic are established or negotiated early in the project. The existence of guarantees, as discussed earlier, also reduces the uncertainty associated with certain variables.

1. *Traffic and tolls section*. In the case study form, all the corridor or existing free road data can be determined with certain accuracy. Travel time is known. The total traffic and its vehicle distribution should be readily available or can be determined from actual traffic counts. The toll route approximate length and travel time should be known in advance, and the toll prices are also fixed by the concessionaire. Based upon the toll-traffic model, Orozco's study (1997) also determined optimum tolls[3] for each category that maximize overall facility income for the Mexican case study. However, in the FEMTH, the user fixes these variables

[3] The tolls suggested are at US\$0.10/km for passenger cars, and US\$0.17/km for trucks. The study concluded that the behavior of buses is almost inelastic and demand practically does not change with toll price.

at will, since tolls are assumed either as set by the government or as an award criterion. Finally, the user also sets the length of the concession period, which is considered fixed once the project has been undertaken.

In the generic form, the non-stochastic variables considered are the toll prices and the concession period.

2. *Design and construction section*. In this section, the costs of design and supervision are considered as being reasonably certain or yet their variations subject to the power of negotiation of the concessionaire. These variables are established early in the project and have predictable market values, which are not likely to vary once the project has started.
3. *Financial data section*. In this section, the capital structure is considered as a fixed value or a variable substantially under the control of the concessionaire. This value is not likely to change considerably once the project has been undertaken. The debt origination fee is also considered as a relatively certain value since it is a market variable, which is negotiated early in the project.

   Expected interest rates prevailing during the quarter *prior* to the analysis can be determined with fair accuracy based upon current market conditions. The user then sets the initial real interest rate, which is the expected rate negotiated for the project's debt at the level effective during the quarter *prior* to the analysis. The reference rate (e.g. prime rate, LIBOR, etc.) prevailing in the market during the same quarter is also set by the user, and its long-term average (or its mode) can be determined from historical data. Subsequent quarterly interest rates are considered stochastic variables, and their treatment is discussed below.
4. *Fiscal data section*. All the variables in the fiscal data section, taxes, and depreciation policies are considered as non-stochastic in the FEMTH. Being toll road projects public/private partnerships of major importance, these variables are assumed to remain relatively fixed throughout the concession period, since changes on tax policies that may adversely affect the project would be subject to negotiation, compensation, or guarantee coverage. Any attempt to model uncertainty on tax policies would be futile, since changes in tax policy are a type of non-stochastic political risk, which is probably impossible to model mathematically.

Initial ADT and ADT Distribution

As discussed earlier, in its case study version the FEMTH calculates the project's initial ADT and its distribution from the toll-traffic mathematical model. This model basically determines the percentage of the total traffic in the corridor that will divert to the toll facility as a function of the toll price. Based upon the difference in total travel time between the existing road and the new toll road, and the toll price per km for each vehicle category, the toll-traffic demand model computes the percentage of total traffic that will divert to the toll road for each category ($\%ADT_D$). Next, given the total ADT on the corridor and its distribution, the FEMTH calculates the ADT for each vehicle category and aggregates it to determine the total ADT and ADT distribution on the new toll road. Figure 6.13 illustrates the interaction between the FEMTH and the toll-traffic demand model to obtain the initial ADT and ADT distribution.

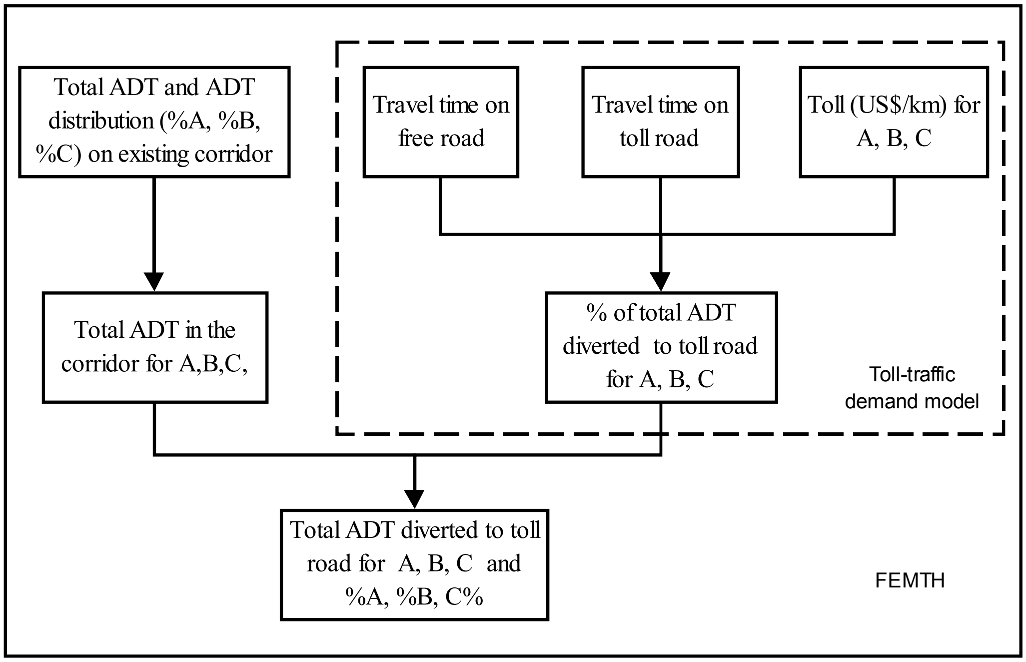


Fig. 6.13 Interaction of the FEMTH and the Toll-Traffic Demand Model

Thus, the uncertainty regarding the expected total ADT and its vehicle category distribution is introduced by the accuracy of the toll-traffic model itself. Using data from eighteen cases in the Mexican toll road network, the actual $\%ADT_D$ was compared to the values predicted by the toll-traffic demand model for each vehicle category. The average change between the actual and the predicted $\%ADT_D$ was about –12 percent for passenger cars. In other words, the percentage of cars actually diverted to the toll road was on average 13 percent lower that the predicted value. The average percentage change in $\%ADT_D$ for buses was about –5 percent and for trucks was +14 percent.

As the range of variation in the values of each category was very wide, the data was further analyzed to characterize its uncertainty. Using BestFit software, the data for each category was tested and fit to the theoretical PDF that best described their behavior. Figures 6.14, 6.15 and 6.16 below illustrate the actual PDF's for the percentage change between the actual and the predicted $\%ADT_D$ for cars, buses, and trucks and their theoretical PDF. The data used in the analysis and the detailed statistics are included in Appendix F.

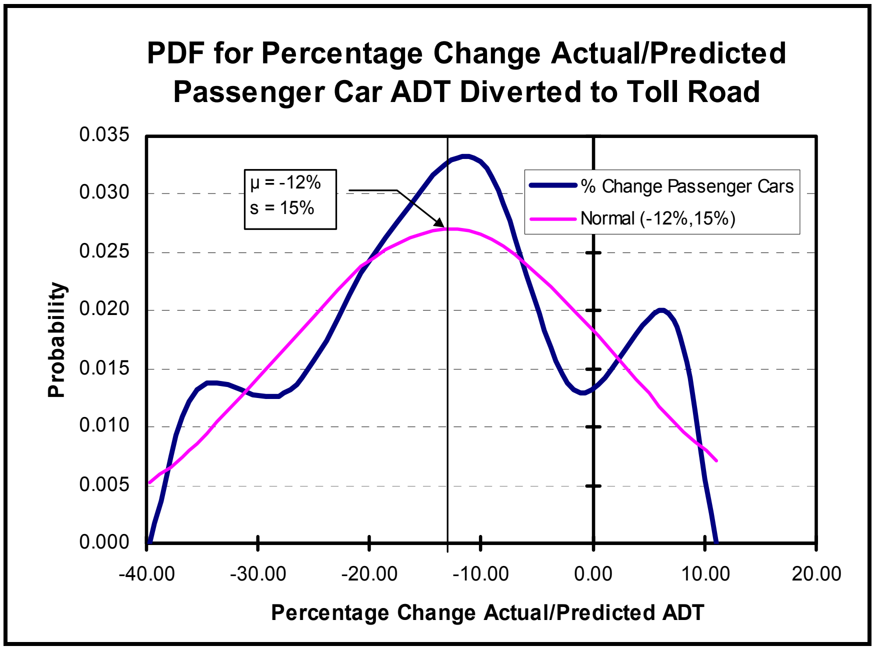


Fig. 6.14 PDF for Percentage Change Actual/Predicted Car $\%ADT_D$

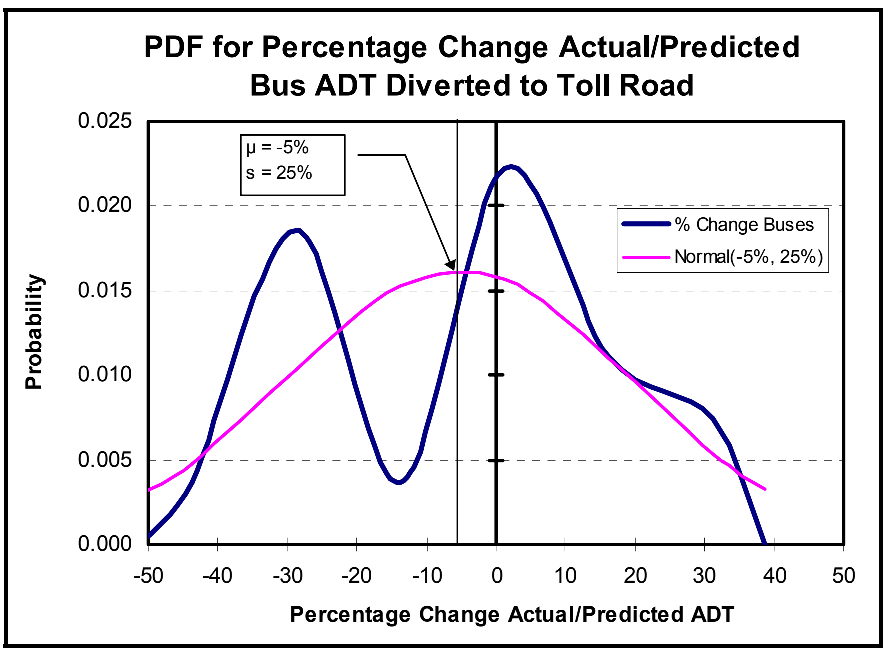


Fig. 6.15 PDF for Percentage Change Actual/Predicted Bus $\%ADT_D$

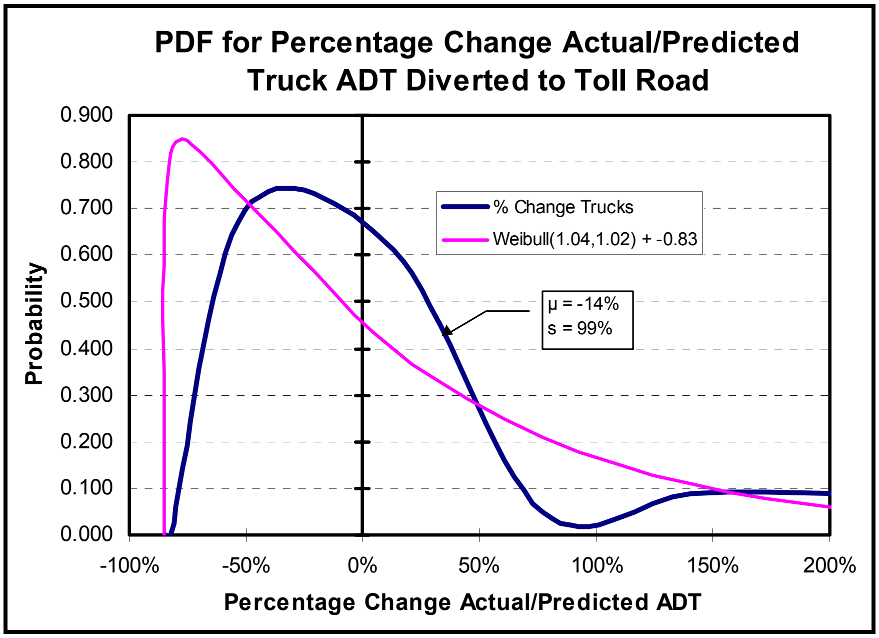


Fig. 6.16 PDF for Percentage Change Actual/Predicted Truck $\%ADT_D$

The analysis with BestFit concluded that the uncertainty associated with the percentage change between the actual and the predicted car $\%ADT_D$ is best characterized as a normal PDF with a mean of –12 percent and a standard deviation of 15 percent. The percentage change for the predicted bus $\%ADT_D$ is also characterized by a normal PDF with a mean of –5 percent, which is closer to zero than the change for cars, but with a larger standard deviation of 25 percent that indicates greater uncertainty. Finally, the percentage change for the predicted truck $\%ADT_D$ was found to best fit a PDF of the type *Weibull* with parameters $\alpha = 1.04$ and $\beta = 1.02$, and –83 percent. Other statistics obtained for this distribution are a mean of 17 percent (3 points above the input data) and a standard deviation of 96 percent (3 points below the input data), which give an idea of its variability.

Once the uncertainties have been characterized, they can be incorporated into the FEMTH as @RISK functions. Thus, the function that would characterize the predicted $\%ADT_D$ in the simulation process would be the $\%ADT_D$ calculated using the toll-traffic demand model affected by its expected percentage change. Thus the @RISK functions that characterize the uncertainty associated with the $\%ADT_D$ for each category are the following:

$$\%ADT_{D(A)}^{*} = \%ADT_{D(A)}\,[1 + (1+RiskNormal(-0.12,0.15))] \qquad (6\text{-}2)$$

$$\%ADT_{D(B)}^{*} = \%ADT_{D(B)}\,[1 + (1+RiskNormal(-0.05,0.25))] \qquad (6\text{-}3)$$

$$\%ADT_{D(C)}^{*} = \%ADT_{D(C)}\,[1+(RiskWeibull(1.04,\ 1.02)-0.83))] \qquad (6\text{-}4)$$

where $\%ADT_{D(A)}^{*}$, $\%ADT_{D(B)}^{*}$ and $\%ADT_{D(C)}^{*}$ are the new $\%ADT_D$ for cars, buses, and trucks respectively, characterized by their particular uncertainty, and $\%ADT_{D(A)}$, $\%ADT_{D(B)}$ and $\%ADT_{D(C)}$ are the original $\%ADT_D$ calculated with the toll-traffic model.

By modeling these three variables, the FEMTH reflects the uncertainty about the total expected ADT, and its composition for the new toll road when the case study input form is used.

On the other hand, if the generic input form is used, the uncertainty about these variables has to be considered in a more general form, resulting in a more incomplete or inaccurate risk analysis. In this case the uncertainty can be characterized using any of the two common types of PDF used for rough modeling when there is no data available: the triangular and the Beta distributions. These PDF's and their use is illustrated in the next few paragraphs, as they are used to characterize other variables in the FEMTH. Both PDF's can be used to directly model the total ADT and the ADT distribution in their respective spreadsheet cells. However, using the generic form also has the inconvenience that the share of one of the vehicle categories in the ADT distribution must be fixed in order to vary the other two without exceeding 100 percent. A suggestion is to fix the value of category that has the smaller share of the expected ADT in order to minimize the impact of the lack of variation, which is usually the bus category.

Traffic Growth Rate

Determining the traffic growth rate on a new toll road is a very difficult task. Complex macroeconomic variables such as the growth on the economy (i.e. real GDP) and the real price to the user of fuel are some of the most important influences on traffic growth rates in the highway network of a country in general (MacPherson, 1993). Forecasting future levels of traffic on free roads is still a very controversial subject, which makes the forecasting of traffic growth in toll roads even more difficult and uncertain, since the introduction of tolls further complicates the economic equation that determines this growth.

A case in point is the Mexican toll highway program. The Ministry of Transportation (SCT) initially specified an annual traffic growth rate of 4 percent in average for all the highways in the program (SCT, 1996). However, this rate has not been attained yet and in some cases the traffic levels fell dramatically in certain periods (Mexican Association of Concessioned Infrastructure [AMICO], 1996). This 4 percent number was very close to the real average growth of the Mexican GDP for the last 30 years, which is at around 5 percent (BDINEGI, 1998].

Risk analysis literature suggests the use of the uniform distribution for this type of variables. Pouliquen in 1970 used the uniform distribution for traffic growth rates in several highway projects in Africa. Jones in 1991 also proposed the use of the uniform distribution to determine the growth of demand on power investment projects. Electricity charges and tolls are both user charges, since users of the service are identifiable and excludable from the service for non-payment. Therefore, the uniform distribution PDF was deemed to be suitable to characterize the traffic growth rate.

The only information needed to develop a uniform PDF is its finite range, which is input by the user in the FEMTH. Based upon the previous discussion, the parameters suggested for the uniform PDF used to characterize the traffic growth rate would be a lower bound of zero, and an upper bound equivalent to the average growth of the GDP, which in the case of Mexico would be of 5 percent. Figure 6.17 illustrates a uniform PDF with these parameters.

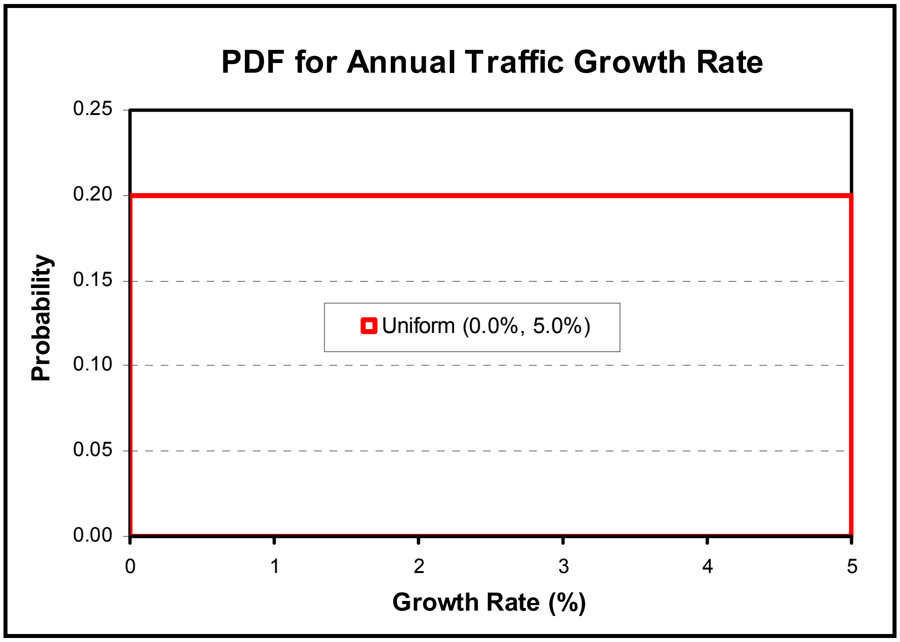


Fig. 6.17 Uniform PDF for Traffic Growth Rate

In a uniform PDF any value within the range has the same probability of occurrence. In the FEMTH, the annual traffic growth rate is assumed to fall between the parameters specified by the user (0 and 5 percent in this case), but year-to-year changes in growth are limited to 2 percent. That is, if year *n* growth is 1 percent, year *n* + 1 growth is constrained to be greater than zero percent and less than 3 percent. Thus the @RISK functions that characterize the uncertainty associated with traffic growth rates are as follows:

$$G_1 = RiskUniform(G_{LB}, G_{UB}) \tag{6-5}$$

$$G_2, G_3, \ldots G_n = RiskUniform(IF(G_{n-1} - 0.02) < G_{LB}, G_{LB}, G_{n-1} - 0.02), IF(G_{n-1} + 0.02 > G_{UB}, G_{UB}, G_{n-1} + 0.02)) \tag{6-6}$$

where G_1 is traffic growth in year 1, G_n is traffic growth in year *n*, G_{LB} and G_{UB} are the lower and upper boundaries for the uniform distribution. As the FEMTH performs the analysis on a quarterly basis, this results in only the annual traffic growth rate for the first quarter of the analysis being sampled from the entire range. Growth rates for subsequent quarters still can take any value within the initial range, but the change is constrained to be within a +/- 0.5 percent from quarter to quarter (2 percent divided by 4).

Roadway and Special Structures Construction Cost

Project cost estimates are refined as the design process advances, and the anticipated range of costs tends to narrow through this process. These estimates can be arranged to estimate the risk of cost overruns. Thus, cost overruns are directly proportional to the stage at which the design of the facility is at the point of the estimate. At the feasibility stage, however, these estimates are purely conceptual and their range of variation can be very wide

The FEMTH requires the user to divide total project cost into conventional roadway and special structures considering that cost overruns and scheduling delays on complex bridges and tunnels can increase substantially the overall facility cost. On the other hand, cost overruns on conventional roadway construction are less of a problem, since the technology and construction techniques are well understood. In other words, the variability of each category is very different and should be considered separately.

Being the total construction cost the product of a number of different cost elements, according to the Central Limit Theorem of statistics, the PDF that could best characterize its uncertainty would be a normal distribution. However, the use of the normal PDF is not recommended to express subjective judgements unless an exceptional amount of data is available to perform a statistical analysis (Pouliquen, 1970). There are several types of PDF that can be used to express subjective judgement when the factor modeled has a finite range of possible values and its mode is known, such as the Beta, PERT and triangular distributions. The first two produce a smooth probability function, as opposed to the triangular. However, the use of the triangular distribution is recommended by Jones to characterize construction cost uncertainty.

A triangular distribution is defined by three points: the minimum, the maximum, and the most likely. Figure 6.18 below illustrates a sample triangular PDF with a minimum of U.S.$200 million, a most likely of U.S.$210 million, and a maximum of U.S.$230 million.

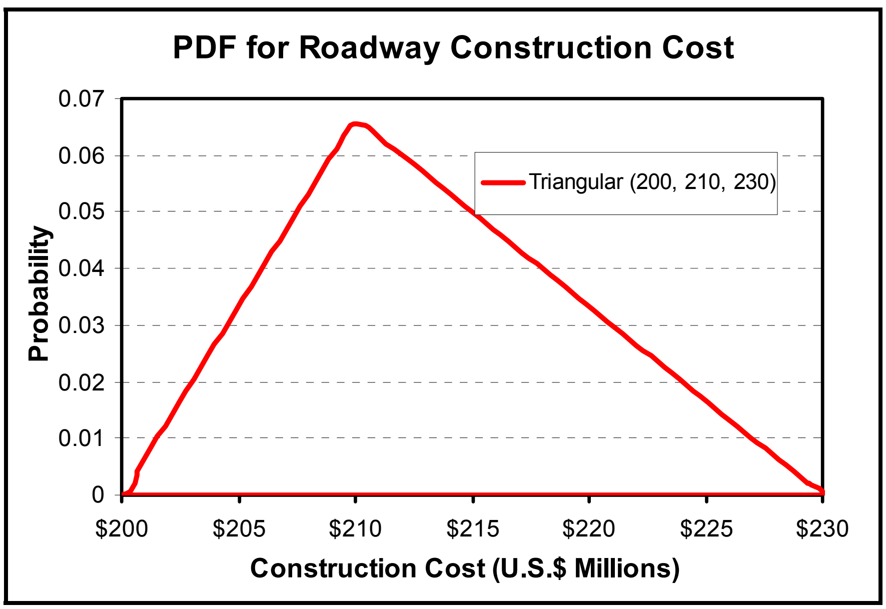


Fig. 6.18 Sample Triangular PDF for Construction Cost

An example of the @RISK functions that would characterize the uncertainty associated with the construction cost of a roadway and special structures would be as follows:

C_R = *RiskTriang(200, 210, 230)* *Roadway cost (U.S.$ millions)* (6-7)

C_S = *RiskTriang(90, 120, 130)* *Tunnel cost (U.S.$ millions)* (6-8)

These functions illustrate the difference in variability between the two categories discussed earlier. The variability in the roadway construction cost is lower than in the tunnel cost. By disaggregating these important cost elements a higher variation in the cost of special structures does not penalize the roadway cost with a higher total cost variability.

Project Schedule

Schedule and costs estimates go hand in hand. The accuracy of the project schedule predicted depends largely upon the stage of project design at which it is developed. Almost the same factors that affect construction cost affect the project schedule. Generally schedule delays result in cost increases too.

Simulation and risk analysis literature in general use a Beta PDF to characterize the uncertainty associated with individual construction activity duration. Since the total project schedule is comprised of a large number of activities, again the Central Limit Theorem would suggest a normal distribution for characterizing the uncertainty associated with overall project duration. However, at the feasibility stage, the development of a detailed activity schedule is very unlikely, and unless enough statistical data is available, the normal distribution should be avoided. Thus, the use of a Beta-PERT[4] distribution to characterize the uncertainty associated with project schedule duration may be appropriate.

A Beta-PERT distribution is generally used for modeling approximate activity time in a PERT network and other random variables that are non-symmetric (Winston, 1996). Although it is also defined by the same three parameters as the triangular distribution, a minimum, a maximum, and a most likely (mode), a Beta-PERT PDF yields a smooth curve. These characteristics make it an easy to work with PDF. Figure 6.18 below depicts a Beta-PERT PDF for a hypothetical project schedule, with a minimum duration of 14 months, a maximum of 22 and a mode of 16 months and compares it with a triangular PDF with the same parameters.

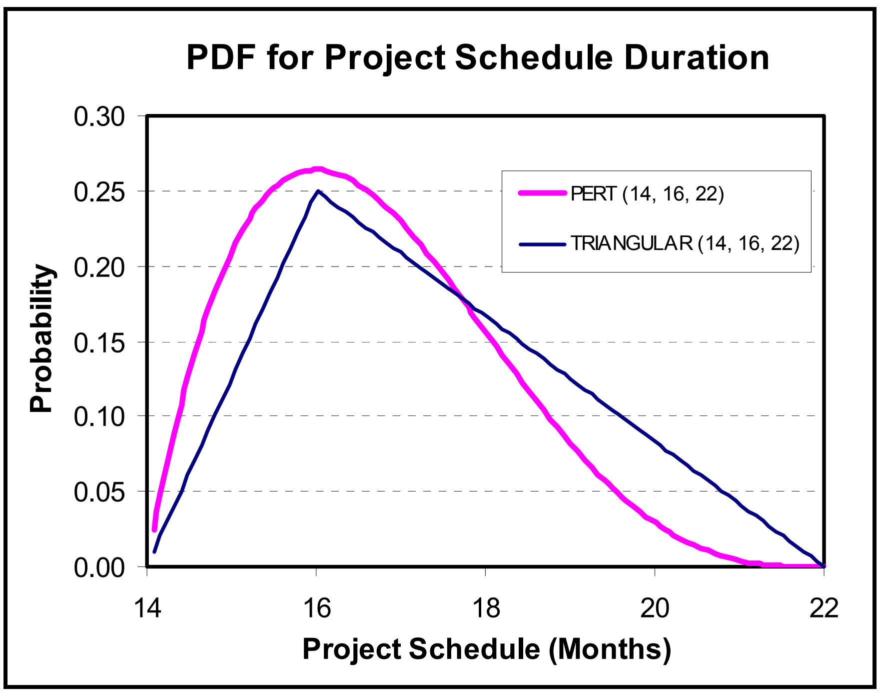


Fig. 6.19 Beta-PERT PDF for Construction Cost

The @RISK functions that would characterize the Beta-PERT distribution in the FEMTH for this example would be:

[4] Program Evaluation and Review Technique for project scheduling

$S_D = RiskPERT(14, 16, 22)$ (6-9)

where S_D is total project schedule duration in months. During the simulation process, the FEMTH samples values from this PDF, determines the monthly disbursement pattern from these values and then calculates the quarterly amounts as described in the project schedule section.

Toll Collection Costs

As discussed earlier, toll collection costs for the most part depend on the type of technology used and the rate of its use. At the feasibility stage the choice of technology has not probably been specified, and in most of the cases the actual system used will be a combination of the three main types, manual, semi-automatic, and totally automated. The *facility operation* section gives an idea of the range of these costs, with a minimum of \$0.05 and a maximum of \$0.10 per transaction in 1994 U.S. dollars (\$0.055 and \$0.11 in 1998 dollars). Depending upon the specified mixture of toll collection systems, a most likely cost can be chosen between these values. Venable (1994) cited that if half of the transactions were automatic or semi-automatic, the average cost per transaction is reduced to \$0.056 (\$0.06 1998 U.S. dollars).

Hence, in this case it may also be appropriate to use a triangular distribution to model toll collection costs when the collection system has not been clearly defined and its rate of use is unknown. Figure 6.20 depicts a triangular distribution with a minimum of \$0.055, a maximum of \$0.11, and a most likely value of \$0.06 U.S. dollars per transaction.

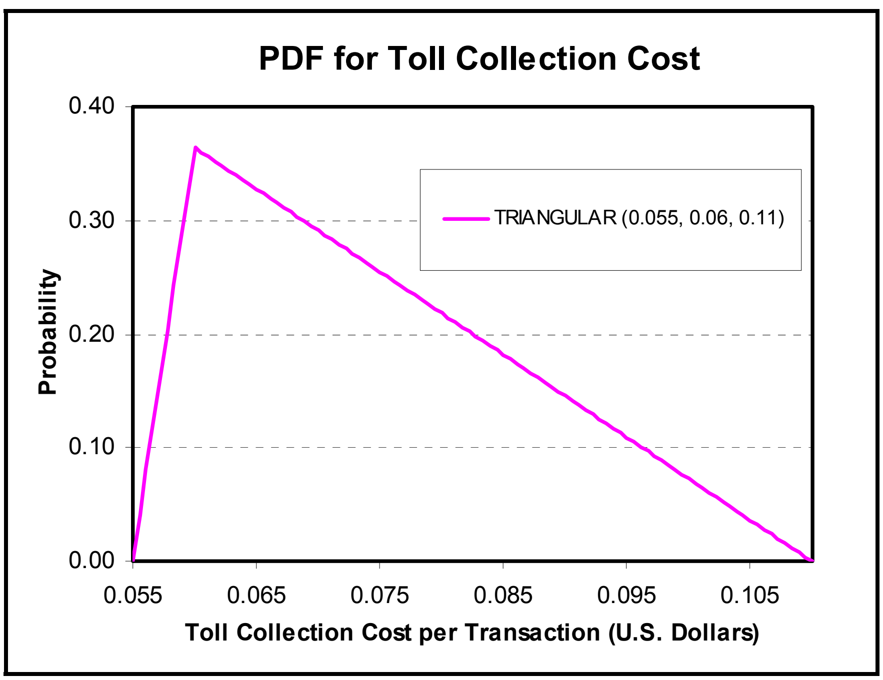


Fig. 6.20 Triangular PDF for Toll Collection Cost

The @RISK function that characterizes this triangular distribution in the FEMTH is:

$$C_{TC} = RiskTriang(0.055, 0.06, 0.11) \quad (6\text{-}10)$$

where C_{TC} is the toll collection cost per transaction in U.S. dollars. The uncertainty about the toll collection system used and its rate of use is reflected in this triangular PDF.

M, R&R Costs

The *facility operation* section also introduced some concepts and estimates for annual maintenance cost allocation. These estimates provide a reference for the range that maintenance costs may have over the life of the facility, with a minimum of 2.5 percent of the roadway construction cost, a maximum of 5.2 percent, and a middle value of 3.5 percent. As in the case of construction and toll collection costs, a triangular distribution based upon these parameters may be appropriate.

However, the type and performance of the pavement used for the roadway and of course by the type and level of traffic in the facility introduce uncertainty about these costs. As traffic increases over time and the level of service of the facility decreases, maintenance costs grow. It would be unreasonable to assume that maintenance costs in *year 1* may be at 4 percent and in *year 10* these costs may be at 2 percent or that they would be at a uniform 2.5 percent. The logical approach would be to assume that the maintenance cost allocation increases or stays at the same rate over time. If maintenance cost allocation in *year 1* is 2.5 percent, the allocation in *year 10* and *15* must be higher, until at some point it reaches the upper bound of 5.2 percent and stays at that level until the end of the analysis.

In order to consider this particular attribute of maintenance costs, a mathematical model was developed to portray it in the FEMTH. This model is basically a moving average equation. The growth of maintenance costs during a year is set at 10 percent of the difference between the upper bound (5.2 percent) and the current maintenance cost. Assuming an initial cost (M_0) in the lower bound (2.5 percent), the model reaches a cost of 4.90 percent on year 20 (M_{20}), for a 20-year average of 4.05 percent. For M_0 in the middle value (3.5 percent), the model yields 4.99 percent M_{20}, with a 20-year average of 4.48 percent. Finally, for M_0 in the upper bound (5.2 percent), the annual cost remains unchanged over time.

To characterize the uncertainty associated with these costs in the simulation process, the triangular distribution is used to model the first quarter costs. Subsequent costs are then obtained based upon this value with the model discussed in the previous paragraph, instead of sampling again from the whole initial range. Thus, if a high maintenance cost is sampled for the first quarter, the FEMTH will not allocate a lower cost for later periods. Figure 6.21 illustrates the maintenance cost growth model over a 30 year period and the @RISK function used in the FEMTH to model the cost for the first quarter. The quarterly cost growth rates are obtained by changing the discussed maintenance cost model to a quarterly basis.

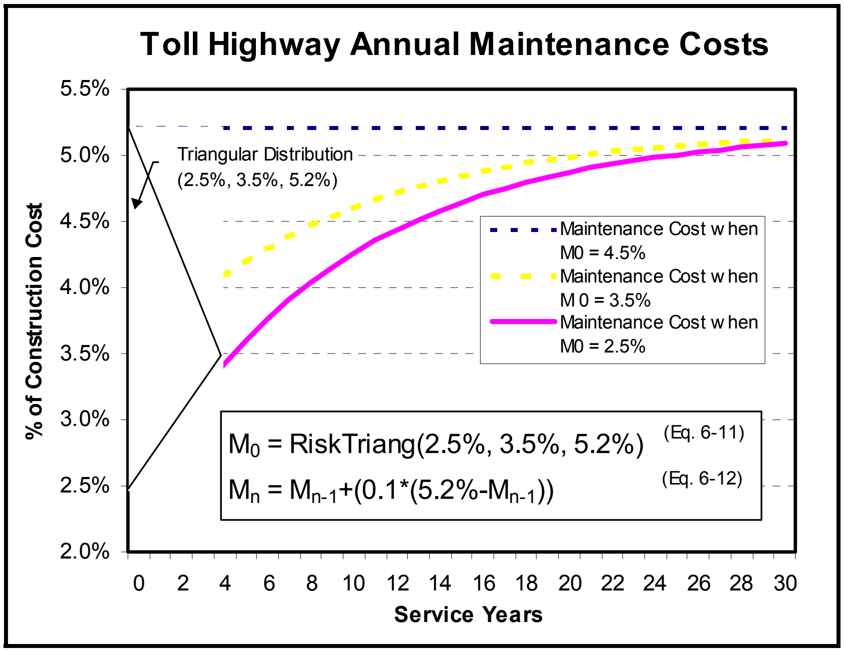


Fig. 6.21 Annual Maintenance Cost Model and PDF

Administrative Costs

General administration or overhead costs of the toll road enterprise were discussed earlier as well. These costs are incorporated into the FEMTH as a function of the total toll collection (operating) and maintenance costs, with an average of 22.5 percent and a range between 18 and 25 percent of the total annual operating and maintenance costs (Gittings, 1982), which already introduces uncertainty into this variable. The triangular distribution might as well be useful to characterize the uncertainty associated with this variable, since the three parameters are defined, a minimum of 18 percent, a maximum of 25 percent, and a most likely of 22.5 percent. The resulting @RISK function is:

$$C_{GA} = RiskTriang(0.18,\ 0.225,\ 0.25) \qquad (6\text{-}13)$$

where CGA is the overhead cost of the concessionaire as a percentage of the total toll collection and maintenance costs in any given period.

Interest Rates

Interest rates are probably one of the most uncertain and difficult to characterize variables. However, enough historical information is available to determine the statistical properties of the most widely used reference interest rates, such as the prime rate and the LIBOR[5]. Winston (1996) suggests the use of the Cox-Ingersoll-Ross model for modeling

[5] Appendix A presents a BestFit statistical analysis on a monthly basis of the real prime rate from 1966 to 1998 and the real LIBOR from 1983 to 1998. By eliminating a small number of negative values (17 out of 385 in the prime

interest rates in @RISK simulation. This model is based upon Vasicek's mean reversion model, which models the annual growth in interest rates in such a way that interest rates revert to a given level over time (e.g. the long term mean or the mode). Vasicek's formula to determine the mean growth of interest rates over a year is:

$$\Delta I_t = a\,(I_\mu - I_n) \tag{6-14}$$

where ΔI_t is the mean change in the interest rate from year n to year $n\text{-}1$ (I_n - I_{n-1}), a is a constant, I_μ is the long term rate, and I_n is the interest rate in year n. This formula forces the changes in interest rates to be positive when they are lower than I_μ and forces it to be negative when interest rates are higher than I_μ.

However, assuming a normally distributed mean annual change in interest rates during a Monte Carlo Simulation, Vasicek's model can yield negative interest rates, which in theory should be avoided. As Winston explains, the Cox-Ingersoll-Ross model uses the same formula as Vasicek for the mean change in interest rates, but prevents negative interest rates from occurring by setting the standard deviation as:

$$\sigma_{\Delta It} = b\,(I_n)^{1/2} \tag{6-15}$$

where $\sigma_{\Delta It}$ is the standard deviation of the mean change in interest rates from year n to year $n\text{-}1$, b is a constant, and I_n is the rate in year n (the current year). When interest rates approach 0 then [$b\,(I_n)^{1/2}$] approaches 0, and the variability in interest rates diminishes, making the occurrence of negative interest rates very improbable (Winston, 1996).

Hence, the Cox-Ingersoll-Ross model is used to model interest rates in the FEMTH. The input screen requires the user to input the initial interest rate (I_0), the initial real reference rate (I_{R0}) and the expected long term real reference rate (I_R), which is the mean or the mode of the rate used to quote the project's interest rate. The difference between I_0 and I_{R0} are the points above or below the reference interest rate, which apply to the rate charged to the project's debt. This number is then added to I_R to determine the long-term rate or I_μ, which is then used by the FEMTH in the Vasicek-Cox-Ingersoll-Ross formula. As for the constants, a and b, an example provided by Winston uses 0.2 for a, and 0.09 for b to model 20 years of interest rates.

By linking the Cox-Ingersoll-Ross model and the FEMTH using @RISK functions, interest rates are then modeled as follows:

User inputs: I_0, I_{R0}, and I_R

$$I_\mu = I_R + (I_0 - I_{R0}); \tag{6-16}$$

$$I_1 = I_0 + RiskNormal(0.02\,(I_\mu - I_0),\ 0.09\,(I_0)^{1/2}); \tag{6-17}$$

$$I_n = I_{n-1} + RiskNormal(0.02\,(I_\mu - I_{n-1}),\ 0.09\,(I_{n-1})^{1/2}) \tag{6-18}$$

Despite the mechanism included in the standard deviation of the Cox-Ingersoll-Ross model, occasionally it yields very small negative interest rates (close to zero), hampering the

and 20 out of 181), both rates were found to fit under a Lognormal PDF. The value of the mean for the prime rate was of 5.18 percent and for the LIBOR was 2.82, with modes of 4.3 and 2.2 percent and standard deviations of 1.73 and 1.03 percent respectively.

calculation process. The FEMTH corrects this problem by substituting these occurrences with interest rates of 0.01 percent.

Discount Rate

If defining a discount rate is a hard task, characterizing its uncertainty is just as difficult. It can be argued that given the long-term nature of toll road project investments and the fact that the discount rate is determined based upon instruments of the same term, investors can expect that their actual realizations (ex-post returns) will in fact, match their ex ante returns (expectations) (Rao, 1992). According to this, once the discount rate has been established following the logic outlined earlier in the *project financing* section, there is little need to vary it, since over the long run, the ex-post returns will be very close to the ex-ante returns.

However, most financial analysis literature suggests varying the discount rate to determine the effects of this variation in project selection. In order to characterize the uncertainty surrounding the discount rate, its two elements, the risk-free rate and the undiversifiable risk premium need to be modeled. These two elements together represent the average total return on the capital markets. The Standard and Poor's 500 (S&P 500) index is a widely used reference for the return on the U.S. capital markets as a whole. Thus, by modeling the historical variability of this index, a meaningful PDF for the discount rate can be developed. Goetzmann (1998) suggests the use of a lognormal PDF as an approximation for the histogram of annual returns on the S&P 500 (1926 to 1995). The nominal average total return on the S&P 500 index during this period was 12.45 percent (8.96 percent after inflation), with a standard deviation of 22.28 percent. On the other hand, the nominal average returns on long term U.S. government bonds was 5.39 percent (1.95 percent real) with a standard deviation of 8 percent (Goetzmann, 1998).

Hence, the PDF for the discount rate used in the FEMTH would the same as the PDF for the S&P 500 index, a lognormal distribution. The PDFs of the discount rate and its elements, the risk-free and the undiversifiable risk premium are illustrated in Figure 6.22[6].

[6] These functions, including the undiversifiable risk premium, were obtained by simulating the S&P 500 and the long term U.S. Treasury Bonds with @RISK and using lognormal probability functions with the parameters cited here. Appendix A presents more details of this analysis.

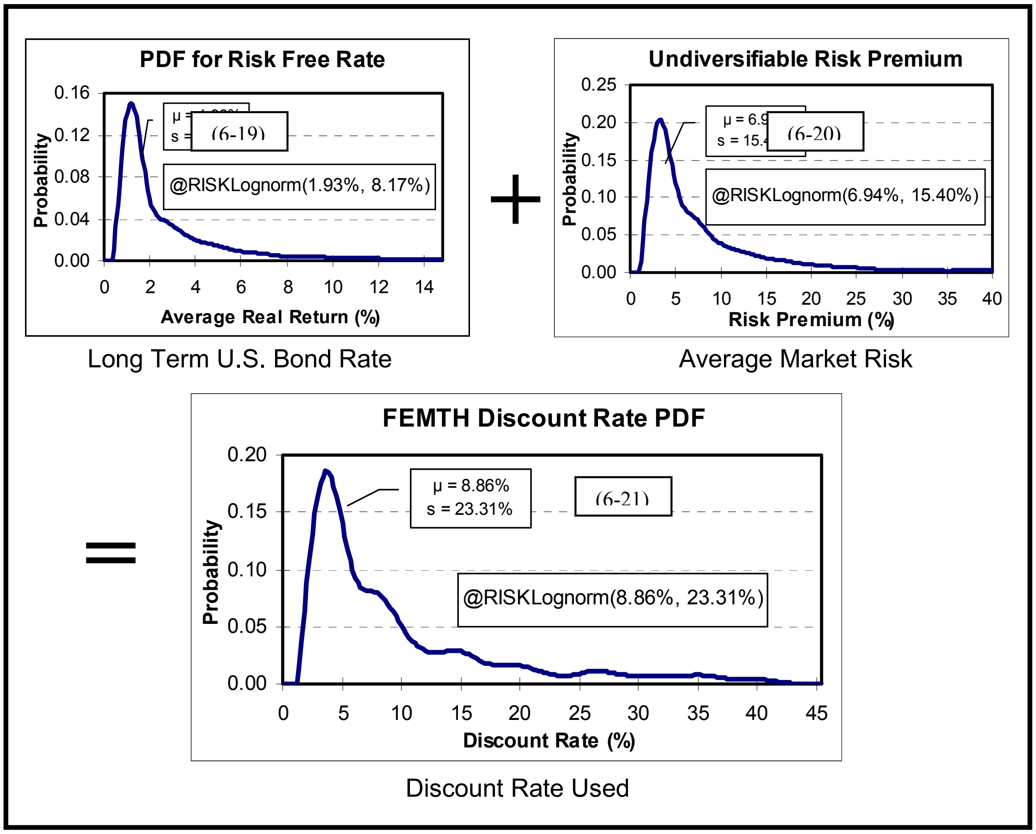


Fig. 6.22 FEMTH Discount Rate PDF and @RISK Functions

The numbers for the risk-free rate and for the undiversifiable risk premium shown are not exactly equal to the values mentioned earlier, due to the different time span of the analyses (1926-1995 vs. 1966-1998). However, their total approximately coincides with the discount rate established earlier. The resulting @RISK function for the FEMTH discount rate is illustrated in Figure 6.21.

Right of Way and Other Income

These are the last two variables in the FEMTH for which uncertainty must be modeled. The cost of the right of way and the income that the project may have from sources other than the operation of the road are totally case specific. The cost of right of way depends upon the localization of the project and the agreements set with the host government. The availability of other income will also depend on the concession agreement and the marketing efforts of the concessionaire. According to the preference of the user, these costs may be both modeled with a triangular distribution. A PERT distribution might prove helpful as well if a smooth distribution is desired.

CHAPTER 7: THE MEXICAN TOLLHIGHWAY NETWORK

As discussed in Chapter 1, the difficulties experienced by private investors involved in the past Mexican toll highway program provide a good example of the dramatic impact that risk and uncertainty can have on the success of this type of project. This chapter discusses the case of the Mexican toll highway network, which served as a basis for this research project, providing a brief historical overview of the Mexican toll road program from its inception to its final rescue by the government. Also included is a summary analysis of the major factors that contributed to the program's financial crisis. Finally, the toll-traffic demand estimation model based upon the Mexican toll road network developed by Orozco and introduced in Chapter 6 is discussed as a basic element of the FEMTH, now under the light of the Mexican experience.

ECONOMIC BACKGROUND

In the mid 1980s following the 1982 recession, the Mexican government made major changes in its economic policy aimed to restore economic growth. These changes included deregulating prices and trade, privatizing most of its state-owned enterprises and opening the economy to foreign competition by joining the General Agreement on Tariffs and Trade (GATT) and the negotiations to create the North American Free Trade Agreement (NAFTA). Inflation fell continuously, from 180 percent in 1987 to 50 percent in 1988, reaching 7.5 percent in 1994, and GDP growth recovered from an annual average of zero over 1982-88 to about 4 percent from 1989 to mid 1991 (World Bank, 1998).

However, as one of the main elements of this strategy was the use of a predetermined nominal exchange rate anchor, the real exchange rate appreciated by about 30 percent between 1989 and the end of 1993. As a consequence, the current account deficit grew from an average of 3 percent of GDP in 1989-90 to 7 percent in 1992-94, and the government had to rely increasingly in foreign capital inflows to finance the deficit (World Bank, 1998).

This large current account deficit generated investor concern about an increasing vulnerability of the economy, which caused both a reduction in foreign capital inflows and movement of capital abroad by residents. In addition, external and domestic events in 1994 further eroded investor confidence. The rise in interest rates by the U.S. Federal Reserve made returns on Mexican investments relatively less attractive, and the uprising in Chiapas and assassination of two leading political figures increased domestic uncertainties. Net foreign capital inflows fell sharply and the Mexican government had to finance the current account deficit with its foreign reserves, which fell dramatically too (World Bank, 1998).

Eventually, in December 22 of 1994 the Mexican government floated the peso, which depreciated substantially, from \$3.45 pesos to the dollar in December 19, to \$6.2 by the end the month, and then stabilizing at around \$7.5 in early 1995. Nominal interest rates reached a high of more than 80 percent and the annual average inflation rate reached 35 percent. The Mexican government responded by launching an economic austerity program in March of 1995, aimed at stabilizing the economy, restoring international confidence, and creating conditions for sustainable economic growth. The austerity program inevitably caused a drop in economic activity. GDP fell by 6.9 percent and domestic investment decreased more than 30 percent in 1995 (World Bank, 1998)

The adjustment to the new economic conditions has been difficult but relatively quick as GDP grew by about 5 percent in 1996 and 6.6 percent in 1997 with most of this growth coming from increased exports. In addition, inflation fell to 27 percent in 1996 and 16 percent in 1997, allowing the moderation of interest rates that reached about 30 percent in 1996 and 20 percent in 1997 (BDINEGI, 1998). According to the World Bank (1988), if Mexico continues with a policy directed to achieve macroeconomic stability and the peso maintains its real value, the growth in exports will continue, and imports will also increase as a result of growth recovery, both supported by the opportunities created by NAFTA.

THE 1989-1994 TOLL HIGHWAY PROGRAM

As part of its economic restructuring program in the mid 1980s, the Mexican government also undertook important policy measures in the highway sector. These measures included deregulating road transport services, outsourcing an important part of highway maintenance on the federal network, decentralizing highway administration, and encouraging private participation in providing road infrastructure (World Bank, 1998). This policy led to a comprehensive highway construction program involving the private sector under the BOT scheme. The program was aimed at constructing 5,400 km of new toll expressways and eight bridges during the years 1989-1994, for an equivalent to US$6.5 billion of private sector investment (Roth, 1996).

Some of the factors behind this major public-private endeavor were the urgent need to upgrade the country's road network to accommodate current traffic needs and to help reduce overall transport costs to Mexico's external trade traffic, hence improving the competitiveness of Mexican exports in international markets. Thus, the program was undertaken under the circumstances of the favorable outlook presented by the Mexican economy. Upgrading the road network as soon as possible seemed mandatory if advantage was to be taken from new foreign trade opportunities. On the other hand, constrained fiscal resources and other urgent social needs made it difficult for the government to take upon the entire endeavor by itself.

The program succeeded at putting idle road building resources to work (Roth, 1996), acquiring a highway network in which all the important corridors have been defined (Magallanes, Díaz & Ramírez, 1996) and creating a market for the construction and management of private road infrastructure. However, as Roth (1996) states, "probably as a result of haste, possibly as a result of political pressures", fundamental flaws in the program became evident when the facilities entered into operations and the concessionaires experienced severe problems, which will be evident in the following sections.

Original Concession Scheme

The Mexican Ministry of Transportation and Communications (SCT) announced the toll road program on behalf of the government in early 1989. The projects were selected by the SCT after being screened for preliminary technical, economic, and financial feasibility (including traffic studies). About 50 projects in the main trunk of the network were deemed feasible, carried on to the design stage, and later announced for public bid under the concession scheme (Cervantes & Rubio 1992).

According to the Mexican law at that time, the maximum concession period was 20 years. At the end of the concession period the road and all the facilities in the right of way should be transferred to the SCT free of liabilities and in excellent service conditions. The SCT committed to provide the right of way and detailed design of the project. The SCT set the toll prices and guaranteed a minimum level of revenues by specifying a minimum ADT, ADT distribution, and annual traffic growth rates (Arias, 1990). Shortfalls in revenues due to variations in the SCT traffic projections would be compensated by extension of the agreed upon concession period.

The criteria for awarding the concessions was the following, in descending order of importance (Zambrano, 1991):

1. Shortest concession period
2. Shortest execution period
3. Soundness of financial package
4. Experience and prestige of the bidder

Thus, in case of two tenders requiring the same number of concession years, the criterion for award would be the shortest project execution period and if the tie persisted, it would be resolved according to the following criterion.

The concessions were finally awarded for the most part to project companies formed by the largest national contractors and a few more to companies formed by regional contractors. The SCT also reached an agreement with national investment institutions to implement financing schemes suitable to the particular characteristics of the program (Zambrano, 1991). Hence, debt funding was mainly obtained through the Mexican banking system in peso denominated loans and other instruments.

Assessment of Program Execution and Initial Operations

The SCT required bidders to submit detailed economic and financial feasibility analyses for each project as part of the bidding documents. These feasibility analyses were carried out under the assumptions of a long-term economic stability, the forthcoming trade bonanza and consequent growth in economic activity.

Toll highway feasibility analyses from the 1990-1992 period suggested conservative scenarios with inflation rates of 15 percent and real interest rates between 10 and 8 percent for 1993 and subsequent years (Arias, Cervantes & Rubio 1990, 1992). Reality turned out to be sour, with inflation reaching 35 percent and real interest rates soaring to 35 percent in 1995.

With respect to the project execution stage of the program, there were also deviations from the initial forecasts. Data from 38 projects shows an average construction cost overrun of 29 percent with a range between 22 percent under the initial estimate to 158 percent above. Figure 7.1 displays the initial bid versus the final project cost in terms of dollars per km per lane. The chart shows that most of the projects incurred in cost overruns. The variation is more pronounced in those projects with a high cost per kilometer per lane, probably because of the higher complexity of the projects. The detailed data is included in Appendix F. In addition, in several cases the final design was not complete at the time of the estimate, leading to changes in project scope and subsequent cost overruns (Ortega, 1996).

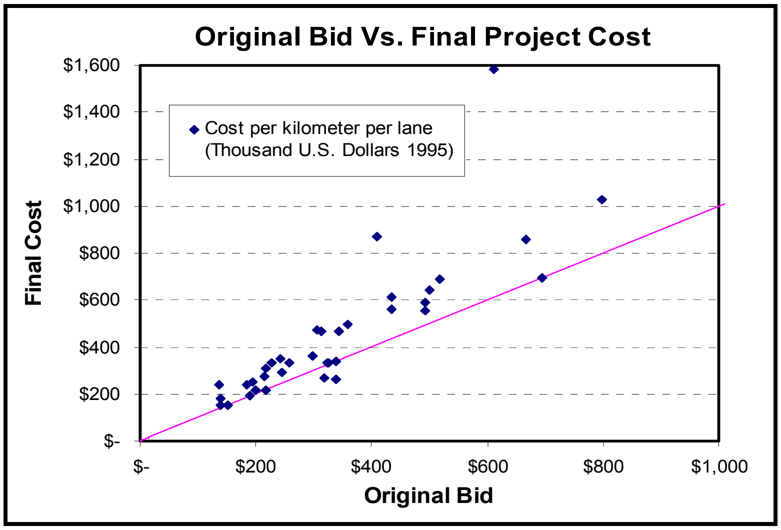


Fig. 7.1 Initial Estimates vs. Actual Costs for Toll Road Projects in the Mexican Network

Regarding the project execution schedule, approximate project completion data available from 20 projects shows an average increase of 19 percent from the initial scheduled duration, ranging from a project completed in less than 70 percent of the initial schedule to a project completed in twice the initial duration. Figure 7.2 compares the initial estimates of project execution duration and the actual duration for 20 projects in the toll network. The chart shows that the data points are fairly spread out around the initial estimate, suggesting a normal variation probably due to an incomplete design, and not a general trend.

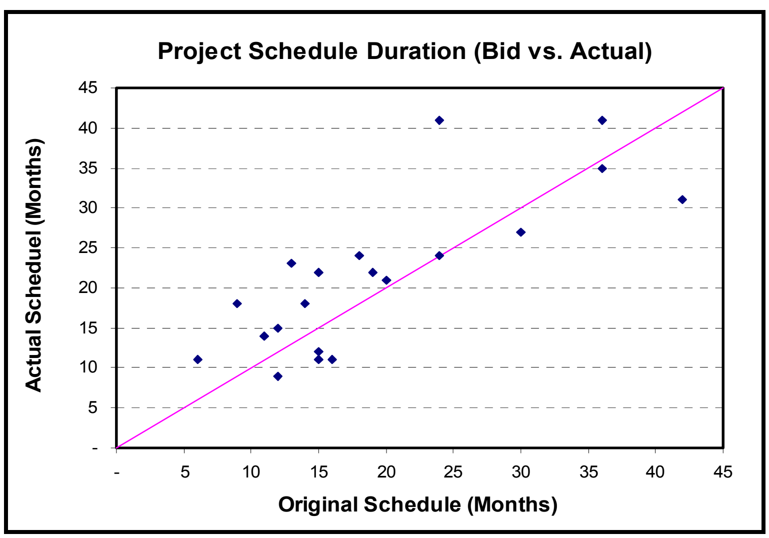


Fig. 7.2 Initial Estimates vs. Actual Schedule Duration for Toll Road Projects in the Mexican Network

By the end of 1993, the SCT had awarded concessions for 4,000 km of toll highways of which 1,500 km were already in operations. However, in most of the cases the actual traffic was very far from the SCT traffic projections. Only 5 out of 38 highways met or exceeded the SCT guaranteed traffic and in the worst cases roads carried as little as 10 to 15 percent of the initial estimates. Figure 7.3 gives further illustration to this problem.

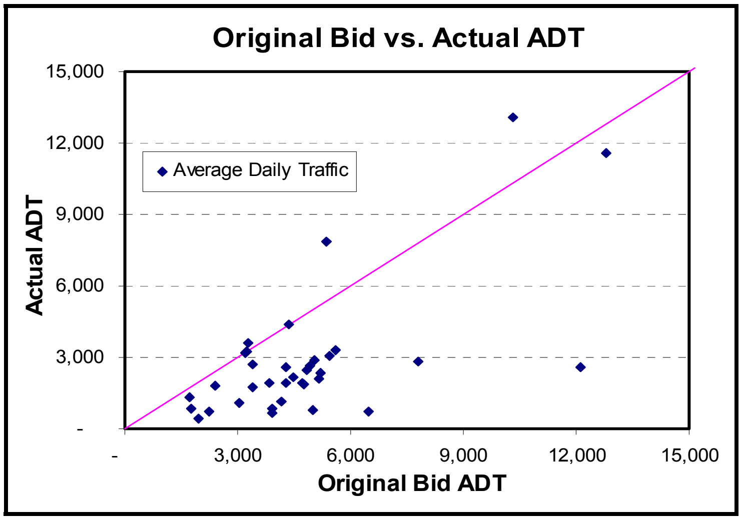


Fig. 7.3 Original Projections vs. Actual Initial ADT in Toll Roads

Increased construction costs and low revenue levels already posed a major difficulty for concessionaires to meet their debt payments. The spike in interest rates of 1995 and the economic recession added to this situation. Outstanding debt grew exponentially and overdue payments became a major problem for the entire banking system. The financial situation of the concessions turned unmanageable and the SCT had to intervene to avoid the bankruptcy of the program in several occasions, as described in the next paragraphs.

Governmental Takeover

The SCT had to restructure the projects under the initial concession scheme in two occasions in 1995 before it finally took over 23 of the most problematic cases in August of 1997 (Gómora, 1997).

The first time the agency granted funds to the concessionaires to assist them in meeting their debt payments. The second time the law governing the concessions was amended to allow concession periods up to 30 years, toll rates were reduced and the concession periods extended for selected projects. Figure 7.4 shows a comparison chart between the original and the finally restructured concession period. The majority of the projects had to increase substantially their initial concession periods and almost half of these had to do it up to the new legal maximum of 30 years.

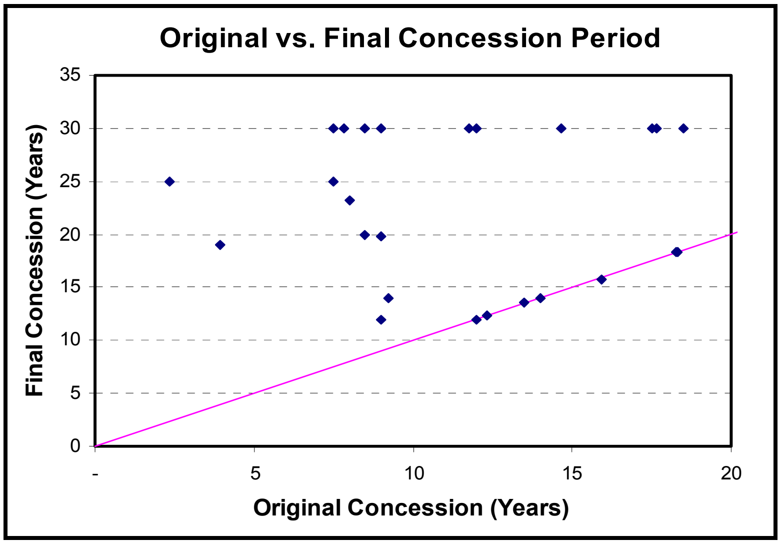


Fig. 7.4 Original Concession Periods vs. Restructured Periods

However, restructuring the projects proved to be a measure that was too small and came too late, as the increased traffic flow due to lower tolls was still insufficient for the concessionaires to meet their obligations.

As the problem continued to grow, the concessionaires and their creditors demanded from the government a definitive solution to the problem. Finally in August 23 of 1992 after two years of negotiations with the concessionaires, the SCT announced the take over of 23 of the projects in the network and further reductions in toll rates as a measure to increase traffic in these highways.

A trust was formed to administer the highways and assume their liabilities and the concessionaires only lost their initial equity invested in the projects. As a result of the governmental takeover, the projects benefited from lower interest rates and longer terms for repayment of their outstanding debt. The total liabilities assumed by the government added up to around US$7.5 billion for only 23 projects, which gives an idea of the magnitude of the problem, since the initial investment was of around US$6.5 billion for the entire program (Gómora, 1997).

Concession Scheme Pitfalls

The problems experienced by the initial concession scheme can be summarized and divided into two types according to their origin. First, the problems originated by factors inherent to the program scheme, or in terms of the discussion about discount rates, the diversifiable risks of the program. Second, the problems originated by external factors, or undiversifiable risks.

Hence, in broad terms, the problem factors inherent to the program were:

1. *Concession award criteria based upon the shortest concession period.* As a consequence of this criterion, some concessions were awarded for periods as low as eight years, when international experience indicates periods between 20 and 50 years.
2. *Above market tolls.* The shortest concession period policy implied charging the highest authorized toll (an average of 20 US cents per km in 1994), in order to recover the

investment and make a profit as early as possible. A study by Queiroz (1997) indicates that nominal toll rates in Mexico are on average higher than those charged in toll roads in several developed countries. Normalized by per capita GNP, the difference becomes even wider, toll rates in Mexico being more than 1600 percent higher than in the U.S. and 400 percent higher than in Japan.

3. *Overly optimistic ADT estimates*. In most of the cases there was an excessive overestimation of the initial ADT, which coupled with high toll prices resulted in even lower traffic levels.
4. *Incomplete Designs*. Incomplete designs resulted in higher construction costs and schedule delays.

On the other hand, regarding the external factors, the economic scenario discussed at the beginning of the chapter had a severe impact on the initial concession program. Most of the projects in the program were highly leveraged with an average debt ratio ranging from 0 to 100 percent and averaging 53 percent. The sharp rise in interest rates in early 1995 increased considerably financing costs and the deep economic recession brought a decline in the already low traffic levels from which the projects could never recover.

The Outlook

The experience achieved and the errors identified in the initial concession scheme should serve as the basis to implement new programs in Mexico. According to the World Bank (1996), the country has reached a point where it needs to expand its road capacity again. With a healthier and less fragile economy the prospects for sustainable growth in the near future are clearer. Thus, private investment in road infrastructure should not be abandoned, since it may prove to be again an excellent solution to the highway financing issue in Mexico.

THE TOLL-TRAFFIC DEMAND ESTIMATION MODEL

The discussion about the Mexican experience made evident that one of the critical factors in the success of a toll highway is an accurate forecast of future revenues. Future revenues depend primarily on the vehicles using the facility and the willingness of the user to pay for the service, two tasks that are hard to predict.

Hence, a reliable feasibility evaluation model would not be complete without a proven methodology that allows estimating its most critical variables, traffic and the optimum toll. The study "Analysis of input variables for a pre-feasibility evaluation model for toll highways" (Orozco, 1997), provides the FEMTH with a methodology to determine these variables. The study, introduced in Chapter 6, was developed based upon data from the Mexican road program and it has proven to yield reliable results when applied to specific cases in this network.

In broad terms Orozco's research can be divided into two main parts. First, a mathematical model that calculates the amount of traffic in a corridor that diverts to a toll facility based upon the toll price and the elasticity of traffic demand. Second, a function that describes the relationship between toll price and gross toll income in a facility and helps in determining the optimum toll or in other words, the toll that maximizes income to the facility. The following sections present a summary of this work, which represents the link between the FEMTH and the Mexican toll road program.

Toll Traffic Estimation

The first assumption in the model is that the corridor where the toll road is or will be located is already served by a free access road. The amount of traffic diverted to the toll road is then calculated as a percentage of the total traffic going between the same origin and destination. The traffic is then divided into three vehicle categories, cars, buses, and trucks.

The data available for the analysis corresponded to 29 origin and destination pairs, toll and free access roads in the Mexican network. The detailed data for the Network is included in Appendix F. The first step was to analyze the relationship between the percentage of traffic diverted to the toll facility as a function of the advantages offered to the user by the toll road in terms of three parameters: travel distance, travel time, and user costs. In the case of travel distances and user costs, the cases under analysis were separated into two groups, one with free access roads shorter than 100 km, and the other with those longer than 100 km. In the case of travel time, the routes were separated into those with travel time shorter than one hour and those with a longer travel time. Those toll roads that serve as urban bypasses or are mainly used by urban traffic were excluded from the analysis, since they showed a totally different behavior.

The three parameters, travel distance, travel time, and user costs, were first individually evaluated and then combined to create a single equation for each group and each type of vehicle of the form:

$$ADT_D = ax + b \qquad (7\text{-}1)$$

where:

ADT_D = ADT diverted to the toll facility in percentage

x = travel distance, time or user cost ratio (FR/TR)

a, b = regression constants (slope and intercept, respectively)

Table 7.1 presents a summary of the resulting coefficients for each group and each variable for the three vehicle types. The correlation coefficient R for the equations shows that users present a better response to those routes involving trips longer than 100 km or one hour.

Table 7.1 Coefficient Summary for Traffic Parameters and Groups (Orozco, 1997)

	FR < 100 km or < 1 hr				FR > 100 km or > 1 hr			
		CAR	BUS	TRUCK		CAR	BUS	TRUCK
TRAVEL DISTANCE	R=	0.366	0.685	0.064	R=	0.688	0.734	0.774
	a=	37.827	100.498	-5.701	a=	43.723	72.410	81.465
	b=	6.265	-56.159	46.430	b=	6.265	-36.511	-76.426
TRAVEL TIME	R=	0.371	0.382	0.269	R=	0.745	0.469	0.596
	a=	10.096	14.717	-6.288	a=	34.516	23.758	32.245
	b=	35.436	40.369	49.523	b=	-20.359	11.234	-32.029
USER COST	R=	0.455	0.695	0.043	R=	0.560	0.789	0.848
	a=	39.617	105.042	-3.953	a=	35.321	81.150	92.452
	b=	0.691	-63.664	45.035	b=	-13.581	-50.114	-93.080

Next, a multi-regression analysis combining the three variables (i.e. distance, time and cost) was performed to develop a single model for each group and each type of vehicle. The variables were analyzed as a toll road to free access road ratio (FR/TR). The resulting prediction model was:

$$ADT_D\,(\%) = K_0 + K_1\,R_d + K_2\,R_t + K_3\,R_c \qquad (7\text{-}2)$$

where:

ADT_D = Percentage of ADT diverted to toll road (for each vehicle category, cars, buses, or trucks)

R_d, R_t, R_c = travel distance, travel time, and user cost ratios

K_0, K_1, K_2, K_3 = equation constants

Table 7.2 presents a summary of the coefficients and the correlation for the traffic prediction model for each vehicle type.

Table 7.2 Coefficient Summary for Traffic Prediction Model (Orozco, 1997)

Coefficient	**Vehicle Type**		
	Car	**Bus**	**Truck**
$\mathbf{K_0}$ =	29.00	47.46	34.48
$\mathbf{K_1}$ =	28.38	37.72	23.07
$\mathbf{K_2}$ =	-25.33	-34.01	-28.89
$\mathbf{K_3}$ =	13.01	11.97	8.59
R =	0.34	0.30	0.22

However, note that the values obtained with this prediction model represent the ADT that can be expected when the toll charged is US$0.75 /km, which is the average toll charged in the cases used to develop the model. These values change after being affected by the elasticity model discussed in the following section. Both sets of results are displayed and compared to the actual traffic data in Table 7.5.

Toll Traffic Estimation and Toll Elasticity

The sensitivity of traffic to toll price changes is an important factor in a toll traffic prediction model. Orozco uses price-elasticity of demand concepts to determine the relationship between the toll price and the traffic volume using the facility as a percentage of the total traffic going between the same origin and destination pair.

Elasticity of travel demand is defined as the percent change in traffic volume resulting from a one-percent change in a given variable, such as time or cost. Elasticity can be estimated following the empirical method, which considers historical data, analyzing the traffic before and after a change in the system is made. This elasticity is a direct measure of the actual conditions of the system under study. Hence, this method was used to analyze the data available from the Mexican case study at a network level.

All the routes involving bypasses or highways used by urban traffic were again excluded from the analysis. The final data set included only eighteen out of the initial twenty-nine toll highways.

In addition, two different groups that showed different behavior were identified for each vehicle type. One group formed by all the routes with 60 percent or more savings in travel time by using the toll alternative, and the other formed by routes with less than 60 percent savings (FR/TR). The latter yielded the best fit to the mathematical model.

The data was fit to a logarithmic elasticity model of the form:

$$ADT_D\,(\%) = m \, Ln \, C_T + n \qquad (7\text{-}3)$$

where:

$ADT_D =$	percentage of ADT diverted to the toll road
$C_T =$	toll cost per km ($/km)
$m, n =$	regression constants

Figure 7.5 depicts the relationship between the ADT diverted and the tolls per km (in US Dollars) for the three vehicle categories and the two travel time groups. The charts show that the routes with a toll highway alternative that offers 60 percent or more savings in travel time is less elastic to changes in the toll, and the ADT diversion does not change considerably when the toll per km increases. Conversely, when savings in travel time are less than 60 percent, the response of the users is highly sensitive or elastic to the toll price.

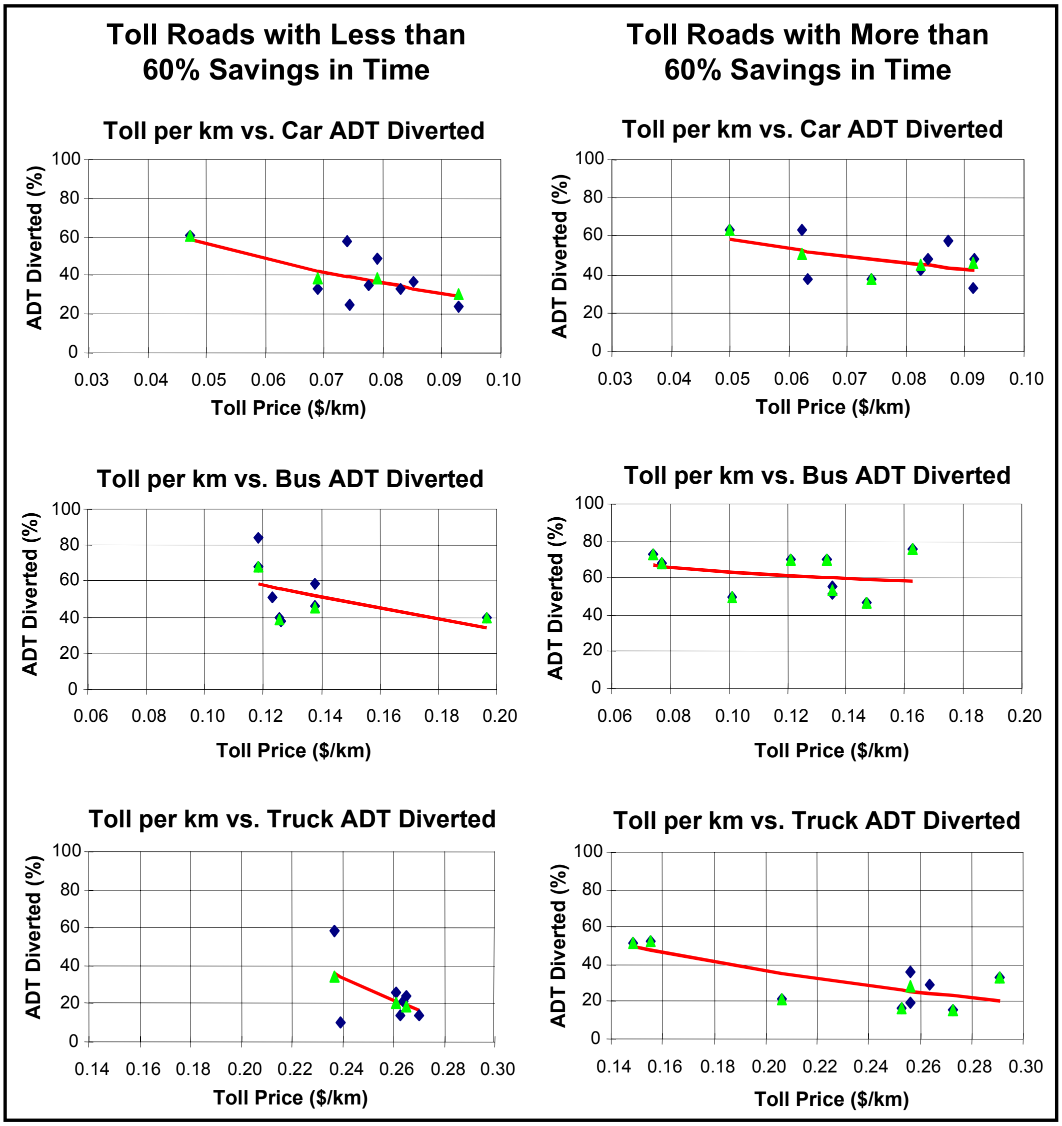


Fig. 7.5 Variation in ADT Diverted vs. Toll per km (Orozco, 1997)

The traffic prediction equations resulting from this analysis are presented in Table 7.3 along with the regression coefficients for each equation. These are the actual equations that were incorporated into the FEMTH in Chapter 6.

Table 7.3 Summary of Traffic Prediction Equations

Category	Time Savings	Traffic Prediction Equation (% of total traffic in the route)	Regression Coefficient
Cars	Less 60%	$ADT_D = -43.48 \text{ Ln } C_T - 73.78$	R = 0.63
	More 60%	$ADT_D = -25.99 \text{ Ln } C_T - 19.61$	R = 0.49
Buses	Less 60%	$ADT_D = -48.25 \text{ Ln } C_T - 44.12$	R = 0.49
	More 60%	$ADT_D = -10.31 \text{ Ln } C_T + 39.47$	R = 0.26
Trucks	Less 60%	$ADT_D = -148.86 \text{ Ln } C_T - 178.42$	R = 0.49
	More 60%	$ADT_D = -43.22 \text{ Ln } C_T - 33.26$	R = 0.75

The elasticity model equations in Table 7.3 and the equations discussed earlier in the *toll-traffic estimation* section were applied to the eighteen cases to obtain the theoretical ADT diverted to the toll facility with both methods and then compare it with the actual numbers. Table 7.4 summarizes the values of ADT diversion calculated with each method, the actual values, and the difference between the actual and the elasticity affected values.

Table 7.4 Summary of Predicted ADT Diversion (Orozco, 1997)

ROUTE	PREDICTED ADT (%)			AFTER ELASTICITY ADT (%)			ACTUAL ADT (%)			DIFFERENCE ADT (%)		
	CAR	BUS	TRUCK	CAR	BUS	TRUCK	CAR	BUS	TRUCK	CAR	BUS	TRUCK
ARMERIA-MANZANILLO	45	48	42	43	35	10	48	39	40	(5)	(4)	(30)
ATLACOMULCO-MARAVATIO	54	69	39	64	74	55	63	73	52	1	1	3
CADEREYTA-REYNOSA	39	44	14	43	72	55	33	35	10	9	37	45
CORDOBA-VERACRUZ	47	71	44	41	69	38	33	47	15	8	23	22
DELICIAS-CAMARGO	48	59	42	65	63	54	60	84	58	5	(21)	(4)
DURANGO-YERBANIS	40	47	17	40	49	28	24	40	10	16	9	18
GUADALAJARA-COLIMA	54	66	39	58	71	55	63	68	53	(5)	3	2
GUADALAJARA-ZAPOTLANEJO	51	62	40	52	67	37	58	68	26	(6)	(1)	12
LA TINAJA-COSOLEACAQUE	37	41	11	28	39	10	24	46	14	4	(8)	(4)
LEON-LAGOS DE MORENO-AGS.	39	45	15	34	47	11	24	35	33	10	12	(21)
MAZATLAN-CULIACAN	42	50	20	41	52	17	35	51	14	6	1	3
MERIDA-CANCUN	47	59	31	51	59	25	38	69	29	13	(11)	(3)
MONTERREY-NUEVO LAREDO	57	75	49	54	74	45	42	51	20	11	22	25
SAN MARTIN TEX.-TLAX.-E. M.	57	75	39	54	72	29	48	75	33	6	(3)	(4)
TEPIC-ENTRONQUE SAN BLAS	63	75	34	58	74	30	57	70	36	1	4	(6)
TIJUANA-TECATE-LIB. TECATE	65	75	55	60	74	52	48	55	17	11	19	35
TORREON-CUENCAME-YERBANIS	39	45	15	35	42	11	33	58	24	2	(16)	(13)
ZAPOTLANEJO-LAGOS DE MORENO	56	69	55	57	71	55	38	49	21	19	22	34
							AVERAGE =			6	5	6
							STD DEV=			7.0	15.3	20.2

The comparison between the ADT diversion predicted by the model and the actual diversion becomes more evident in Figures 7.6, 7.7, and 7.8, which compare the values for cars, buses, and trucks respectively.

In the figures it is evident that the values obtained with the model for passenger cars and buses are very reliable. However, the author points out that probably due to high toll prices trucks do not seem to respond to the use of toll roads.

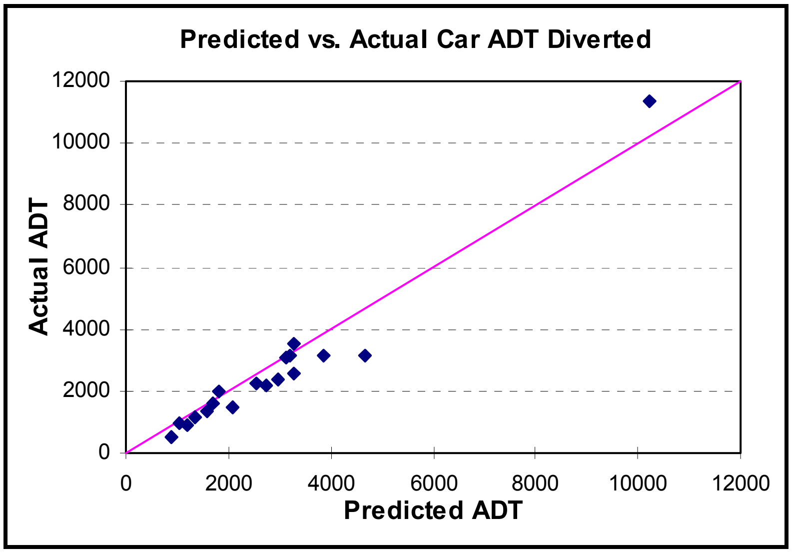


Fig. 7.6 Comparison of Predicted and Actually Diverted Car ADT (after Orozco, 1997)

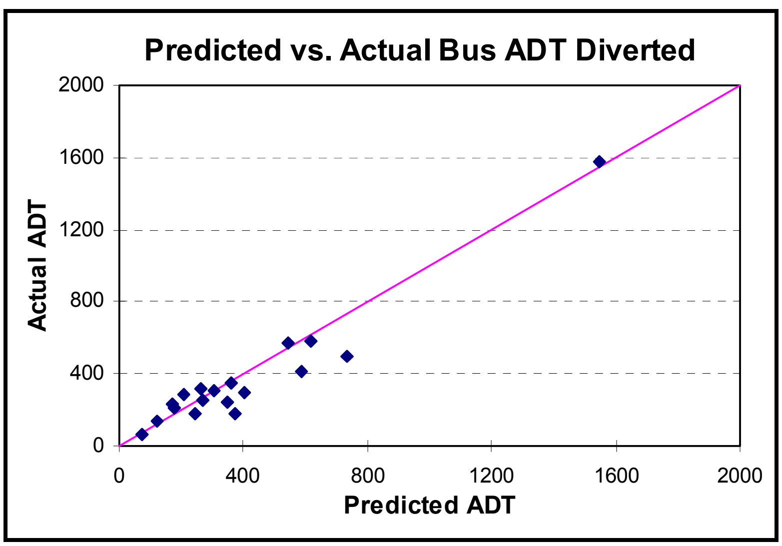


Fig. 7.7 Comparison of Predicted and Actually Diverted Bus ADT (after Orozco, 1997)

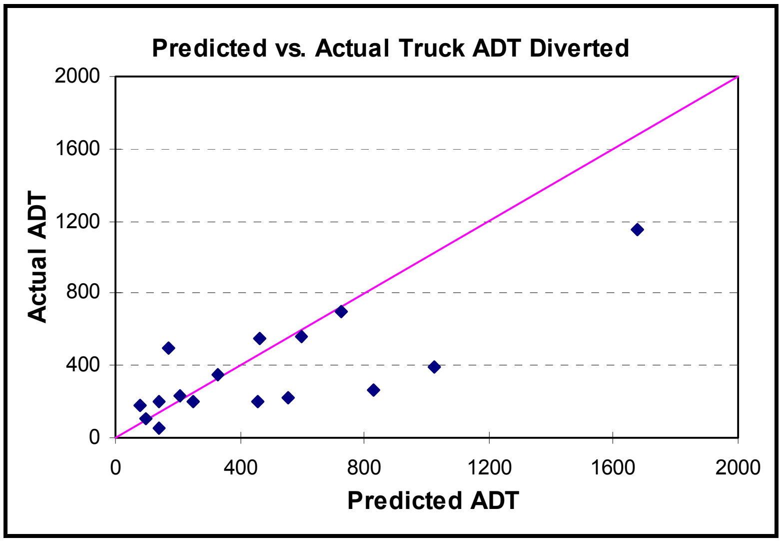


Fig. 7.8 Comparison of Predicted and Actually Diverted Truck ADT (after Orozco, 1997)

Toll Price and Toll Facility Income

This is the second and last part of the toll-traffic demand study. Using the toll-traffic demand prediction model discussed in the previous section and a total toll income function, Orozco analyzes the data from the Mexican toll roads to calculate the tolls that would maximize gross income at the network level for the initial data set of 29 projects.

The underlying idea behind the author's analysis is the fact that raising toll prices in a facility will increase gross income only up to a certain point, after which gross income will decline due to the user's freedom of choice in whether or not to use the facility. This was the case in Mexico, where the use of a toll highway is voluntary, and there is always an alternate free route. The user will pay the toll only if he or she perceives that the benefits received in terms of time, distance, safety, and cost are worth the price.

Thus, the income function is defined as:

$$I = y\,x \qquad (7\text{-}4)$$

where:

I = income function
y = demand function ($y = m \, Ln \, x + n$)
x = toll to be charged per km
n, m = constants

Note that the demand function is the toll-traffic demand prediction model, which represents the percentage of ADT diverted to the toll highway. Thus, the resulting model is of the form:

$$I = (m \, Ln \, x + n)\, x \qquad (7\text{-}5)$$

The set of data used in the development of the traffic demand models was then analyzed as a whole using the income function at a network level. Figures 7.9, 7.10, and 7.11 show the income function for the three vehicle categories, cars, buses, and trucks respectively. The constants used for the demand function are also shown with each figure.

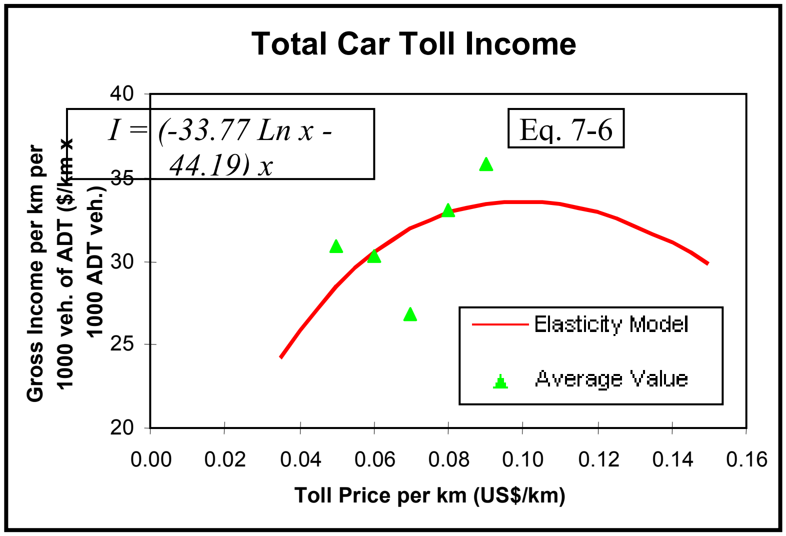


Fig. 7.9 Income Function for Cars (after Orozco, 1997)

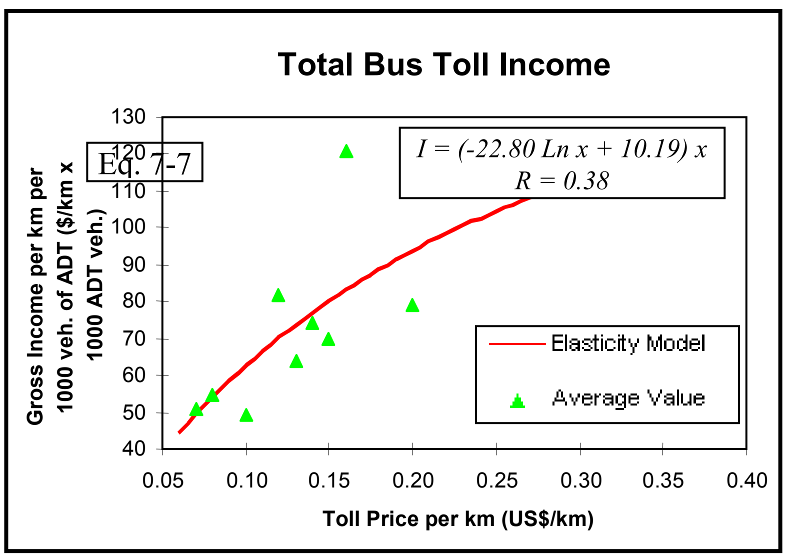


Fig. 7.10 Income Function for Buses (after Orozco, 1997)

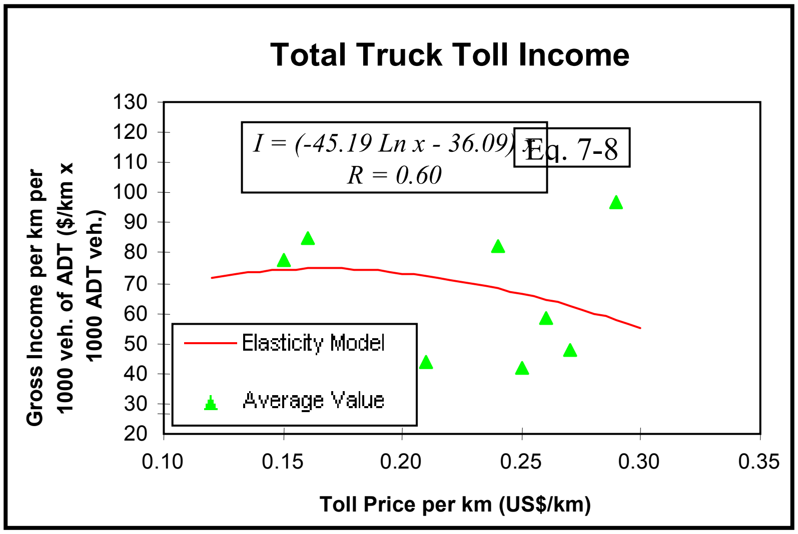


Fig. 7.11 Income Function for Trucks (after Orozco, 1997)

Thus, according to Orozco, the optimum tolls for the Mexican road network derived from these functions are US$0.10/km for passenger cars and US$0.17 for trucks. The behavior of buses is almost inelastic, since the demand practically does not change when the toll price varies. As Figure 7.10 indicates, the toll producing the maximum income would be much higher than the actual prices. As these values would be beyond the range considered in the elasticity model, they should not be extrapolated.

However, the data analyzed was limited and the values obtained here should not be consider as an absolute solution. Further research, updating, and calibrating the models with more data and studying every project separately are recommended to improve the accuracy of the model.

THE TOLL TRAFFIC ESTIMATION MODEL AND THE FEMTH

The model developed by Orozco contributes to the development of the FEMTH in a very important way. It provides information about the variable that has proven to be one of the most important factors in the success or failure of a toll road project.

Having a reliable model for traffic prediction helps the analyst in narrowing down the critical uncertainties surrounding a proposed project. Chapter 6 already described the integration of the feasibility evaluation model and the toll-traffic demand model. Although the toll-traffic model was estimated based upon data from the Mexican network, and the results presented here are only applicable to projects in this region, it provides a methodology that can be used in any other network or project where data is available.

At this point, and for the purposes of this research, the information provided by the toll-traffic demand model can be directly used in the FEMTH to evaluate projects in the Mexican toll network, which is the subject of the next chapter.

CHAPTER 8: APPLICATION OF THE FEMTH TO EXISTING TOLL HIGHWAYS IN THE MEXICAN ROAD NETWORK

This chapter presents the application of the FEMTH, the toll-traffic demand model and the risk analysis methodology to two actual case studies in the Mexican toll highway network. As discussed in Chapter 7, in August of 1997 the Mexican government took over 23 out of 52 highways under the initial concession scheme that were deemed as unfeasible given their financial situation. The rest of the cases remained under the control of the concessionaires, as they were judged as viable enterprises.

Based upon the data available for this research and the cases used in the development of the toll-traffic model, one case from each group was selected for analysis. First, from the group of highways not rescued by the government is the San Martin Texmelucan–Tlaxcala–El Molinito toll highway, and from the rescued group is the Monterrey–Nuevo Laredo toll highway. The map in Figure 8.1 shows their approximate geographical location.

Although the data available is very limited, the application of the FEMTH to these two cases serves two purposes. First, to show the application of the model to an actual case and second, to compare the results obtained to the actual feasibility appraisal of these roads in the rescue program.

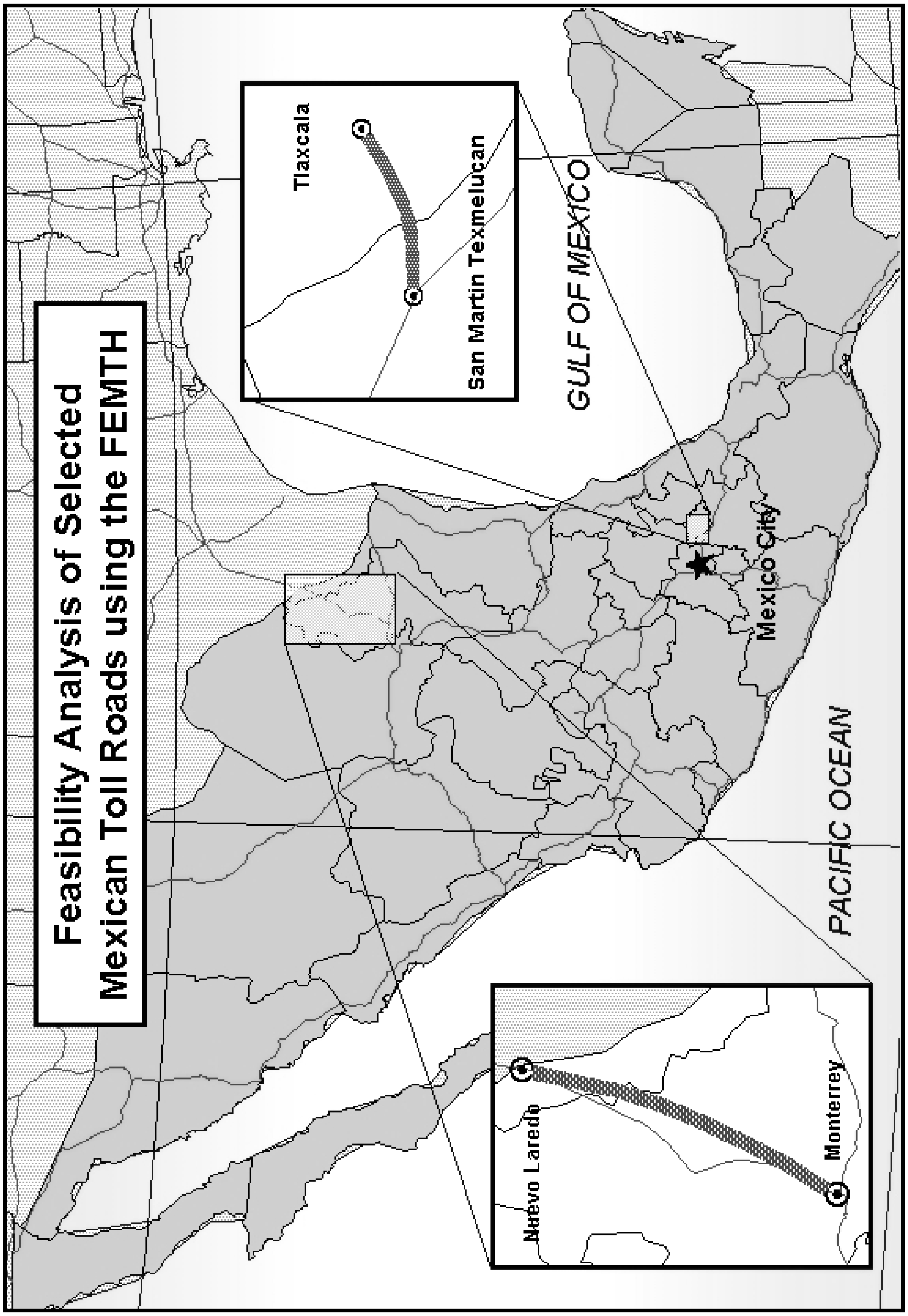


Fig. 8.1 Location of Toll Highway Cases Analyzed

ASSUMPTIONS

The following assumptions were made to enable the analysis considering the limited schedule and cost data available, as well as the several modifications that the concession agreements for these roads suffered during their early years. Most of the data, including cost and schedule data, was obtained or calculated from records kept by SCT for the years 1995-96 and other technical publications.

1. Both projects have not been constructed and the evaluation date is approximately during the first semester of 1996, since most of the data available is from late 1995 to early 1996.
2. The interest rate on borrowed funds is pegged to the prime rate. According to Ortega (Ortega, 1996), the Mazatlan–Culiacan toll highway, which was included in the rescue program, refinanced its debt converting it to US Dollars at an international interest rate of 9 percent. This took place approximately during late 1994 or early 1995, when the nominal prime rate fluctuated between 8.5 and 9 percent [see Appendix A].
3. The concession period is for 30 years after the original completion date. For tax purposes, the facility is fully depreciated during this period using the straight-line method.
4. The right of way and the detailed design are furnished by the SCT, and no toll revenue tax is levied on these projects.
5. The tolls used in the analysis are those prevailing approximately in the analysis period, just before the government rescued the roads in difficulties.
6. Because of the consistent controversy found in literature regarding the discount rate used for the NPV, two analyses were performed. One using a fixed discount rate and one more where the discount rate was modeled according to the PDF discussed in Chapter 6. The results of the second analysis are presented only for the purpose of comparison.

Some probability density functions and parameters were slightly changed from those mentioned in Chapter 6 in order to reflect the characteristics of the particular projects and reinforce the notion that subjective judgement is part of the risk analysis process. Other concession conditions not specifically addressed here follow the concepts discussed throughout this study and those applicable to the Mexican concession program and discussed in Chapter 7.

San Martin Texmelucan-Tlaxcala-El Molinito Toll Highway

The San Martin Texmelucan-Tlaxcala-El Molinito toll highway is located approximately 90 km east from Mexico City, in the states of Puebla and Tlaxcala. The four-lane 26-km road links the existing toll and toll free highways Mexico City-Puebla at the San Martin Texmelucan intersection, to the city of Tlaxcala, capital of the state of Tlaxcala. As in almost every case in the network, a two-lane toll free road already serves the route. The approximate travel time in the 35-km two-lane toll free road is 25 (0.41 hr) minutes, while in the 26-km four-lane toll road is 15 minutes (0.24 hr). Figure 8.2 shows the approximate geographic location of the project in greater detail.

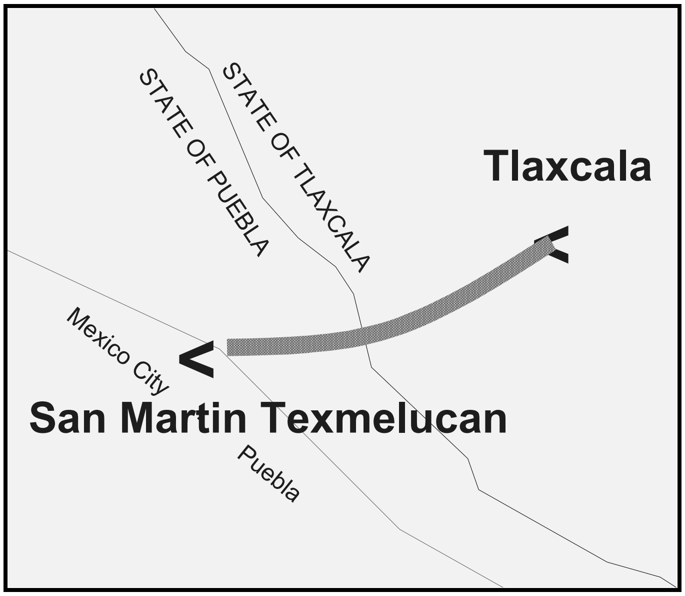


Fig. 8.2 San Martin Texmelucan-Tlaxcala-El Molinito Toll Highway

Analysis Input Data

This section describes in detail the input variables used in the analysis as well as the PDFs used to describe them in the analysis. A summary table is included at the end of this section.

Traffic and Tolls Data Section

Following the logic assumed by Orozco, the total route traffic considered for the analysis is the sum of the traffic using both, the toll and the toll free road. Table 8.1 presents the actual traffic data for both roads in the route as well as the tolls to be charged on each vehicle category. The actual toll road data will be compared later to the numbers yielded by the toll-traffic demand model.

Table 8.1 Actual Traffic Data for the San Martin Texmelucan-Tlaxcala-El Molinito Route

VEHICLE TYPE	FREE ROAD		TOLL ROAD†		TOTAL ROUTE		TOLL PRICES* (US$/km)
	ADT	Share	ADT	Share	ADT	Share	
Car	3,310	83.0%	2,278	74.0%	5,588	79.1%	0.08
Bus	159	4.0%	570	18.5%	729	10.3%	0.16
Truck	518	13.0%	231	7.5%	749	10.6%	0.22
TOTAL	**3,987**	**100.0 %**	**3,079**	**100.0 %**	**7,066**	**100.0 %**	

Sources: AMICO, IMT and Orozco (1996, 1997)
† Actual values; * 1 US$ = 7.8 Mexican Pesos (1996)

Based upon these tolls, the total traffic in the route and the characteristics of the road, the expected values for the traffic using the toll highway yielded by the toll-traffic demand model are as follows:

Table 8.2 Toll-Traffic Demand Model Predicted Traffic for Toll Highway

CATEGORY	EXPECTED ADT	ADT SHARE
Car	2,233	76.2%
Bus	408	13.9%
Truck	290	9.9%
TOTAL	2,931	100.0%

The numbers yielded by the toll traffic demand model are very close to the actual traffic. The total expected traffic is only 5 percent lower than the actual, and the variations in the categories are within reasonable limits. The uncertainty associated with these values is reflected within the FEMTH, using the PDFs built into the FEMTH and discussed in Chapter 6.

The traffic growth rate is assumed as varying uniformly between 0 and 5 percent annually, and with a consecutive yearly variation limited to ± 2 percent, as discussed in Chapter 6 as well. The concession period was set to 31 years, including the project execution stage.

Design and Construction Data Section

The construction cost and schedule data obtained for the project was limited to the original proposal and the final costs and completion dates. The project was bid at approximately US$14,230,000 and 9 months of execution. But as a consequence of additions and change orders the final cost climbed up to about US$22,000,000 and the execution schedule to 18 months (SCT & Zambrano, 1996, 1991). Thus, the project was finally about 57 percent above budget and with a schedule slippage of 100 percent.

Hence, the project construction cost was described with a PERT distribution with parameters US$14,230,000 as a minimum, US$17,000,000 (about 20 percent above) as an arbitrary most likely or middle point, and a maximum of US$22,000,000. The PERT distribution, shown in Figure 8.3, was chosen above the triangular only because a smooth PDF was desired.

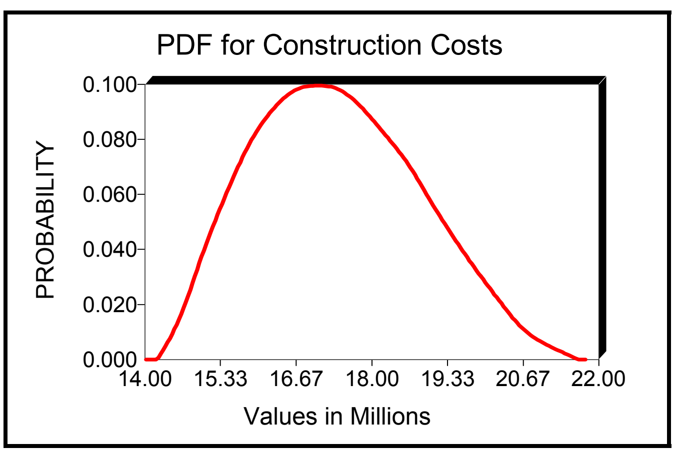


Fig. 8.3 Construction Cost PDF for the San Martin-Tlaxcala Project

On the other hand, the project schedule duration was also described as a PERT distribution, with parameters 9 months as a minimum, 12 months (about 33 percent above) as the most likely and 18 months as the maximum. Supervision costs were fixed at 3 percent of the project construction cost. Figure 8.4 depicts the PDF for the project schedule.

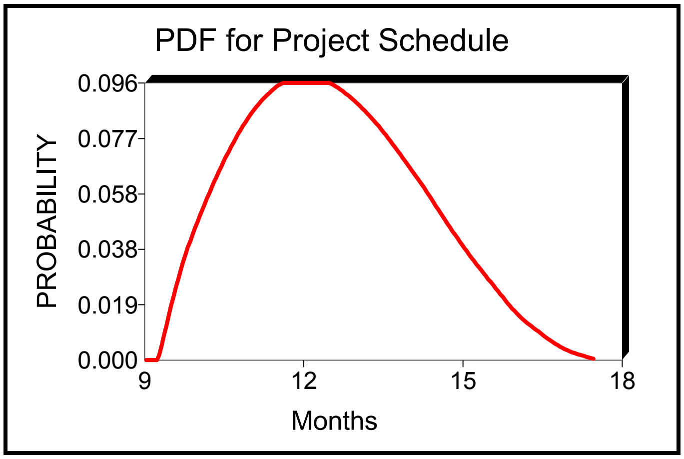


Fig. 8.4 Schedule PDF for the San Martin-Tlaxcala Project

Operation and Maintenance Data Section

Toll collection costs were described using a triangular distribution with parameters US$0.055, US$0.06, and US$0.09 per transaction.

The initial annual maintenance, rehabilitation and reconstruction costs were also described with a triangular distribution with parameters 2.5, 3 and 4 percent of the construction costs. The maximum value for this variable throughout the concession period discussed in Chapter 6 was changed from 5.2 to a 5 percent of the construction cost.

The administrative costs were described with a triangular PDF with the parameters set in Chapter 6, at 18, 22.5 and 25 percent of the operation and maintenance costs.

Financial Data Section

The capital structure of the San Martin Texmelucan-Tlaxcala-El Molinito is formed by 21 percent private capital, 24 percent capital from the government of the State of Tlaxcala, 4 percent from the federal government, and the remaining 51 percent through a bank loan. Since the governmental funds were not granted as subsidies, they are assumed as being equity funds.

The origination fee for the loan is set at a fixed 3 percent. The real prime interest rate in the quarter previous to the beginning of the analysis (late 1996) is around 5 percent (see Appendix A). Thus, the effective rate on the loan is set at 5 percent, expecting a long-term average of the real prime rate of 3.77 percent.

The discount rate used in the first analysis is fixed at 8.86 percent. A lognormal PDF with mean of 8.86 percent and a standard deviation of 23 percent describes the second discount rate used in the analysis, as described in Chapter 6.

Fiscal Data Section

From the list discussed in Chapter 6, the following taxes are applicable for the analysis. A corporate income tax of 34 percent, a presumptive income tax of 2 percent, a profit sharing tax of 10 percent, and a general value added tax of 15 percent. The depreciation period is 30 years.

Other Income

No data was available for this section.

User Input Data and Expected Values Summary Table

Table 8.3 summarizes the user data input, their PDFs where applicable, and the expected values for each variable as well as the results obtained by the FEMTH based on these expected values. Figure 8.5 illustrates the Input Form loaded with the project information and Figure 8.6 illustrates the Results Screen displaying information based upon the expected values for the project variables.

Table 8.3 User Input Data and Expected Values Summary Table

VARIABLE	@RISK FUNCTION (PDF)	EXPECTED VALUE
Total ADT in the corridor	N/A	7,060
Toll free road data:		
Travel time	N/A	0.41 hr
Car ADT share	N/A	79.1%
Bus ADT share	N/A	10.3%
Truck ADT share	N/A	10.6%
Concession period	N/A	31 years
Toll road data:		
Length	N/A	26 km
Travel time	N/A	0.24 hr
Car toll price	N/A	US$0.08/km
Bus toll price	N/A	US$0.16/km
Truck toll price	N/A	US$0.22/km
Traffic growth rate	RiskUniform(0%,5%)	2.5%
Toll-traffic demand results:		
Total traffic diverted to toll road	N/A	2,931
Car ADT share	N/A	76.2%
Bus ADT share	N/A	13.9%
Truck ADT share	N/A	9.9%
Design and construction:		
Project construction cost	RiskPert(14.2, 17.0, 22.0) (millions)	US$17.3x$10^6$
Supervision cost	N/A	3%
Project schedule duration	RiskPert(9, 12, 18)	13 months

VARIABLE	@RISK FUNCTION (PDF)	EXPECTED VALUE
Operation and Maintenance:		
Toll collection costs	RiskTriang(0.055,0.06,0.09)	US$0.068
Initial M,R&R costs	RiskTriang(2.5%,3%,4%)	3.17%
Maximum	N/A	5%
Administration Costs	RiskTriang(18%,22.5%,25%)	21.8%
Financial:		
Equity capital	N/A	49%
Debt capital	N/A	51%
Loan origination fee	N/A	3%
Initial interest rate	N/A	5%
Initial real reference rate	N/A	5%
Expected long term avg. rate	N/A	3.77%
Discount rate (fixed)	N/A	8.86%
Discount rate (variable)	RiskLognorm(8.86%, 23%)	8.86%
Fiscal		
Corporate marginal income tax	N/A	34%
Presumptive income tax	N/A	2%
Profit sharing tax	N/A	10%
General value added tax	N/A	15%
Depreciation Period	N/A	30 years
Financial Analysis Results		
Project NPV	N/A	**US$712,167**
Project IRR	N/A	**9.24%**
Equity NPV	N/A	**US$2,251,817**
Equity IRR	N/A	**10.45%**

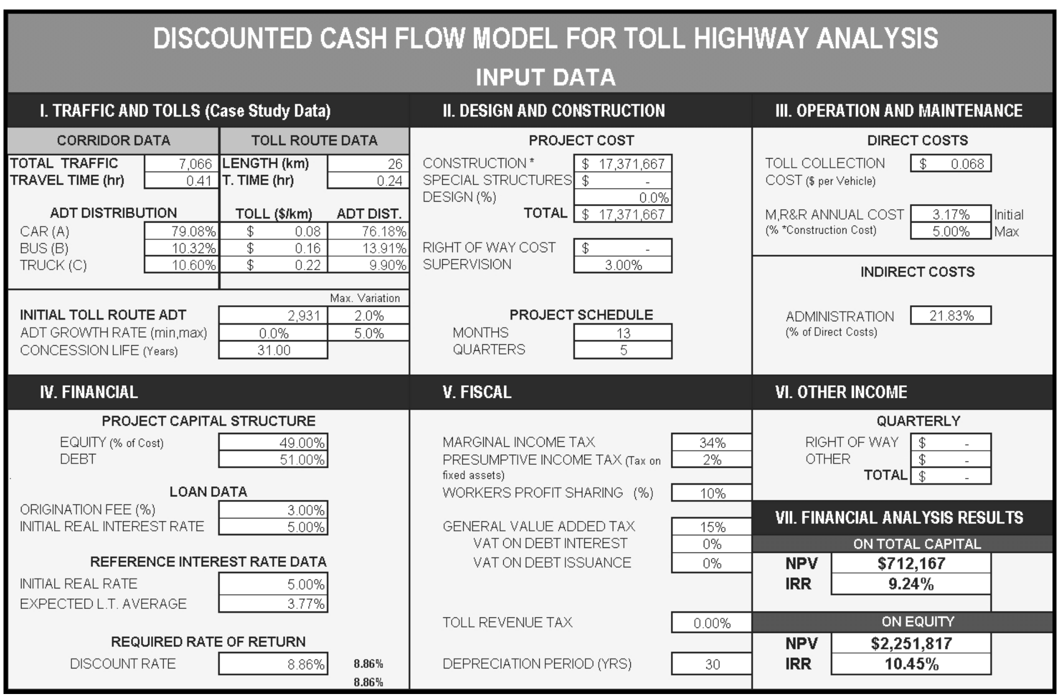


Fig. 8.5 Input Form for the San Martin Texmelucan-Tlaxcala-El Molinito Toll Highway

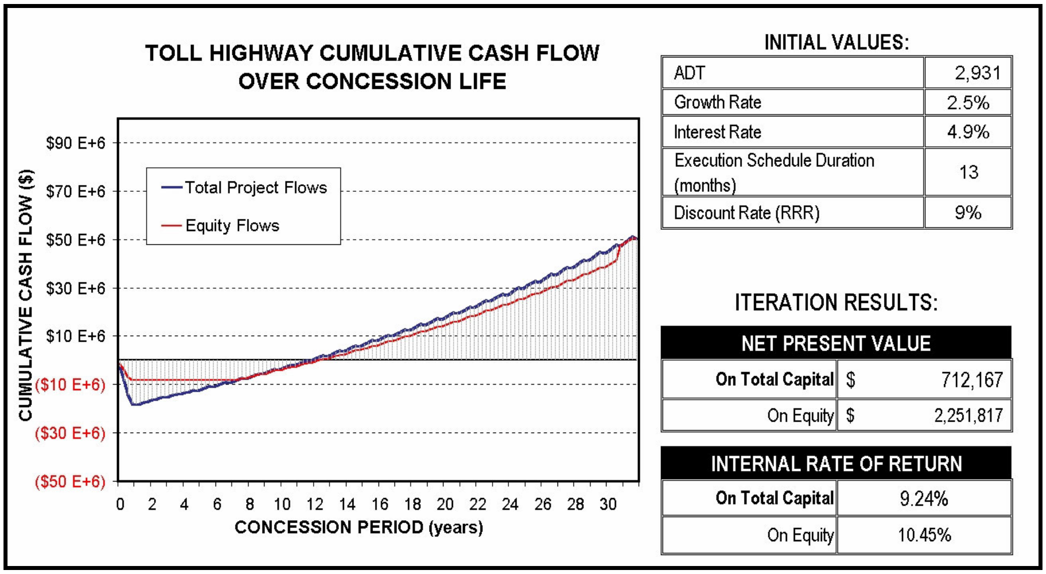


Fig. 8.6 Results Screen for the San Martin Texmelucan-Tlaxcala-El Molinito Toll Highway with Expected Input Values

Risk Analysis Results

The computer simulation is the easiest operation of the entire risk analysis. Once the input data is loaded in the form, the risk analysis was carried out. The spreadsheet cells corresponding to the FEMTH objective functions, the NPV and the IRR for both, the project and equity cash flows were added as @RISK output variables and the simulation run. The PDFs modeled in the analysis for the ADT and ADT distribution, calculated based upon the toll-traffic demand model were also illustrated for this case study. In addition, to illustrate the interest rate modeling technique used and the PDFs modeled, the cells corresponding to the interest rates for the first 40 quarters (10 years) of the project life were also added as @RISK outputs.

The analysis consisted of two simulations. The first one was carried out using a fixed discount rate for the NPV analysis. In the second, the interest rate was modeled using the PDF discussed earlier. Each simulation consisted of 2000 iterations performed on a total of 291 input variables, considering that the traffic growth rate and interest rates are modeled for each quarter. After this number of iterations the sample was considered as being statistically significant, since the average percent change in the mean and standard deviation obtained for the output variables was less than 1.5 percent.

ADT and ADT distribution

Figures 8.7 and 8.8 illustrate the PDFs of the total initial ADT and the ADT distribution for the three vehicle categories modeled by the FEMTH using the toll-traffic demand model developed by Orozco, and their individual PDFs applied in the analysis. According to Figure 8.7, The simulated initial ADT traffic has a mean of 2,905 and a standard deviation of 402 vehicles per day, a little lower than the 2,931 calculated with the expected values. The figure also shows that the range goes from a minimum of about 2,000 to a maximum of about 4,700 vehicles per day.

Figure 8.8 shows that the mean car traffic share is 76.6 percent, with a standard deviation of 6.4 percent, a minimum of 52 and a maximum of 89. Bus traffic share has a mean of 14.1 percent, a standard deviation of 3.3 percent, and range between 6 and 27 percent, while truck traffic share has a mean of 9.3 percent, standard deviation of 6.5 percent and range between 1.6 and 38 percent.

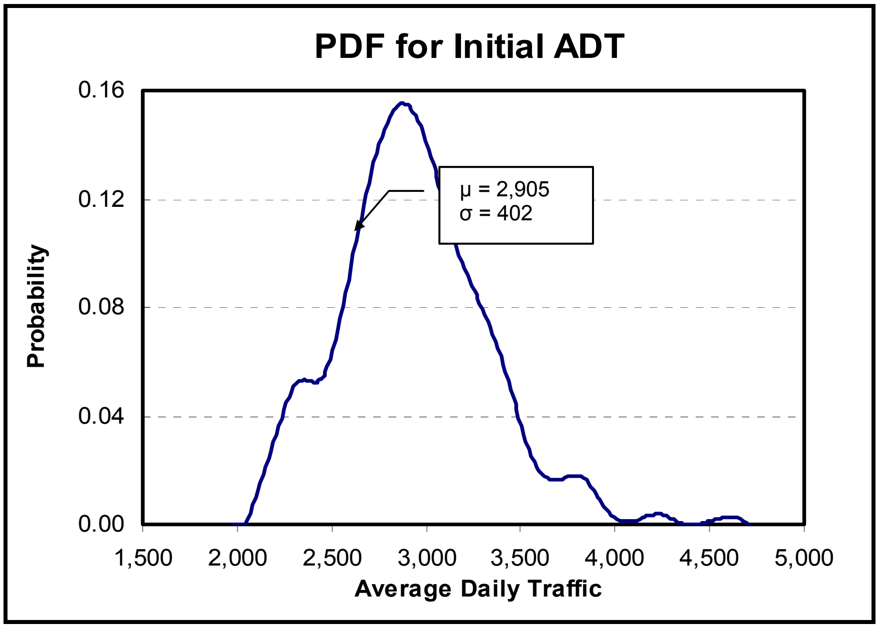


Fig. 8.7 PDF for initial ADT in the San Martin Texmelucan-Tlaxcala-El Molinito Toll Road Project

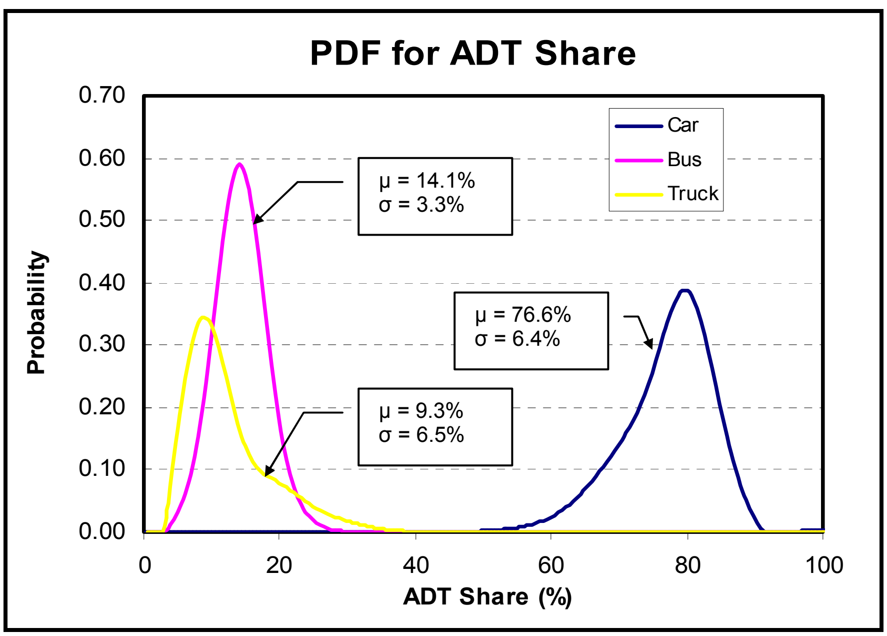


Fig. 8.8 PDF for ADT distribution in the San Martin Texmelucan-Tlaxcala-El Molinito Toll Road Project

Modeling Interest Rates for the Project

This section illustrates the interest rates modeled for the project during the simulation process. As stated earlier, the interest rate for the project debt was assumed as being pegged to the prime rate plus zero points, that is, the pure prime rate. The real rate at project start was set at 5 percent, and the long-term average of the real prime rate as 3.77 percent. As Figure 8.9 below shows, albeit the interest rate value starts at 5 percent, the periodic mean value of the interest rate tends to gradually reach the average of 3.77 percent, varying according to the Cox-Ingersoll-Ross model discussed in Chapter 6.

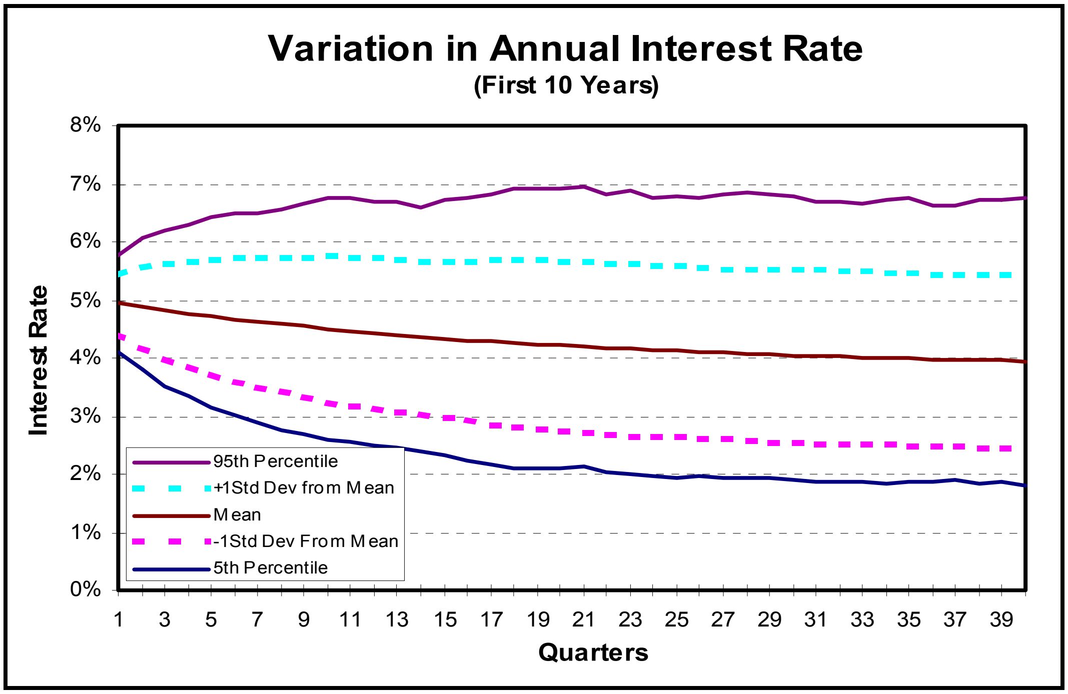


Fig. 8.9 Interest Rates Modeled for the San Martin Texmelucan-Tlaxcala-El Molinito Toll Road Project

During the simulation process, the computer takes samples around this mean, forming a PDF for the interest rate for each specific quarter. As the quarter being analyzed gets farther in time from the project start, the mean interest rate tends to reach 3.77 percent, but its range also starts to increase, going from as low as zero to as high as about 12 percent, reflecting the increasing uncertainty about future interest rates. The highest prime interest rate researched for this study was a 9.99 percent in June of 1991 [See Appendix A]. According to the simulation statistics, the highest recorded in the analysis was of 11.7 percent in the 25th quarter (6th year) of the project life. Figure 8.10 illustrates the resulting PDFs for the interest rate in the 1st, 12th and 40th quarters of the project life.

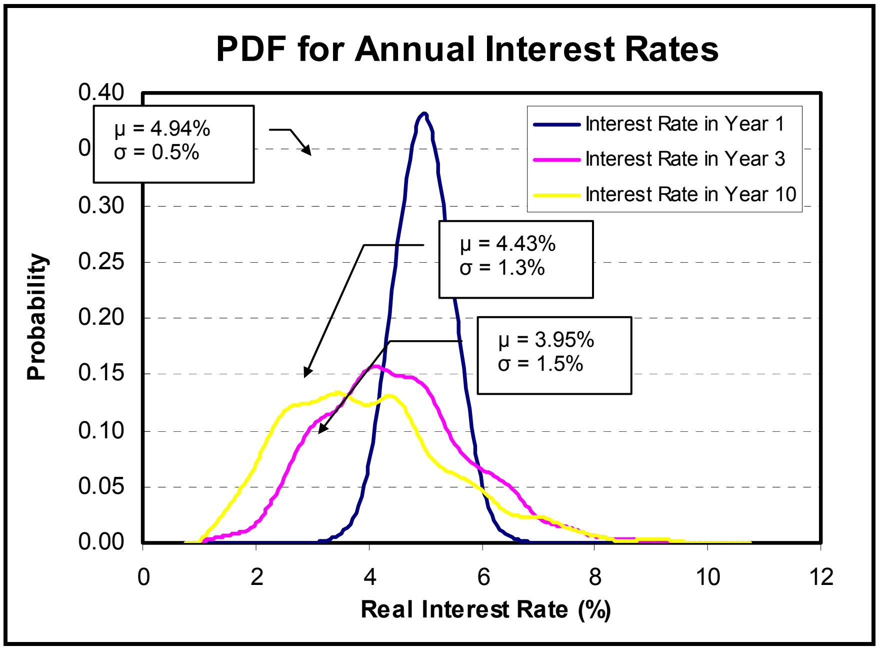


Fig. 8.10 PDF for Interest Rates Modeled for the San Martin Texmelucan-Tlaxcala-El Molinito Toll Road Project (Quarters1, 12 and 40)

Net Present Value Analysis

The deterministic NPV analysis carried out with the expected values for each variable yielded a NPV of US$712,167 for the total project cash flows, and $2,251,817 for the equity cash flows. Following traditional NPV analysis rules, this project would be ranked as good, since it meets the requirement of having a positive NPV. But, what are the probabilities of the project achieving this result?

The results of the NPV risk analysis for the project and equity cash flows are summarized in Figures 8.11, 8.12, 8.13, 8.14 and 8.15. The detailed statistics and output of the analysis are included in Appendix G.

Figure 8.11 compares the PDF for the project's NPV calculated with both, the fixed and the variable discount rate. Using a fixed discount rate the NPV of the project cash flows has mean of US$842,217 and a standard deviation of US$4,429,869, (about 30 percent of the initial project cost). On the other hand, using a lognormally distributed varying discount rate, the mean project NPV goes up to US$18,773,520 with a standard deviation of US$20,885,430, which is very high and extremely disperse.

The use of a variable discount rate in the NPV analysis certainly adds up to the uncertainty surrounding the project and generates little additional information. The concept of a variable discount rate is very abstract and can be arguable. The difficulty implied by the discount rate per se is considered one of the shortcomings of the NPV method. However, an extensive discussion on the topic is out of the scope of this report and the results are presented here only to illustrate its effects in the analysis.

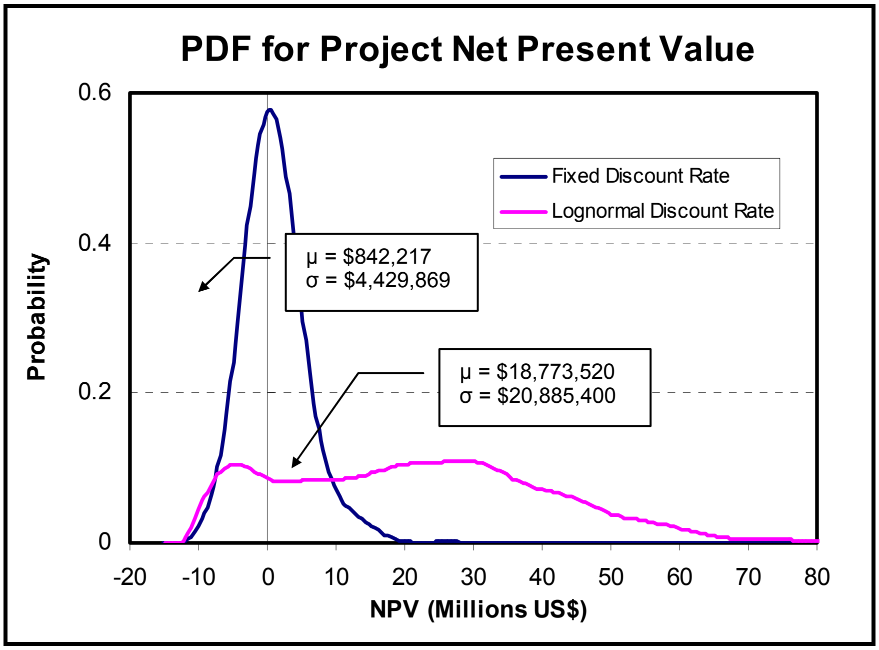


Fig. 8.11 PDF for NPV of the San Martin Texmelucan-Tlaxcala-El Molinito Toll Road Total Project Cash Flows

Cumulative distribution functions (CDF), such as the one shown in Figure 8.12 are more explicit. Because the scale in this chart is not very accurate, Figure 8.13 provides a scaled detail of the same data. Along the x-axis are the NPVs and along the y-axis the probability that these NPVs will not be exceeded. For example, using the fixed discount rate there is about a 55 percent probability that the NPV will be greater than zero. On the other hand, when using the variable discount rate the probability is 75 percent. The curve can also be used to determine the probability that the NPV will fall within a given range by taking the difference along the ordinate of the two extreme points of the range. For example, there is about a 20 percent chance that the NPV will be between US$1 and US$3 million dollars (using the fixed discount rate). The figure also shows that the probability of getting a NPV inferior to US$712,167, the NPV obtained using the conventional analysis using the expected values for each variable, is about 50 percent, and the probability of getting above this figure is also about 50 percent. In other words, the PDF of the NPV is close to a normal distribution, which is logical according to the Central Limit Theorem.

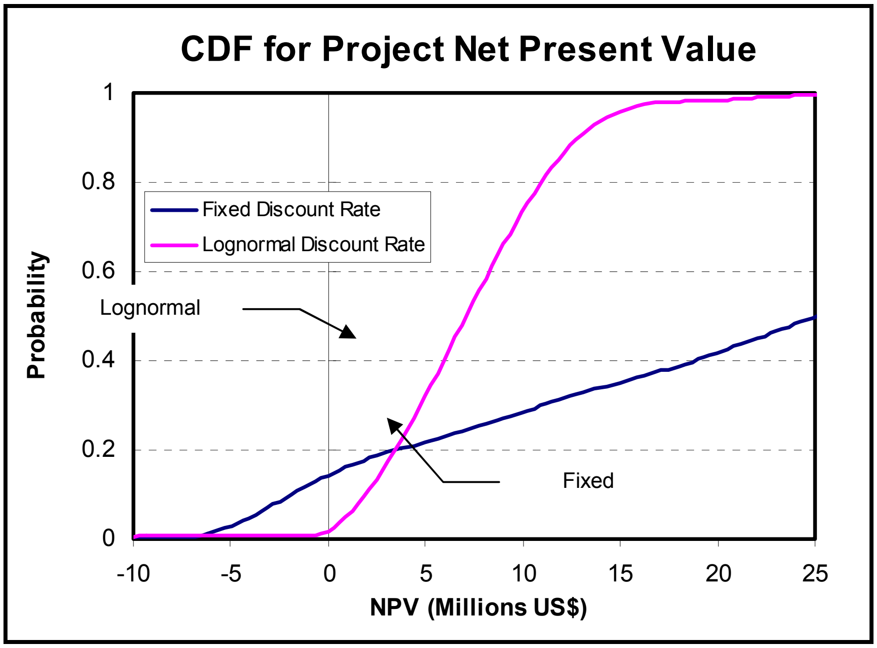


Fig. 8.12 CDF for NPV of the San Martin Texmelucan-Tlaxcala-El Molinito Toll Road Total Project Cash Flows

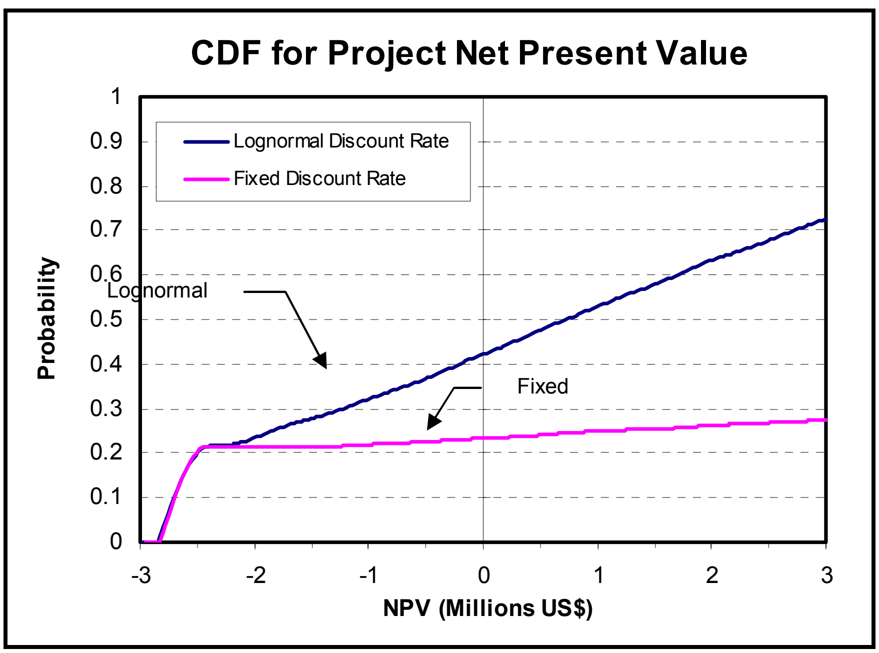


Fig. 8.13 CDF for NPV of the San Martin Texmelucan-Tlaxcala-El Molinito Toll Road Total Project Cash Flows (Detail)

However, examining the project from the point of view of the NPV of cash flows to equity, the figures are more favorable due to the leveraging of equity with borrowed funds. Figure 8.14 compares the PDF for the project and equity cash flows using a fixed discount rate.

The NPV of the flows to equity has a mean of US$2,413,932 and a standard deviation of US$3,765,930. That is, the PDF is tighter and with a higher mean than the PDF for the project NPV.

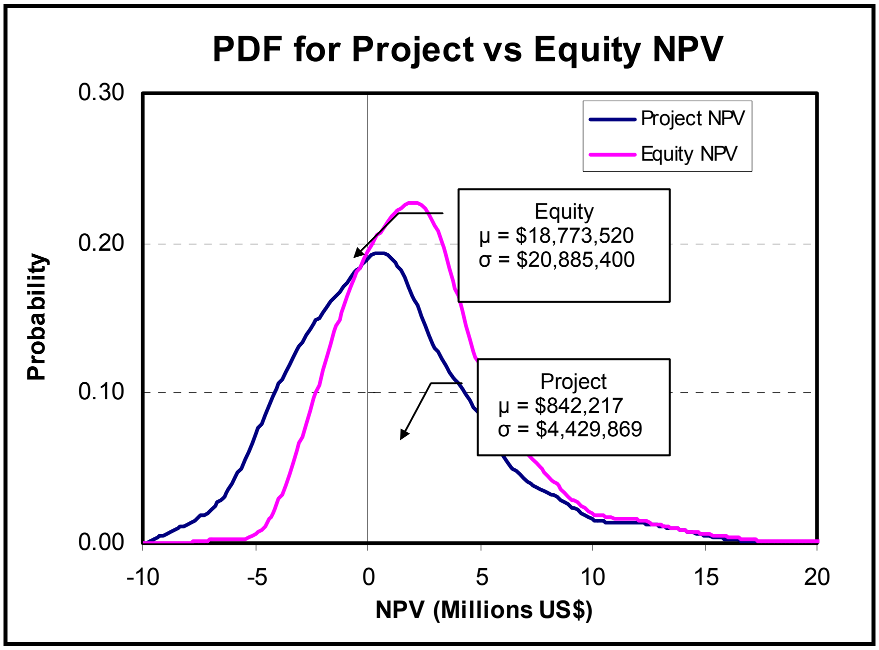


Fig. 8.14 PDF for NPV of the San Martin Texmelucan-Tlaxcala-El Molinito Project vs. Equity Cash Flows

Figure 8.15 shows a detail of the CDF for the analysis that provides more additional information. For example, there is about a 75 percent probability that the NPV will be greater than zero compared to 55 percent for the project, and there is about a 40 percent chance that the equity flows NPV will be between US$1 and US$4 million dollars. The probability of getting a NPV inferior to US$2,251,817, the NPV obtained in the deterministic analysis, is about 48 percent, and the probability of getting above this number is about 52 percent.

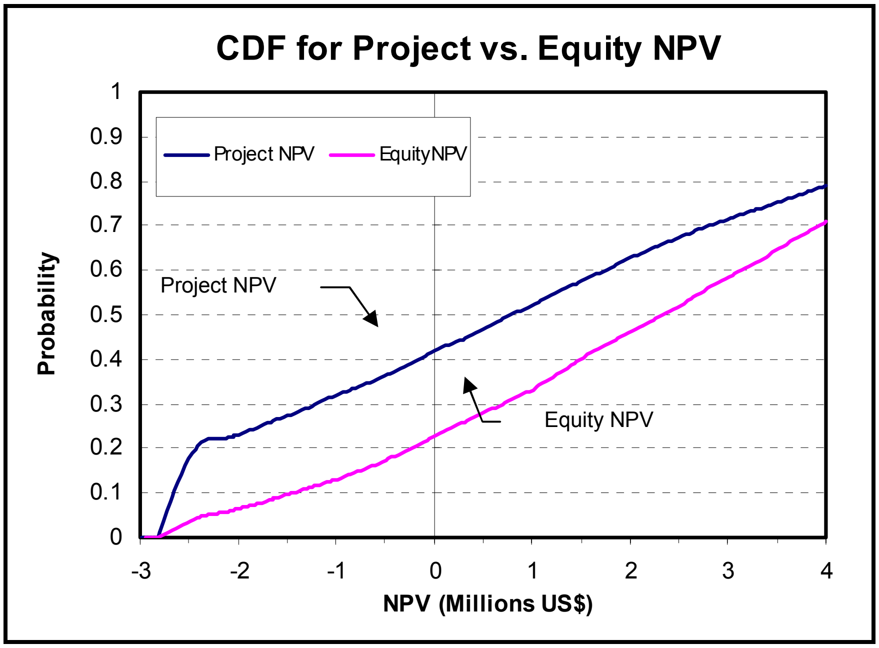


Fig. 8.15 CDF for NPV of the San Martin Texmelucan-Tlaxcala-El Molinito Project vs. Equity Cash Flows (Detail)

At first glance, from the project point of view, the results of the NPV risk analysis seem to indicate that the highway is a risky venture, since it has a high probability of not reaching a positive NPV (45 percent). However, from the point of view of the equity investor, the project may still prove to be worthwhile. The internal rate of return analysis presented next provides additional insight on the project's risk.

Internal Rate of Return Analysis

The IRR analysis carried out with the expected values for each variable yielded an IRR of 9.24 percent for the total project cash flows, and 10.45 percent for the equity cash flows. According to the traditional IRR rules, this project would be ranked as good, since it meets the requirement of having an IRR higher than the RRR of 8.86 percent specified in Chapter 6.

The results of the risk analysis for the IRR of the project and equity cash flows are summarized in Figures 8.16, 8.17 and 8.18. The detailed statistics and output of the analysis are also included in Appendix G.

Figure 8.16 compares the PDFs of the IRR for both, the project and equity cash flows. The IRR for the project has mean of 9.26 percent and a standard deviation of 2.3 percent, while the IRR for equity cash flows has a mean of 10.48 percent and a slightly higher standard deviation of 2.5 percent.

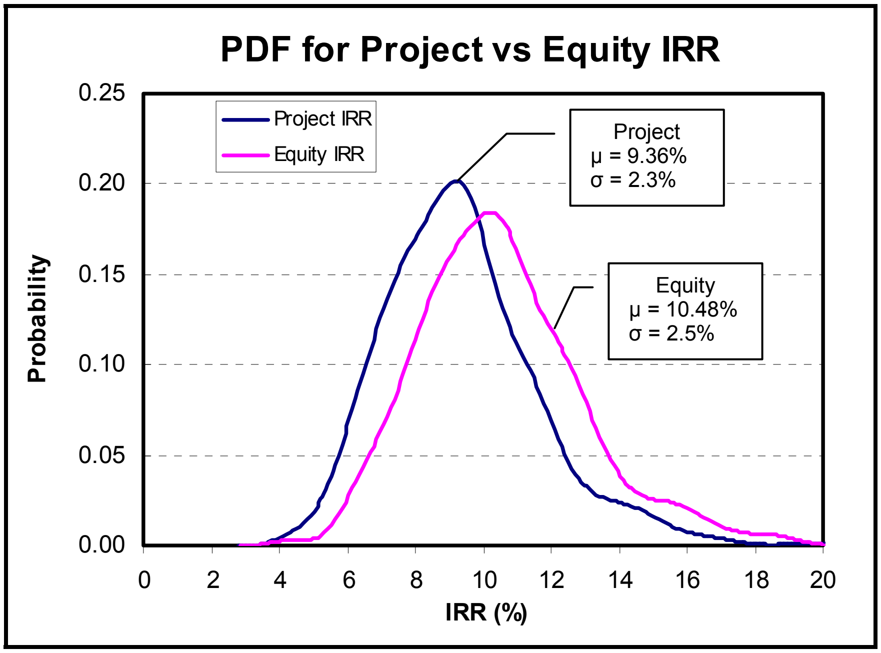


Fig. 8.16 PDF for IRR of the San Martin Texmelucan-Tlaxcala-El Molinito Project vs. Equity Cash Flows

The same chart but in a CDF format is shown in Figure 8.17 and Figure 8.18 depicts the scaled detail of the same data. The figure shows that there is about a 60 percent probability that the project IRR will be greater than the RRR and a 77 percent probability for the equity IRR. Besides, the probability of the project achieving an IRR inferior to 9.2 percent, the rate obtained using the deterministic analysis, is about 46 percent, while the probability of reaching the IRR of 10.45 percent for the equity flows is about 48 percent.

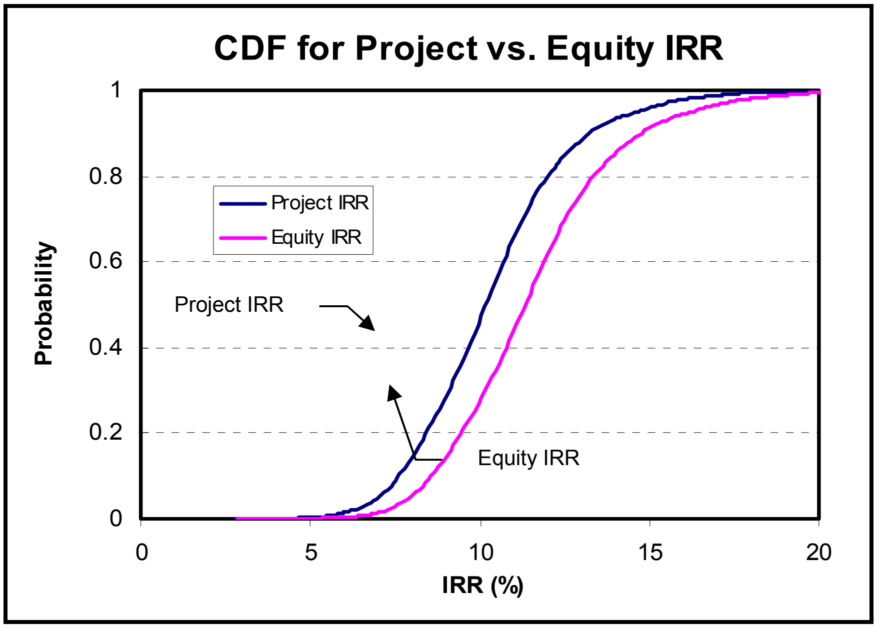


Fig. 8.17 CDF for IRR of the San Martin Texmelucan-Tlaxcala-El Molinito Project vs. Equity Cash Flows

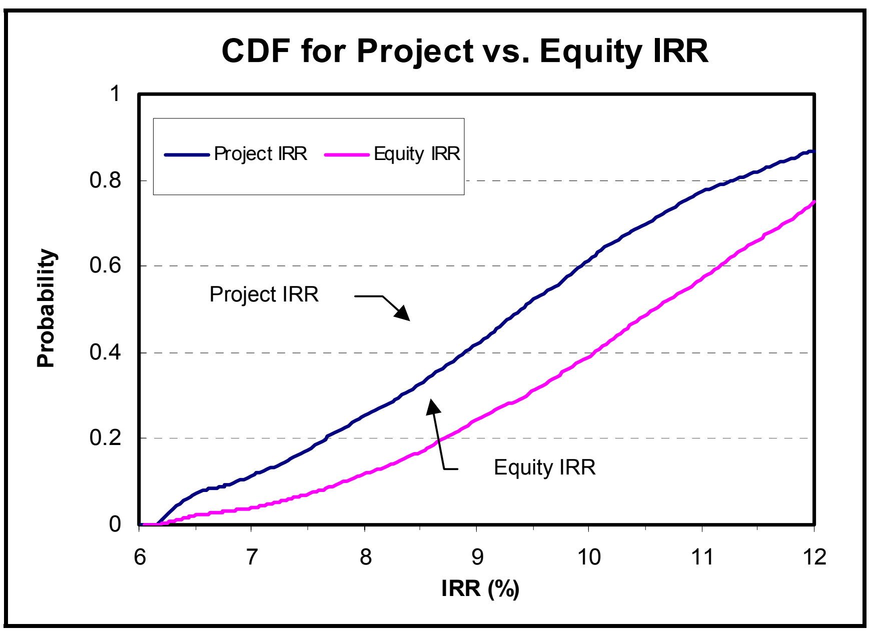


Fig. 8.18 CDF for IRR of the San Martin Texmelucan-Tlaxcala-El Molinito Project vs. Equity Cash Flows (Detail)

The detailed statistics of the analysis in Appendix G show that at the 5th percentile the IRR is almost 6 percent for the project and 6.8 percent for the equity invested. Therefore the probability of getting a return inferior to 6 percent is very slim, for both, the project and the equity invested. This information provides additional insight about project risk to any decision-maker regardless of his/her particular RRR.

Sensitivity and Scenario Analyses

Once the amount of risk associated with the project was measured, the variables that have the strongest influence in the overall project outcome and the combination of these variables that contribute significantly towards reaching or not reaching the project goals were identified using @RISK sensitivity and scenario analyses capabilities. Based upon this information, the decision-maker can determine whether the risk associated with these variables is manageable or not. The possibility of implementing risk mitigation and control measures on the project critical variables can significantly reduce its overall risk and increase the probability of a successful project outcome.

An IRR sensitivity analysis was carried out for the total project cash flows using @RISK multivariate stepwise regression analysis. The results of the analysis are summarized in Figure 8.19, which depicts a tornado diagram with the normalized regression coefficients associated with each variable. The R^2 value for the regression equation was 0.99, indicating a linear relationship between the variables and the project IRR.

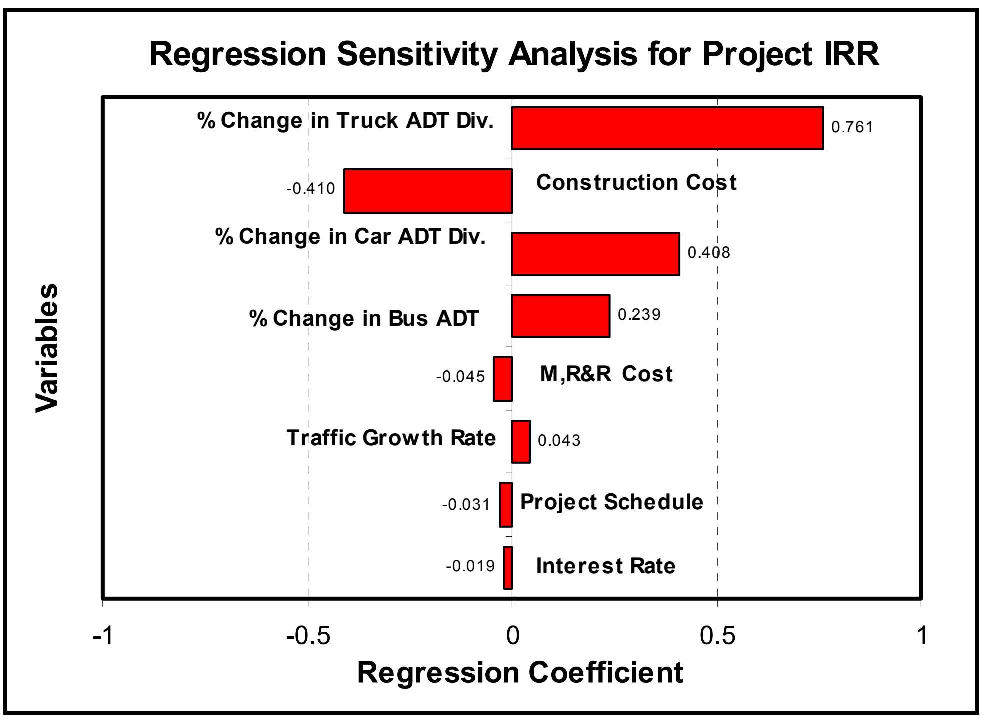


Fig. 8.19 Project IRR Regression Sensitivity Analysis of the San Martin Texmelucan-Tlaxcala-El Molinito Toll Highway

The results show that the most critical variables are the percent change in the amount of traffic diverted to the facility on its three categories and the project construction costs. On the other hand, initial maintenance costs, traffic growth rate, project schedule and interest rates have a very low regression coefficient, and operation and administration costs do not even appear in the diagram.

Based upon the critical variables, two scenarios were calculated for the project IRR. The first one is a desirable scenario, and corresponds to a target of an IRR higher than the 75th percentile, that is, higher than 10.52 percent. The combination of variables that contributes significantly towards reaching this number is:

- Construction cost on or below US$16,541,940 (about the 32nd percentile).
- Percent change in predicted car ADT diverted from the toll free highway on or above –3.73 percent (about the 68th percentile from a range between –40 and +15 percent).
- Percent change in predicted truck ADT diverted from the toll free highway on or above 100 percent (about the 84th percentile from a range between –83 and +200 percent)

The second, an unfavorable scenario, corresponds to a project IRR below the 25th percentile, that is, equal or lower than 7.7 percent. The combination of significant variables for this target is as follows:

- Construction costs on or above US$18,189,650 (about the 71st percentile).
- Percent change in predicted car ADT diverted from the toll free highway on or below –19.82 percent (about the 25th percentile)

Summary of Analysis Results

It may be concluded that considering solely the equity investor standpoint, the FEMTH indicates that the risk associated with the San Martin Texmelucan-Tlaxcala-El Molinito toll road may still be within reasonable limits. However, from a project point of view, the risk may seem quite high, and obtaining debt finance at a favorable rate may be difficult.

As far as the actual project turnout and the decision of not including it in the SCT rescue program, we may say that it coincides to some extent with the results of this analysis. Although the project construction costs were actually on the upper boundary, the uncertainty about the amount of traffic deviated to the facility is now gone, since the project is currently operating. Besides, the fact that different levels of government are involved as equity investors favors obtaining a favorable debt interest rate. In addition, considering the location of the project and the potential for growing commuter traffic to Mexico City, chances are the actual average traffic growth will be higher than the values assumed for this analysis.

MONTERREY-NUEVO LAREDO TOLL HIGHWAY

The Monterrey-Nuevo Laredo toll highway is located for the most part in the northern state of Nuevo Leon. The four-lane 146-km road links the city of Monterrey at its outskirts, with the four-lane section of the toll free Federal highway 85, about 30 km south from the city of Nuevo Laredo, in the Mexico-US border. The two-lane section of highway 85 serves the same route, with a length of 231 km, for an average travel time of 2.54 hrs, while in the toll road the approximate travel time is 1.33 hrs. Figure 8.20 shows a detail of the approximate geographic location of the project.

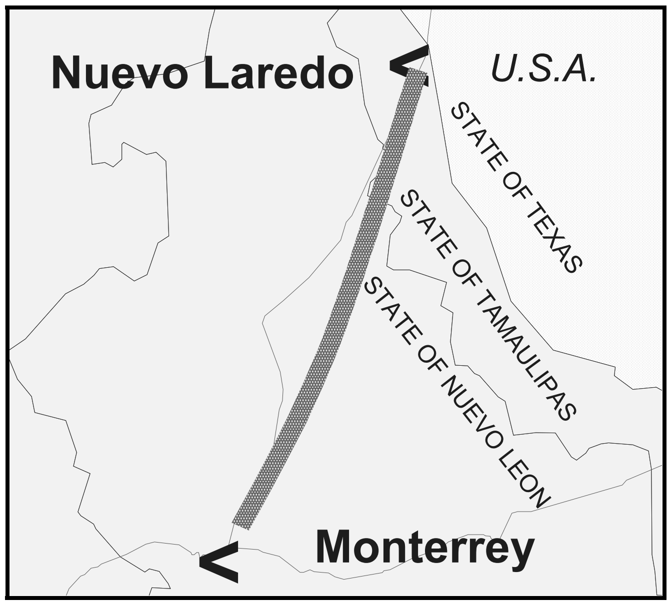


Fig. 8.20 Monterrey-Nuevo Laredo Toll Highway

The analysis carried out for this case is only briefly explained, since the logic for interpreting the results was already introduced in the San Martin Texmelucan-Tlaxcala-El Molinito case study.

Analysis Input Data

This section describes only the input variables and PDFs that changed from the previous project. The rest of the variables are assumed to keep the same values. The summary table listing of all the variables is included at the end of this subsection.

Traffic and Tolls Data Section

Table 8.4 presents the actual traffic data for both roads in the route and the tolls to be charged on each vehicle category.

Table 8.4 Actual Traffic Data for the Monterrey-Nuevo Laredo Route

VEHICLE TYPE	FREE ROAD		TOLL ROAD†		TOTAL ROUTE		TOLL PRICES* (US$/km)
	ADT	Share	ADT	Share	ADT	Share	
Car	3,834	83.8%	2,584	85.0%	6,418	84.3%	0.08
Bus	156	3.4%	243	8.0%	399	5.2%	0.14
Truck	586	12.8%	213	7.0%	798	10.5%	0.26
TOTAL	**4,576**	**100.0 %**	**3,040**	**100.0 %**	**7,615**	**100.0 %**	

Sources: AMICO, IMT and Orozco (1996, 1997)
† Actual values; * 1 US$ = 7.8 Mexican Pesos (1996)

Hence, the expected values for the traffic using the toll highway yielded by the toll-traffic demand model are the following:

Table 8.5 Toll-Traffic Demand Model Predicted Traffic in Toll Highway

CATEGORY	EXPECTED ADT	ADT SHARE
Car	2,521	84.4%
Bus	227	7.6%
Truck	240	8.0%
TOTAL	2,988	100.0%

The numbers yielded by the toll traffic demand model in this case are also very close to the actual traffic. The total expected traffic is only around 2 percent lower than the actual, and the variations in the categories are also very low. The assumed concession period is 32 years, to allow for a project execution stage of two years.

Design and Construction Data Section

The construction cost and schedule data obtained for the project was also limited to the original proposal and the final costs and completion dates. The project was bid at approximately US$141,538,462 and 20 months of execution, the final cost was about US$168,589,749 and the execution schedule was about 21 months (SCT & Zambrano, 1996, 1991).

Thus, the project construction cost was again described using a PERT distribution, with parameters US$141,538,500 as a minimum, US$167,000,000 (about 20 percent above) as the most likely value, and a maximum of US$168,589,000. The resulting PDF is shown in Figure 8.21 below.

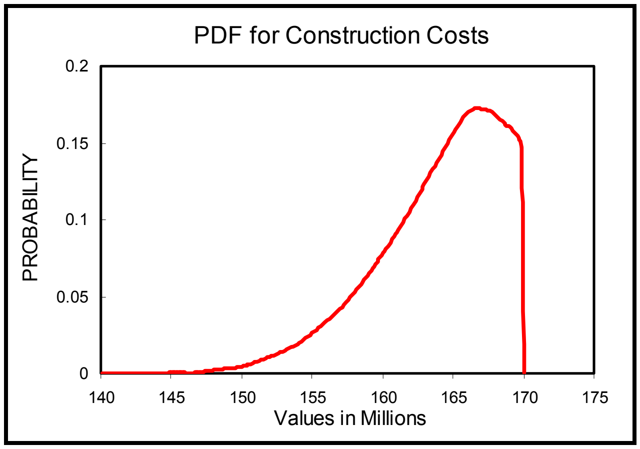


Fig. 8.21 Construction Cost PDF for the Monterrey-Nuevo Laredo Project

On the other hand, the project schedule duration was assumed as a PERT distribution with parameters 19 months as a minimum, 21 months as the most likely and 23 months as the maximum, as depicted in Figure 8.22.

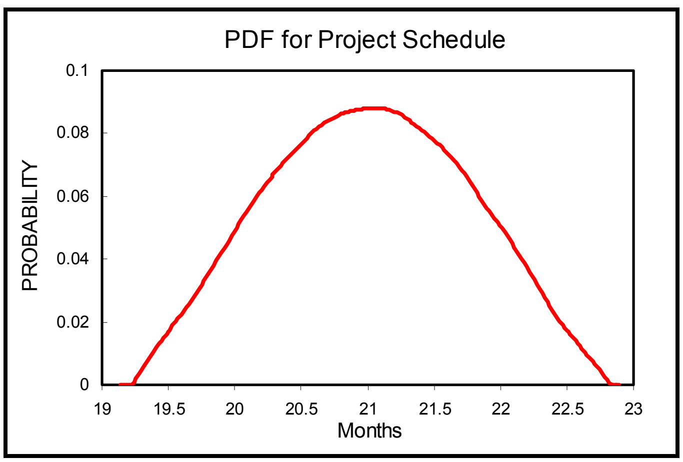


Fig. 8.22 Schedule PDF for the San Martin-Tlaxcala Project

Financial Data Section

The capital structure of the Monterrey-Nuevo Laredo consists of 25 percent private capital, another 25 percent from the federal government through PEMEX, the state owned national oil company, and the remaining 50 percent was obtained through a bank loan. The government capital is also considered equity capital in the analysis.

User Input Data and Expected Values Summary Table

Table 8.6 summarizes the user data input for the project, the PDFs where applicable, the expected values for each variable, and the results obtained by the FEMTH based upon these values. Figure 8.23 illustrates the Input Form loaded with the project information and Figure 8.24 illustrates the Results Screen displaying information based upon the expected values for the project variables.

Table 8.6 User Input Data and Expected Values Summary Table

VARIABLE	@RISK FUNCTION (PDF)	EXPECTED VALUE
Total ADT in the corridor	N/A	7,615
Toll free road data:	N/A	32 years
Travel time	N/A	2.54 hr
Car ADT share	N/A	84.3%
Bus ADT share	N/A	5.2%
Truck ADT share	N/A	10.5%
Concession period	N/A	32 years
Toll road data:		
Length	N/A	146 km
Travel time	N/A	1.33 hr
Car toll price	N/A	US$0.08/km
Bus toll price	N/A	US$0.14/km
Truck toll price	N/A	US$0.26/km
Traffic growth rate	RiskUniform(0%,5%)	2.5%
Toll-traffic demand results:		
Total traffic diverted to toll road	N/A	2,988
Car ADT share	N/A	84.4%
Bus ADT share	N/A	7.6%
Truck ADT share	N/A	8.0%
Design and construction:		
Project construction cost	RiskPert(141.5, 167.0, 168.6)x10^6	US$163x$10^6$
Supervision cost	N/A	3%
Project schedule duration	RiskPert(9, 12, 18)	21 months
Operation and Maintenance:		
Toll collection costs	RiskTriang(0.055,0.06,0.09)	US$0.068
Initial M,R&R costs	RiskTriang(2.5%,3%,4%)	3.17%
Maximum	N/A	5%
Administration Costs	RiskTriang(18%,22.5%,25%)	21.8%
Financial:		
Equity capital	N/A	50%
Debt capital	N/A	50%
Loan origination fee	N/A	3%
Initial interest rate	N/A	5%
Initial real reference rate	N/A	5%
Expected long term avg. rate	N/A	3.77%
Discount rate (fixed)	N/A	8.86%
Discount rate (variable)	RiskLognorm(8.86%, 23%)	8.86%

VARIABLE	@RISK FUNCTION (PDF)	EXPECTED VALUE
Fiscal		
Corporate marginal income tax	N/A	34%
Presumptive income tax	N/A	2%
Profit sharing tax	N/A	10%
General value added tax	N/A	15%
Depreciation Period	N/A	30 years
Financial Analysis Results		
Project NPV	N/A	**US$712,167**
Project IRR	N/A	**9.24%**
Equity NPV	N/A	**US$2,251,817**
Equity IRR	N/A	**10.45%**

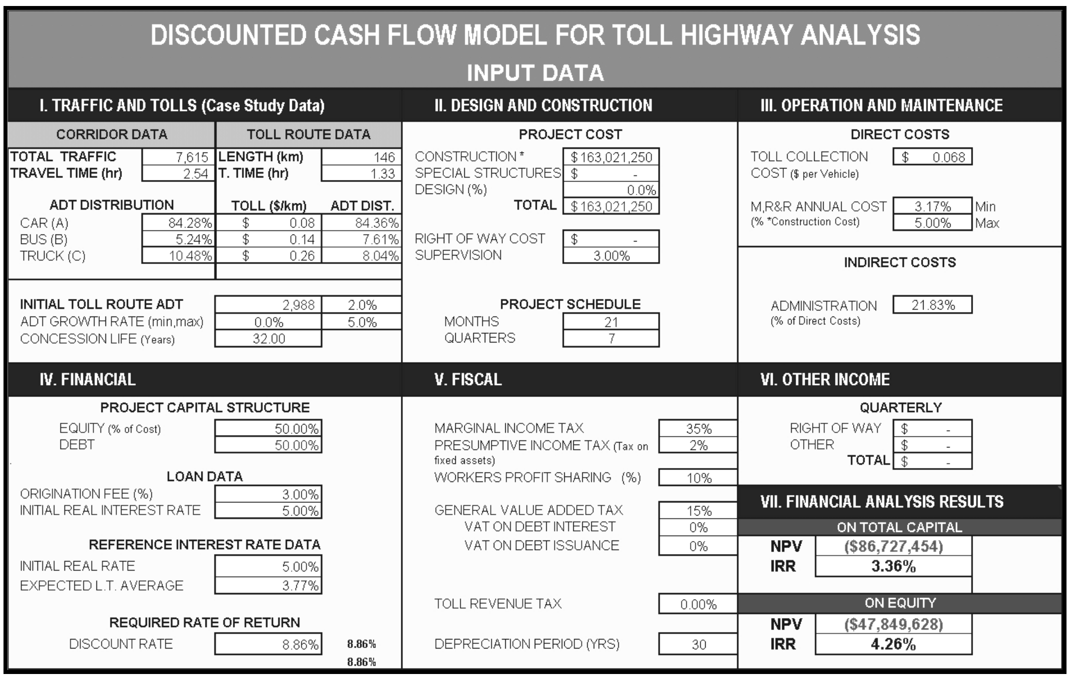


Fig. 8.23 Input Form for the Monterrey-Nuevo Laredo Toll Highway

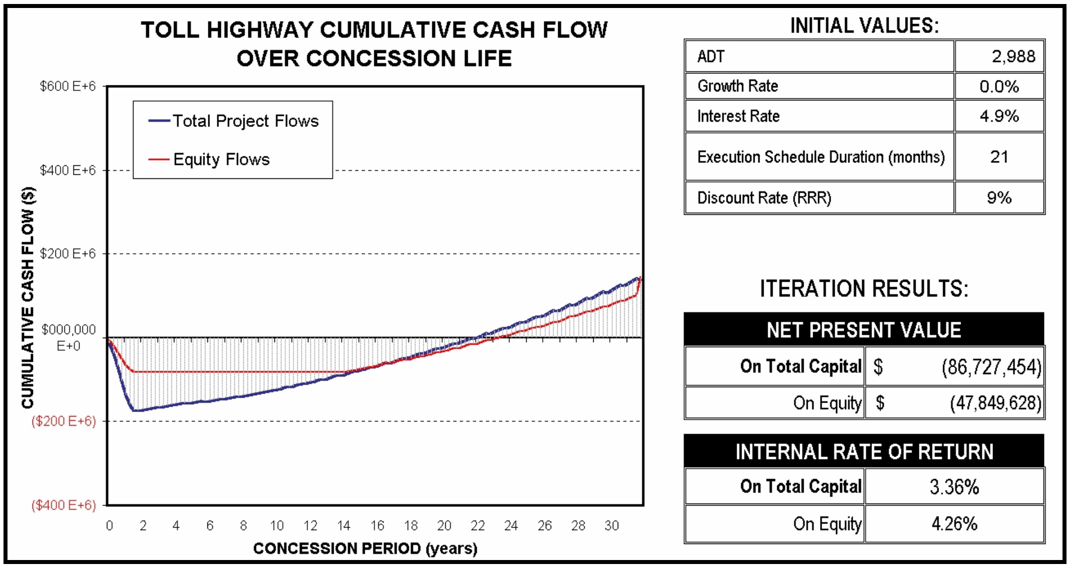


Fig. 8.24 Results Screen for the Monterrey-Nuevo Laredo Toll Highway with Expected Input Values

Risk Analysis Results

The risk analysis run for this project was essentially identical to the analysis of the San Martin Texmelucan-Tlaxcala-El Molinito highway. The detailed statistics and results of the analysis for both, the NPV and the IRR are also included in Appendix G. For the sake of conciseness, the results presented in this section are limited only to the IRR, which provides a more general measure for the project outcome.

The IRR analysis carried out with the expected values for each variable yielded an IRR of 3.36 percent for the total project cash flows, and 4.26 percent for the equity cash flows. These values are totally below the RRR of 8.86 percent. Thus, the deterministic analysis already indicates that the project does not meet the specified profitability requirements.

Figure 8.25 compares the PDF of the IRR for both, the project and equity cash flows. According to the risk analysis, the IRR for the project is even lower that the traditional analysis expected value, with a mean of 3.03 percent and a standard deviation of 2.3 percent. The IRR for equity cash flows is slightly higher, with a mean of 3.95 percent and a standard deviation of 2.4 percent.

The CDF in Figure 8.26 shows the probabilities of the project achieving the RRR for both, total flows and equity flows, are extremely low, less than 5 percent. Therefore, without going into more specific details, it is evident that the project is not financially feasible.

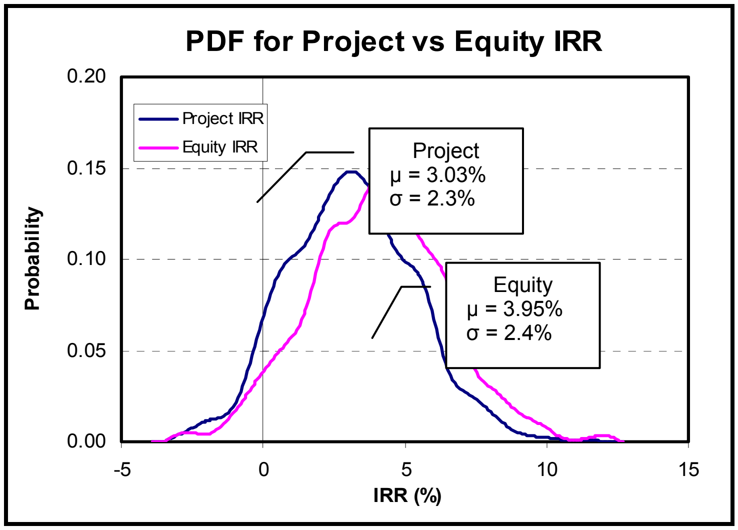


Fig. 8.25 PDF for IRR of the Monterrey-Nuevo Laredo Project vs. Equity Cash Flows

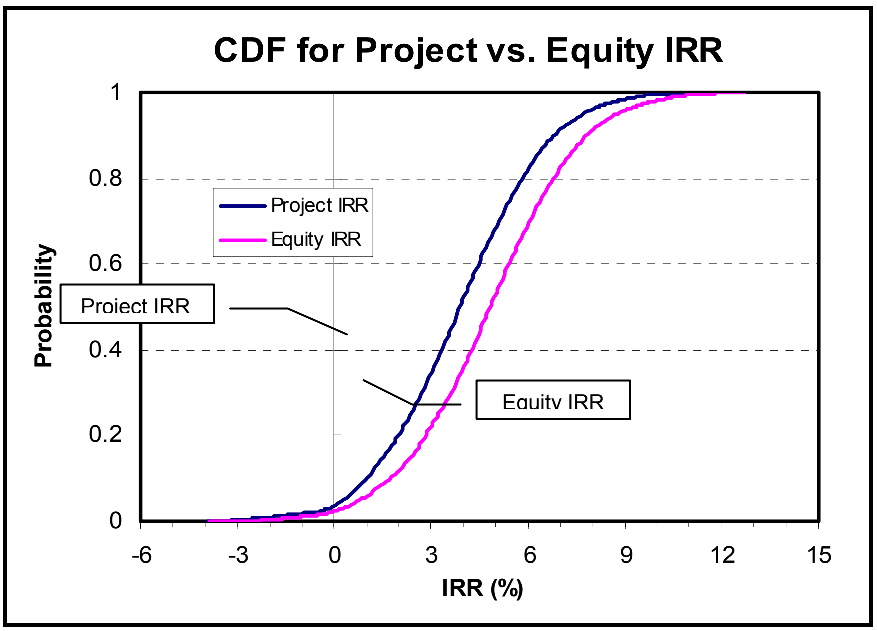


Fig. 8.26 CDF for IRR of the Monterrey-Nuevo Laredo Project vs. Equity Cash Flows

Sensitivity Analysis

Even though the risk analysis results clearly indicate that the Monterrey-Nuevo Laredo toll road is not a viable enterprise under the conditions assumed, a sensitivity analysis was performed to detect the main weaknesses of the project.

The regression sensitivity analyses carried out on the project IRR and NPV yielded a very low R^2 value for the regression equations. The second option offered by @RISK, the rank-order correlation sensitivity analysis also yielded very low correlation coefficients for the IRR.

However, the same correlation analysis performed on the project NPV yielded better coefficients. The tornado diagram in Figure 8.27 summarizes these results.

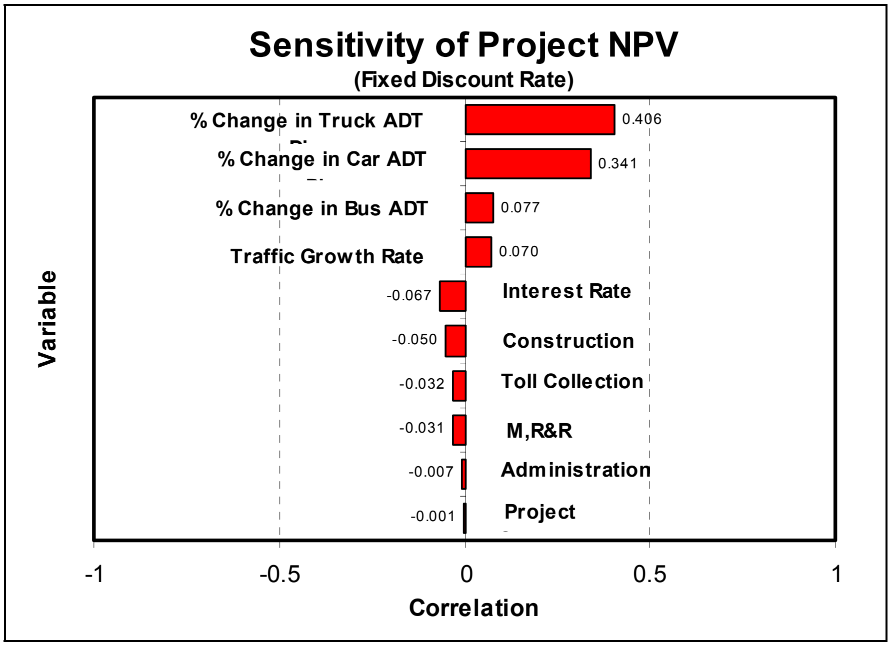


Fig. 8.27 Project IRR Regression Sensitivity Analysis of the Monterrey-Nuevo Laredo Toll Highway

The figure shows that the primary factor influencing the project NPV is traffic. The traffic that would divert to the highway and its growth rate are simply insufficient to support the project.

Summary of Analysis Results

The results of the analysis are evident. The Monterrey-Nuevo Laredo toll road is not a project that can be considered for private financing given the present conditions. Hence the FEMTH appraisal definitely coincides with the decision of including the project in the group of toll roads rescued by the SCT.

CHAPTER 9: CONCLUSIONS AND RECCOMENDATIONS

Risk is an intrinsic part of BOT toll highway projects. Measuring these risks is the most important issue in a financial feasibility evaluation. A financial feasibility evaluation computer model for BOT toll highways – Feasibility Evaluation Model for Toll Highways (FEMTH) - which incorporates probabilistic risk analyses of its most critical variables was developed in this research project. The FEMTH is intended to provide decision-makers in the public and private sectors with a pre-project planning tool that helps assessing realistically not only the expected financial outcome of a proposed BOT toll highway project, but also the probability of attaining it.

The FEMTH was created as a Microsoft Excel for Windows 95 template that requires the use of @RISK, an external add-in to Excel (Palisade, 1996), which enables the model to perform risk analysis. The functions and programming capabilities built into Excel were used to automate and customize the calculations in the spreadsheet according to the data input by the user, that is, the characteristics and variables for the particular project being analyzed. Thus, the user action in the spreadsheet is limited to feed in the basic data into the model and specify the desired settings for the simulation process.

The results of the model can be visualized during the simulation process in the FEMTH results screen. Once the analysis has been completed, the @RISK user interface provides the user with the detailed results from the simulation, not only in graphical charts, but also as a detailed statistical database for all the variables in the model. The graphic results as well as the detailed statistics can be easily brought back into Excel for further analysis, database creation, or simply for presentation in user customized reports or charts.

SUMMARY

Assessing the overall project risk demands describing realistically the variability associated with the inputs to the analysis, a task that is partly quantitative and partly subjective. The context in which toll road projects exist, within a larger transportation system with competing modes, and within the strategic economic plan of a state, region, or nation must be well understood in order to reasonably describe the variables influencing their behavior and hence, their feasibility. Chapter 2 situated the reader in this macroeconomic transportation framework, and Chapter 3 provided an understanding of the origination of a toll highway and other essential BOT project concepts. Chapters 4 and 5 set the project lifecycle stage at which the FEMTH is intended to be used, and familiarized the reader with the feasibility and risk analysis concepts used for project evaluation.

Chapter 6 discussed the development of the FEMTH from a theoretical concept to its final application and incorporation of risk analysis in a computer model. This chapter also described all the feasibility evaluation input variables and their proposed probabilistic description as well as the incorporation of Orozco's toll-traffic demand model to predict the one of the model's most important variable, traffic.

Chapter 7 brought to light the recent experience with the BOT concept for toll roads in Mexico, which provided extensive data for this research. Its problematic nature illustrated the importance of a realistic feasibility and risk evaluation, and exemplified the high impact that risk can have in this type of project. In addition, this chapter described in detail Orozco's toll-traffic demand model within the context of the Mexican toll road network. Finally, Chapter 8 applied the FEMTH to two case studies in the Mexican network, demonstrating that the results yielded by both the FEMTH and the toll-traffic demand model were fairly reliable when compared to actual performance of the case studies.

CONCLUSIONS

It is felt that the following are the two major contributions produced by this study:

1. The development of a toll highway pre-project planning tool which integrates probabilistic risk analysis and simulation concepts that were not of practical use before into an affordable and easy to use computer model. According to the Construction Industry Institute (CII) pre-project planning concept discussed in Chapter 4, this tool would bridge the *evaluate alternatives* and *analyze project risks* functions within the pre-project planning process.
2. The development of a conceptual and mathematical representation of the major variables that affect the financial outcome of a toll highway project and their interaction, particularly through the incorporation of a reliable toll-traffic demand model. Being revenue (tolls times traffic), one of the most critical variables in a toll highway project, the toll-traffic demand model developed by Orozco (1997) rounds up the computer model by providing reliable estimates of toll-traffic. The results from Orozco's research were also used to establish preliminary probability distribution functions of these estimates.

On the other hand, the major conclusions drawn from this study are the following:

1. Risk is present in all the stages of a toll highway project, as Levy states, "Risk is an intrinsic part of the BOT concept" (Levy, 1996). The application of the risk analysis methodology and computer simulation can effectively assess the financial risk associated with a toll highway in its early stages, and lead to better investment decisions.
2. The application of the FEMTH before a decision on whether to commit the resources for the project is made, that is, before it is finally authorized for detailed design and construction, can lead to a total reconfiguration of the project or its definitive abandonment. The results yielded by the FEMTH can expose and measure the specific weaknesses of a project. If these weaknesses can be re-assessed, by a reduction in project scope or a change in the design strategy, a marginally risky project can be turned into a profitable investment.
3. The results of the FEMTH can definitely point out the most critical areas for the risk management strategy of a toll road project. One of the most important characteristics of a successful toll road concession agreement is an adequate allocation of risks among the parties involved. Recognizing the risks involved and their magnitude at the early stages of a project can help in identifying the party more capable of bearing them, significantly reducing the probability of future disputes and claims.
4. Host governments can also benefit from the use of the FEMTH. The results yielded by the model can help governments establish the amount of financial support granted to those projects that are socially needed but not commercially profitable if the total investment was to be made privately. In this manner, a financially constrained government can leverage its infrastructure construction funds by two or threefold, fostering the general economic prosperity of the region, as explained in Chapter 5.

LIMITATIONS OF THE RESEARCH

The level of detail of the input data required for the FEMTH corresponds to the conceptual planning stage of the project, that is, before the project is authorized for detailed design. This is due in part to the lack of availability of highly detailed data found for this research. Although Mexican authorities and concessionaires were always willing to cooperate, the data was gathered during the very difficult period of the restructuring and rescue of the toll highway program, which made it difficult for them to release sensitive information. However, it is at the conceptual planning stage when the feasibility and risk analysis can have the greatest impact, as shown by CII's project influence curve in Chapter 4.

The FEMTH was developed with a focus towards inter-city toll roads and the type of concession agreement described here. Toll roads within urban areas or congestion relievers pose a more complicated revenue structure, since the toll prices vary according to the time of the day, the number of passengers, etc. Besides, the toll-traffic demand model was developed also based upon inter-city roads and for a certain range of values at a network level, since the few urban roads from the Mexican toll road network showed a completely different behavior. Thus, the results yielded by both models should not be extrapolated to cases that are evidently outside these categories.

In summary, the general procedure for the risk analysis of toll highways has been set forth in this research. The FEMTH and the toll-traffic demand model are not universal. When the conditions established here change, the model must be adapted accordingly based upon the specific characteristics of each project and concession agreement and of course, actualized toll-traffic demand data.

RECOMMENDATIONS FOR FUTURE RESEARCH

As the experience with toll roads increases, and more data becomes available, the level of detail and the accuracy of both, the FEMTH and the toll-traffic demand model can definitely be improved. Once a more extensive historical database can be established, better probability distribution functions for the input variables can be obtained, the correlation among the model variables can be established with more accuracy, and the toll-traffic demand model can be re-calibrated even at the project level.

Such an endeavor would require a cooperative effort from host governments, financiers, concessionaires, and contractors to share information and develop a truly comprehensive and collective database that would allow a more comprehensive analysis of all these variables. This would benefit all the parties involved, increasing the potential for further development of the BOT concept. Governments and society in general would benefit from expanded infrastructure stock, financiers and concessionaires from more secure and profitable investments, and contractors from increased work. The authors envision the end result of this effort as a form of Project Definition Rating Index (PDRI) for toll highways, such as that developed by CII for industrial facilities (CII, 1995).

Finally, the FEMTH can be substantially improved from a computer software standpoint, being developed as an individual piece of software and adding more database and data sharing capabilities. Due to the complexity of the FEMTH itself and the fact that the simulation software is run using other major software as a platform, the simulation process consumes a large amount of computer resources which slows down the speed of analysis. The FEMTH should be programmed as an integral piece of software with an improved interface and advanced database capabilities that take full advantage of the currently available computer systems. The FEMTH, its methodology and structure and the software tools are there to be used.

APPENDIX A.

SUMMARY OF ECONOMIC AND FINANCIAL INDICATORS

A.1 NOMINAL AND REAL LONG-TERM U.S. TREASURY BOND YIELD AND PRIME INTEREST RATE (1966-1998)

A.2 STATISTICS AND BESTFIT ANALYSIS RESULTS FOR THE LONG-TERM U.S. TREASURY BOND REAL YIELD AND THE PRIME REAL INTEREST RATE (1966-1998)

A.3 NOMINAL AND REAL LONDON INTERBANK OFFERED RATE (LIBOR) (1983-1998)

A.4 STATISTICS AND BESTFIT ANALYSIS RESULTS FOR THE LIBOR (1983-1998)

A.5 SIMULATION ANALYSIS USED TO ARRIVE AT THE VARIABLE DISCOUNT RATE

A.1 NOMINAL AND REAL LONG-TERM U.S. TREASURY BOND YIELD AND PRIME INTEREST RATE (1966-1998)

Source Data: Board of Governors of the U.S. Federal Reserve System (1998)

APPENDIX A.1

NOMINAL AND REAL LONG TERM U.S. TREASURY BOND YIELD AND PRIME RATES

Monthly Data (1966-1998)

Month / Year	Inflation in the US	Nominal Long Term US Bond Yield	Real Long Term US Bond Yield	Nominal Prime Interest Rate	Real Prime Interest Rate
Jan-66	1.90%	4.52%	2.57%	5.00%	3.04%
Feb-66	2.53%	4.71%	2.12%	5.00%	2.41%
Mar-66	2.52%	4.72%	2.14%	5.35%	2.76%
Apr-66	2.83%	4.65%	1.77%	5.50%	2.60%
May-66	2.83%	4.69%	1.81%	5.50%	2.60%
Jun-66	2.50%	4.73%	2.18%	5.52%	2.95%
Jul-66	2.81%	4.84%	1.98%	5.75%	2.86%
Aug-66	3.42%	4.95%	1.48%	5.88%	2.38%
Sep-66	3.42%	4.94%	1.47%	6.00%	2.49%
Oct-66	3.72%	4.83%	1.07%	6.00%	2.20%
Nov-66	3.72%	4.87%	1.11%	6.00%	2.20%
Dec-66	3.40%	4.76%	1.31%	6.00%	2.51%
Jan-67	3.40%	4.51%	1.07%	5.96%	2.48%
Feb-67	2.77%	4.61%	1.79%	5.75%	2.90%
Mar-67	2.77%	4.56%	1.75%	5.71%	2.87%
Apr-67	2.45%	4.64%	2.14%	5.50%	2.98%
May-67	2.75%	4.90%	2.09%	5.50%	2.68%
Jun-67	2.74%	4.99%	2.19%	5.50%	2.69%
Jul-67	2.73%	5.01%	2.22%	5.50%	2.69%
Aug-67	2.42%	5.12%	2.64%	5.50%	3.01%
Sep-67	2.72%	5.16%	2.38%	5.50%	2.71%
Oct-67	2.40%	5.36%	2.89%	5.50%	3.02%
Nov-67	2.70%	5.66%	2.88%	5.68%	2.90%
Dec-67	2.99%	5.59%	2.52%	6.00%	2.92%
Jan-68	3.58%	5.39%	1.75%	6.00%	2.33%
Feb-68	3.88%	5.38%	1.45%	6.00%	2.05%
Mar-68	3.86%	5.59%	1.66%	6.00%	2.06%
Apr-68	3.85%	5.46%	1.55%	6.20%	2.26%
May-68	3.84%	5.55%	1.65%	6.50%	2.56%
Jun-68	4.12%	5.40%	1.23%	6.50%	2.29%
Jul-68	4.39%	5.29%	0.86%	6.50%	2.02%
Aug-68	4.38%	5.23%	0.81%	6.50%	2.03%
Sep-68	4.37%	5.28%	0.87%	6.45%	2.00%
Oct-68	4.64%	5.44%	0.77%	6.25%	1.54%
Nov-68	4.63%	5.56%	0.89%	6.25%	1.55%
Dec-68	4.61%	5.88%	1.21%	6.60%	1.90%
Jan-69	4.30%	5.99%	1.62%	6.95%	2.54%
Feb-69	4.57%	6.11%	1.47%	7.00%	2.32%
Mar-69	5.11%	6.22%	1.05%	7.24%	2.02%
Apr-69	5.38%	6.03%	0.62%	7.50%	2.02%
May-69	5.36%	6.11%	0.71%	7.50%	2.03%
Jun-69	5.33%	6.28%	0.90%	8.23%	2.75%
Jul-69	5.30%	6.27%	0.92%	8.50%	3.04%
Aug-69	5.56%	6.22%	0.63%	8.50%	2.79%
Sep-69	5.54%	6.55%	0.96%	8.50%	2.80%
Oct-69	5.51%	6.49%	0.93%	8.50%	2.83%
Nov-69	5.76%	6.74%	0.92%	8.50%	2.59%
Dec-69	6.01%	6.91%	0.85%	8.50%	2.35%

APPENDIX A.1 (Cont.)

NOMINAL AND REAL LONG TERM U.S. TREASURY BOND YIELD AND PRIME RATES

Monthly Data (1966-1998)

Month / Year	Inflation in the US	Nominal Long Term US Bond Yield	Real Long Term US Bond Yield	Nominal Prime Interest Rate	Real Prime Interest Rate
Jan-70	6.00%	6.92%	0.87%	8.50%	2.36%
Feb-70	5.96%	6.67%	0.67%	8.50%	2.39%
Mar-70	5.65%	6.72%	1.01%	8.39%	2.59%
Apr-70	5.88%	6.85%	0.91%	8.00%	2.00%
May-70	5.87%	7.24%	1.30%	8.00%	2.01%
Jun-70	5.84%	7.34%	1.42%	8.00%	2.04%
Jul-70	5.81%	6.92%	1.05%	8.00%	2.07%
Aug-70	5.26%	7.07%	1.72%	8.00%	2.60%
Sep-70	5.51%	6.88%	1.30%	7.83%	2.20%
Oct-70	5.48%	6.88%	1.33%	7.50%	1.92%
Nov-70	5.45%	6.58%	1.07%	7.28%	1.74%
Dec-70	5.42%	6.28%	0.82%	6.92%	1.42%
Jan-71	5.16%	6.18%	0.97%	6.29%	1.08%
Feb-71	4.88%	6.14%	1.20%	5.88%	0.95%
Mar-71	4.60%	5.94%	1.28%	5.44%	0.80%
Apr-71	4.07%	6.00%	1.85%	5.28%	1.16%
May-71	4.31%	6.32%	1.93%	5.46%	1.10%
Jun-71	4.53%	6.38%	1.77%	5.50%	0.92%
Jul-71	4.27%	6.38%	2.03%	5.91%	1.58%
Aug-71	4.51%	6.27%	1.68%	6.00%	1.42%
Sep-71	4.00%	6.05%	1.97%	6.00%	1.92%
Oct-71	3.74%	5.92%	2.10%	5.90%	2.09%
Nov-71	3.23%	5.86%	2.55%	5.53%	2.23%
Dec-71	3.21%	6.00%	2.70%	5.49%	2.21%
Jan-72	3.21%	6.01%	2.71%	5.18%	1.90%
Feb-72	3.45%	6.06%	2.52%	4.75%	1.26%
Mar-72	3.44%	6.06%	2.53%	4.75%	1.27%
Apr-72	3.43%	6.16%	2.64%	4.97%	1.49%
May-72	3.17%	6.07%	2.81%	5.00%	1.77%
Jun-72	2.67%	6.01%	3.25%	5.04%	2.31%
Jul-72	2.91%	6.01%	3.02%	5.25%	2.28%
Aug-72	2.90%	5.94%	2.96%	5.27%	2.30%
Sep-72	3.14%	6.05%	2.82%	5.50%	2.29%
Oct-72	3.37%	6.00%	2.55%	5.73%	2.29%
Nov-72	3.60%	5.79%	2.11%	5.75%	2.07%
Dec-72	3.35%	5.96%	2.53%	5.79%	2.36%
Jan-73	3.58%	6.78%	3.08%	6.00%	2.33%
Feb-73	3.80%	6.88%	2.97%	6.02%	2.14%
Mar-73	4.49%	6.91%	2.32%	6.30%	1.73%
Apr-73	4.94%	6.86%	1.83%	6.61%	1.59%
May-73	5.38%	6.99%	1.53%	7.01%	1.55%
Jun-73	5.82%	7.06%	1.17%	7.49%	1.58%
Jul-73	5.57%	7.29%	1.63%	8.30%	2.59%
Aug-73	7.12%	7.61%	0.46%	9.23%	1.97%
Sep-73	7.10%	7.25%	0.14%	9.86%	2.57%
Oct-73	7.51%	7.18%	-0.31%	9.94%	2.26%
Nov-73	7.93%	7.30%	-0.59%	9.75%	1.68%
Dec-73	8.35%	7.29%	-0.98%	9.75%	1.29%

APPENDIX A.1 (Cont.)

NOMINAL AND REAL LONG TERM U.S. TREASURY BOND YIELD AND PRIME RATES

Monthly Data (1966-1998)

Month / Year	Inflation in the US	Nominal Long Term US Bond Yield	Real Long Term US Bond Yield	Nominal Prime Interest Rate	Real Prime Interest Rate
Jan-74	8.97%	7.47%	-1.38%	9.73%	0.69%
Feb-74	9.55%	7.46%	-1.91%	9.21%	-0.31%
Mar-74	9.89%	7.73%	-1.96%	8.85%	-0.94%
Apr-74	9.61%	8.01%	-1.46%	10.02%	0.37%
May-74	10.17%	8.14%	-1.84%	11.25%	0.98%
Jun-74	10.31%	8.10%	-2.00%	11.54%	1.12%
Jul-74	10.90%	8.26%	-2.38%	11.97%	0.97%
Aug-74	10.31%	8.60%	-1.55%	12.00%	1.53%
Sep-74	11.29%	8.59%	-2.42%	12.00%	0.64%
Oct-74	11.39%	8.37%	-2.71%	11.68%	0.26%
Nov-74	11.51%	7.98%	-3.17%	10.83%	-0.61%
Dec-74	11.63%	7.91%	-3.34%	10.50%	-1.02%
Jan-75	11.16%	7.88%	-2.95%	10.05%	-1.00%
Feb-75	10.64%	7.71%	-2.65%	8.96%	-1.52%
Mar-75	9.76%	7.99%	-1.61%	7.93%	-1.67%
Apr-75	9.72%	8.36%	-1.24%	7.50%	-2.02%
May-75	9.04%	8.22%	-0.76%	7.40%	-1.51%
Jun-75	8.97%	8.04%	-0.86%	7.07%	-1.75%
Jul-75	9.27%	8.17%	-1.01%	7.15%	-1.94%
Aug-75	8.25%	8.50%	0.23%	7.66%	-0.55%
Sep-75	7.61%	8.57%	0.89%	7.88%	0.25%
Oct-75	7.17%	8.35%	1.10%	7.96%	0.73%
Nov-75	7.12%	8.28%	1.08%	7.53%	0.38%
Dec-75	6.71%	8.23%	1.43%	7.26%	0.52%
Jan-76	6.50%	8.01%	1.42%	7.00%	0.47%
Feb-76	6.10%	8.03%	1.82%	6.75%	0.62%
Mar-76	5.89%	7.97%	1.96%	6.75%	0.81%
Apr-76	5.87%	7.86%	1.88%	6.75%	0.83%
May-76	6.02%	8.13%	1.99%	6.75%	0.69%
Jun-76	5.80%	8.03%	2.11%	7.20%	1.32%
Jul-76	5.21%	8.00%	2.65%	7.25%	1.94%
Aug-76	5.55%	7.91%	2.23%	7.01%	1.38%
Sep-76	5.35%	7.78%	2.31%	7.00%	1.57%
Oct-76	5.32%	7.70%	2.26%	6.77%	1.38%
Nov-76	4.77%	7.64%	2.74%	6.50%	1.65%
Dec-76	4.75%	7.30%	2.43%	6.35%	1.53%
Jan-77	5.08%	7.48%	2.28%	6.25%	1.11%
Feb-77	5.75%	7.75%	1.90%	6.25%	0.48%
Mar-77	6.24%	7.80%	1.47%	6.25%	0.01%
Apr-77	6.72%	7.73%	0.95%	6.25%	-0.44%
May-77	6.51%	7.80%	1.21%	6.41%	-0.09%
Jun-77	6.64%	7.64%	0.94%	6.75%	0.10%
Jul-77	6.61%	7.64%	0.97%	6.75%	0.13%
Aug-77	6.41%	7.68%	1.19%	6.83%	0.39%
Sep-77	6.39%	7.64%	1.18%	7.13%	0.70%
Oct-77	6.19%	7.77%	1.48%	7.52%	1.25%
Nov-77	6.51%	7.85%	1.26%	7.75%	1.17%
Dec-77	6.49%	7.94%	1.37%	7.75%	1.19%

APPENDIX A.1 (Cont.)

NOMINAL AND REAL LONG TERM U.S. TREASURY BOND YIELD AND PRIME RATES

Monthly Data (1966-1998)

Month / Year	Inflation in the US	Nominal Long Term US Bond Yield	Real Long Term US Bond Yield	Nominal Prime Interest Rate	Real Prime Interest Rate
Jan-78	6.61%	8.18%	1.47%	7.93%	1.23%
Feb-78	6.23%	8.25%	1.90%	8.00%	1.66%
Mar-78	6.35%	8.23%	1.77%	8.00%	1.55%
Apr-78	6.30%	8.34%	1.92%	8.00%	1.60%
May-78	6.73%	8.43%	1.59%	8.27%	1.44%
Jun-78	7.15%	8.50%	1.26%	8.63%	1.38%
Jul-78	7.42%	8.65%	1.14%	9.00%	1.47%
Aug-78	7.55%	8.47%	0.85%	9.01%	1.36%
Sep-78	7.98%	8.47%	0.45%	9.41%	1.33%
Oct-78	8.55%	8.67%	0.11%	9.94%	1.28%
Nov-78	8.51%	8.75%	0.22%	10.94%	2.24%
Dec-78	8.63%	8.88%	0.23%	11.55%	2.68%
Jan-79	8.87%	8.94%	0.06%	11.75%	2.64%
Feb-79	9.40%	9.00%	-0.37%	11.75%	2.15%
Mar-79	9.62%	9.03%	-0.54%	11.75%	1.95%
Apr-79	9.97%	9.08%	-0.81%	11.75%	1.62%
May-79	10.30%	9.19%	-1.01%	11.75%	1.31%
Jun-79	10.34%	8.92%	-1.28%	11.65%	1.19%
Jul-79	10.67%	8.93%	-1.57%	11.54%	0.78%
Aug-79	11.17%	8.98%	-1.97%	11.91%	0.67%
Sep-79	11.49%	9.17%	-2.08%	12.90%	1.26%
Oct-79	11.40%	9.85%	-1.39%	14.39%	2.69%
Nov-79	11.88%	10.30%	-1.41%	15.55%	3.28%
Dec-79	12.48%	10.12%	-2.10%	15.30%	2.51%
Jan-80	13.02%	10.60%	-2.14%	15.25%	1.97%
Feb-80	13.26%	12.13%	-1.00%	15.63%	2.09%
Mar-80	13.76%	12.34%	-1.25%	18.31%	4.00%
Apr-80	13.74%	11.40%	-2.06%	19.77%	5.30%
May-80	13.46%	10.36%	-2.73%	16.57%	2.74%
Jun-80	13.44%	9.81%	-3.20%	12.63%	-0.71%
Jul-80	12.34%	10.24%	-1.87%	11.48%	-0.76%
Aug-80	12.11%	11.00%	-0.99%	11.12%	-0.88%
Sep-80	11.87%	11.34%	-0.47%	12.23%	0.32%
Oct-80	12.01%	11.59%	-0.38%	13.79%	1.59%
Nov-80	11.91%	12.37%	0.41%	16.06%	3.71%
Dec-80	11.79%	12.40%	0.54%	20.35%	7.65%
Jan-81	11.18%	12.14%	0.87%	20.16%	8.08%
Feb-81	10.80%	12.80%	1.80%	19.43%	7.79%
Mar-81	9.97%	12.69%	2.47%	18.05%	7.34%
Apr-81	9.53%	13.20%	3.35%	17.15%	6.96%
May-81	9.33%	13.60%	3.90%	19.61%	9.40%
Jun-81	9.12%	12.96%	3.52%	20.03%	9.99%
Jul-81	10.22%	13.59%	3.06%	20.39%	9.23%
Aug-81	10.26%	14.17%	3.55%	20.50%	9.29%
Sep-81	10.39%	14.67%	3.87%	20.08%	8.77%
Oct-81	9.66%	14.68%	4.58%	18.45%	8.02%
Nov-81	9.16%	13.35%	3.84%	16.84%	7.04%
Dec-81	8.55%	13.45%	4.52%	15.75%	6.64%

APPENDIX A.1 (Cont.)

NOMINAL AND REAL LONG TERM U.S. TREASURY BOND YIELD AND PRIME RATES

Monthly Data (1966-1998)

Month / Year	Inflation in the US	Nominal Long Term US Bond Yield	Real Long Term US Bond Yield	Nominal Prime Interest Rate	Real Prime Interest Rate
Jan-82	8.06%	14.22%	5.70%	15.75%	7.12%
Feb-82	7.35%	14.22%	6.40%	16.56%	8.58%
Mar-82	6.56%	13.53%	6.54%	16.50%	9.33%
Apr-82	6.31%	13.37%	6.64%	16.50%	9.59%
May-82	6.47%	13.24%	6.36%	16.50%	9.42%
Jun-82	6.83%	13.92%	6.64%	16.50%	9.06%
Jul-82	6.24%	13.55%	6.88%	16.26%	9.43%
Aug-82	5.69%	12.77%	6.70%	14.39%	8.24%
Sep-82	4.92%	12.07%	6.81%	13.50%	8.18%
Oct-82	5.01%	11.17%	5.86%	12.52%	7.15%
Nov-82	4.49%	10.54%	5.79%	11.85%	7.05%
Dec-82	3.76%	10.54%	6.54%	11.50%	7.46%
Jan-83	3.64%	10.63%	6.74%	11.50%	7.58%
Feb-83	3.43%	10.88%	7.20%	11.45%	7.76%
Mar-83	3.53%	10.63%	6.85%	11.00%	7.21%
Apr-83	3.82%	10.48%	6.41%	11.00%	6.91%
May-83	3.49%	10.53%	6.81%	11.55%	7.79%
Jun-83	2.54%	10.93%	8.18%	10.50%	7.76%
Jul-83	2.43%	11.40%	8.76%	10.50%	7.88%
Aug-83	2.53%	11.82%	9.06%	10.89%	8.16%
Sep-83	2.82%	11.63%	8.57%	11.00%	7.96%
Oct-83	2.81%	11.58%	8.53%	11.00%	7.96%
Nov-83	3.21%	11.75%	8.27%	11.00%	7.54%
Dec-83	3.72%	11.88%	7.87%	11.00%	7.02%
Jan-84	4.11%	11.75%	7.34%	11.00%	6.62%
Feb-84	4.49%	11.95%	7.14%	11.00%	6.23%
Mar-84	4.69%	12.38%	7.35%	11.50%	6.51%
Apr-84	4.46%	12.65%	7.84%	12.00%	7.22%
May-84	4.15%	13.43%	8.91%	12.50%	8.02%
Jun-84	4.13%	13.44%	8.94%	13.00%	8.51%
Jul-84	4.12%	13.21%	8.73%	13.00%	8.53%
Aug-84	4.20%	12.54%	8.00%	13.00%	8.44%
Sep-84	4.18%	12.29%	7.78%	12.75%	8.22%
Oct-84	4.17%	11.98%	7.50%	12.50%	8.00%
Nov-84	3.97%	11.56%	7.30%	11.25%	7.00%
Dec-84	3.87%	11.52%	7.36%	10.75%	6.62%
Jan-85	3.47%	11.45%	7.71%	10.50%	6.79%
Feb-85	3.46%	11.47%	7.75%	10.50%	6.81%
Mar-85	3.64%	11.81%	7.89%	10.50%	6.62%
Apr-85	3.62%	11.47%	7.58%	10.50%	6.64%
May-85	3.70%	11.05%	7.09%	10.00%	6.07%
Jun-85	3.69%	10.45%	6.52%	9.50%	5.60%
Jul-85	3.49%	10.50%	6.77%	9.50%	5.80%
Aug-85	3.29%	10.56%	7.03%	9.50%	6.01%
Sep-85	3.09%	10.61%	7.29%	9.50%	6.21%
Oct-85	3.18%	10.50%	7.10%	9.50%	6.13%
Nov-85	3.45%	10.06%	6.39%	9.50%	5.84%
Dec-85	3.73%	9.54%	5.60%	9.50%	5.56%

APPENDIX A.1 (Cont.)

NOMINAL AND REAL LONG TERM U.S. TREASURY BOND YIELD AND PRIME RATES

Monthly Data (1966-1998)

Month / Year	Inflation in the US	Nominal Long Term US Bond Yield	Real Long Term US Bond Yield	Nominal Prime Interest Rate	Real Prime Interest Rate
Jan-86	3.81%	9.40%	5.38%	9.50%	5.48%
Feb-86	3.07%	8.93%	5.69%	9.50%	6.24%
Mar-86	2.23%	7.96%	5.60%	9.00%	6.62%
Apr-86	1.58%	7.39%	5.72%	8.50%	6.81%
May-86	1.48%	7.52%	5.95%	8.50%	6.92%
Jun-86	1.75%	7.57%	5.72%	8.50%	6.63%
Jul-86	1.56%	7.27%	5.62%	8.00%	6.34%
Aug-86	1.56%	7.33%	5.68%	7.50%	5.85%
Sep-86	1.74%	7.62%	5.78%	7.50%	5.66%
Oct-86	1.46%	7.70%	6.15%	7.50%	5.95%
Nov-86	1.28%	7.52%	6.17%	7.50%	6.15%
Dec-86	1.09%	7.37%	6.21%	7.50%	6.34%
Jan-87	1.45%	7.39%	5.86%	7.50%	5.96%
Feb-87	2.08%	7.54%	5.35%	7.50%	5.31%
Mar-87	2.99%	7.55%	4.43%	7.50%	4.38%
Apr-87	3.71%	8.25%	4.38%	7.75%	3.90%
May-87	3.78%	8.78%	4.81%	8.25%	4.30%
Jun-87	3.59%	8.57%	4.81%	8.25%	4.50%
Jul-87	3.85%	8.64%	4.61%	8.25%	4.24%
Aug-87	4.20%	8.97%	4.58%	8.25%	3.89%
Sep-87	4.26%	9.59%	5.11%	8.75%	4.30%
Oct-87	4.43%	9.61%	4.96%	9.00%	4.37%
Nov-87	4.43%	8.95%	4.33%	8.75%	4.14%
Dec-87	4.34%	9.12%	4.58%	8.75%	4.23%
Jan-88	3.97%	8.83%	4.68%	8.75%	4.60%
Feb-88	3.87%	8.43%	4.39%	8.50%	4.46%
Mar-88	3.85%	8.63%	4.60%	8.50%	4.48%
Apr-88	3.83%	8.95%	4.93%	8.50%	4.50%
May-88	3.82%	9.23%	5.21%	9.00%	4.99%
Jun-88	3.89%	9.00%	4.92%	9.00%	4.92%
Jul-88	4.05%	9.14%	4.89%	9.50%	5.24%
Aug-88	3.94%	9.32%	5.17%	10.00%	5.83%
Sep-88	4.09%	9.06%	4.78%	10.00%	5.68%
Oct-88	4.16%	8.89%	4.54%	10.00%	5.60%
Nov-88	4.16%	9.02%	4.67%	10.00%	5.61%
Dec-88	4.32%	9.01%	4.49%	10.50%	5.92%
Jan-89	4.56%	8.93%	4.18%	10.50%	5.68%
Feb-89	4.71%	9.01%	4.10%	11.50%	6.48%
Mar-89	4.86%	9.17%	4.11%	11.50%	6.33%
Apr-89	5.00%	9.03%	3.84%	11.50%	6.19%
May-89	5.22%	8.83%	3.43%	11.50%	5.97%
Jun-89	5.04%	8.27%	3.07%	11.00%	5.67%
Jul-89	4.86%	8.08%	3.07%	10.50%	5.38%
Aug-89	4.60%	8.12%	3.37%	10.50%	5.64%
Sep-89	4.25%	8.15%	3.74%	10.50%	6.00%
Oct-89	4.39%	8.00%	3.45%	10.50%	5.85%
Nov-89	4.55%	7.90%	3.20%	10.50%	5.69%
Dec-89	4.54%	7.90%	3.21%	10.50%	5.70%

APPENDIX A.1 (Cont.)

NOMINAL AND REAL LONG TERM U.S. TREASURY BOND YIELD AND PRIME RATES

Monthly Data (1966-1998)

Month / Year	Inflation in the US	Nominal Long Term US Bond Yield	Real Long Term US Bond Yield	Nominal Prime Interest Rate	Real Prime Interest Rate
Jan-90	5.07%	8.26%	3.03%	10.00%	4.69%
Feb-90	5.13%	8.50%	3.21%	10.00%	4.63%
Mar-90	5.10%	8.56%	3.29%	10.00%	4.66%
Apr-90	4.60%	8.76%	3.97%	10.00%	5.16%
May-90	4.27%	8.73%	4.28%	10.00%	5.50%
Jun-90	4.57%	8.46%	3.72%	10.00%	5.19%
Jul-90	4.71%	8.50%	3.62%	10.00%	5.05%
Aug-90	5.47%	8.86%	3.22%	10.00%	4.30%
Sep-90	5.98%	9.03%	2.88%	10.00%	3.80%
Oct-90	6.10%	8.86%	2.60%	10.00%	3.68%
Nov-90	6.09%	8.54%	2.31%	10.00%	3.69%
Dec-90	5.93%	8.24%	2.18%	9.50%	3.37%
Jan-91	5.50%	8.27%	2.63%	9.50%	3.79%
Feb-91	5.18%	8.03%	2.71%	9.00%	3.64%
Mar-91	4.78%	8.29%	3.35%	9.00%	4.03%
Apr-91	4.77%	8.21%	3.28%	9.00%	4.04%
May-91	4.83%	8.27%	3.28%	8.50%	3.50%
Jun-91	4.59%	8.47%	3.71%	8.50%	3.74%
Jul-91	4.35%	8.45%	3.93%	8.50%	3.98%
Aug-91	3.73%	8.14%	4.25%	8.50%	4.60%
Sep-91	3.33%	7.95%	4.47%	8.50%	5.00%
Oct-91	2.88%	7.93%	4.91%	8.00%	4.98%
Nov-91	2.95%	7.92%	4.83%	7.50%	4.42%
Dec-91	3.02%	7.70%	4.54%	6.50%	3.38%
Jan-92	2.57%	7.58%	4.89%	6.50%	3.83%
Feb-92	2.78%	7.85%	4.93%	6.50%	3.62%
Mar-92	3.14%	7.97%	4.69%	6.50%	3.26%
Apr-92	3.13%	7.96%	4.68%	6.50%	3.27%
May-92	2.98%	7.89%	4.77%	6.50%	3.42%
Jun-92	3.04%	7.84%	4.66%	6.50%	3.36%
Jul-92	3.11%	7.60%	4.36%	6.00%	2.80%
Aug-92	3.10%	7.39%	4.16%	6.00%	2.81%
Sep-92	2.94%	7.34%	4.27%	6.00%	2.97%
Oct-92	3.15%	7.53%	4.24%	6.00%	2.76%
Nov-92	3.00%	7.61%	4.47%	6.00%	2.91%
Dec-92	2.86%	7.44%	4.45%	6.00%	3.05%
Jan-93	3.21%	7.34%	4.01%	6.00%	2.71%
Feb-93	3.20%	7.09%	3.77%	6.00%	2.72%
Mar-93	3.04%	6.82%	3.67%	6.00%	2.87%
Apr-93	3.17%	6.85%	3.56%	6.00%	2.74%
May-93	3.17%	6.92%	3.63%	6.00%	2.74%
Jun-93	2.95%	6.81%	3.75%	6.00%	2.96%
Jul-93	2.74%	6.63%	3.79%	6.00%	3.18%
Aug-93	2.73%	6.32%	3.49%	6.00%	3.18%
Sep-93	2.65%	6.00%	3.26%	6.00%	3.26%
Oct-93	2.71%	5.94%	3.14%	6.00%	3.20%
Nov-93	2.64%	6.21%	3.48%	6.00%	3.27%
Dec-93	2.71%	6.25%	3.45%	6.00%	3.20%

APPENDIX A.1 (Cont.)

NOMINAL AND REAL LONG TERM U.S. TREASURY BOND YIELD AND PRIME RATES

Monthly Data (1966-1998)

Month / Year	Inflation in the US	Nominal Long Term US Bond Yield	Real Long Term US Bond Yield	Nominal Prime Interest Rate	Real Prime Interest Rate
Jan-94	2.49%	6.29%	3.70%	6.00%	3.42%
Feb-94	2.48%	6.49%	3.91%	6.00%	3.43%
Mar-94	2.48%	6.91%	4.33%	6.25%	3.68%
Apr-94	2.33%	7.27%	4.82%	6.75%	4.32%
May-94	2.26%	7.41%	5.03%	7.25%	4.88%
Jun-94	2.46%	7.40%	4.82%	7.25%	4.67%
Jul-94	2.73%	7.58%	4.72%	7.25%	4.40%
Aug-94	2.86%	7.49%	4.50%	7.75%	4.75%
Sep-94	2.92%	7.71%	4.65%	7.75%	4.69%
Oct-94	2.57%	7.94%	5.23%	7.75%	5.05%
Nov-94	2.64%	8.08%	5.30%	8.50%	5.71%
Dec-94	2.64%	7.87%	5.10%	8.50%	5.71%
Jan-95	2.77%	7.85%	4.95%	8.50%	5.58%
Feb-95	2.82%	7.61%	4.66%	9.00%	6.01%
Mar-95	2.81%	7.45%	4.51%	9.00%	6.02%
Apr-95	3.01%	7.36%	4.23%	9.00%	5.82%
May-95	3.14%	6.95%	3.70%	9.00%	5.68%
Jun-95	3.00%	6.57%	3.47%	9.00%	5.83%
Jul-95	2.73%	6.72%	3.89%	8.75%	5.86%
Aug-95	2.58%	6.86%	4.17%	8.75%	6.01%
Sep-95	2.51%	6.55%	3.94%	8.75%	6.09%
Oct-95	2.77%	6.37%	3.50%	8.75%	5.82%
Nov-95	2.57%	6.26%	3.60%	8.75%	6.02%
Dec-95	2.51%	6.06%	3.47%	8.66%	6.00%
Jan-96	2.69%	6.05%	3.27%	8.50%	5.66%
Feb-96	2.62%	6.24%	3.53%	8.25%	5.49%
Mar-96	2.80%	6.60%	3.70%	8.25%	5.30%
Apr-96	2.86%	6.79%	3.83%	8.25%	5.24%
May-96	2.85%	6.93%	3.97%	8.25%	5.25%
Jun-96	2.72%	7.06%	4.23%	8.25%	5.39%
Jul-96	2.91%	7.03%	4.01%	8.25%	5.19%
Aug-96	2.84%	6.84%	3.89%	8.25%	5.26%
Sep-96	2.96%	7.03%	3.95%	8.25%	5.14%
Oct-96	2.95%	6.81%	3.75%	8.25%	5.15%
Nov-96	3.20%	6.48%	3.17%	8.25%	4.89%
Dec-96	3.27%	6.55%	3.18%	8.25%	4.82%
Jan-97	3.00%	6.83%	3.72%	8.25%	5.10%
Feb-97	2.99%	6.69%	3.59%	8.25%	5.11%
Mar-97	2.72%	6.93%	4.09%	8.28%	5.41%
Apr-97	2.46%	7.09%	4.51%	8.50%	5.89%
May-97	2.21%	6.94%	4.63%	8.50%	6.15%
Jun-97	2.27%	6.77%	4.40%	8.50%	6.09%
Jul-97	2.20%	6.51%	4.21%	8.50%	6.16%
Aug-97	2.20%	6.58%	4.29%	8.50%	6.16%
Sep-97	2.13%	6.50%	4.28%	8.50%	6.24%
Oct-97	2.06%	6.33%	4.18%	8.50%	6.31%
Nov-97	1.81%	6.11%	4.22%	8.50%	6.57%
Dec-97	1.69%	5.99%	4.23%	8.50%	6.70%
Jan-98	1.56%	5.81%	4.19%	8.50%	6.83%

A.2 STATISTICS AND BESTFIT ANALYSIS RESULTS FOR THE LONG-TERM U.S. TREASURY BOND REAL YIELD AND THE PRIME REAL INTEREST RATE (1966-1998)

LONG-TERM U.S. TREASURY BOND

(Data Combined for the 20 and 30-year Bond)

	Real Bond Yield	Lognormal Distribution
Parameter 1 (Mean)		4.05
Parameter 2 (Std. Dev.)		4.30
@RISKFormula		RiskLognorm(4.05,4.3)
Minimum	-0.47	
Maximum	9.06	
Mean	3.52	4.05
Mode	4.30	1.25
Median	3.47	2.80
Standard Deviation	2.11	4.30
Variance	4.47	18.50
Skewness	0.68	3.72
Kurtosis	2.61	34.92

Table A.1 Statistics of the Long-Term U.S. Treasury Bond Yield (1966-1998) and the BestFit Lognormal PDF

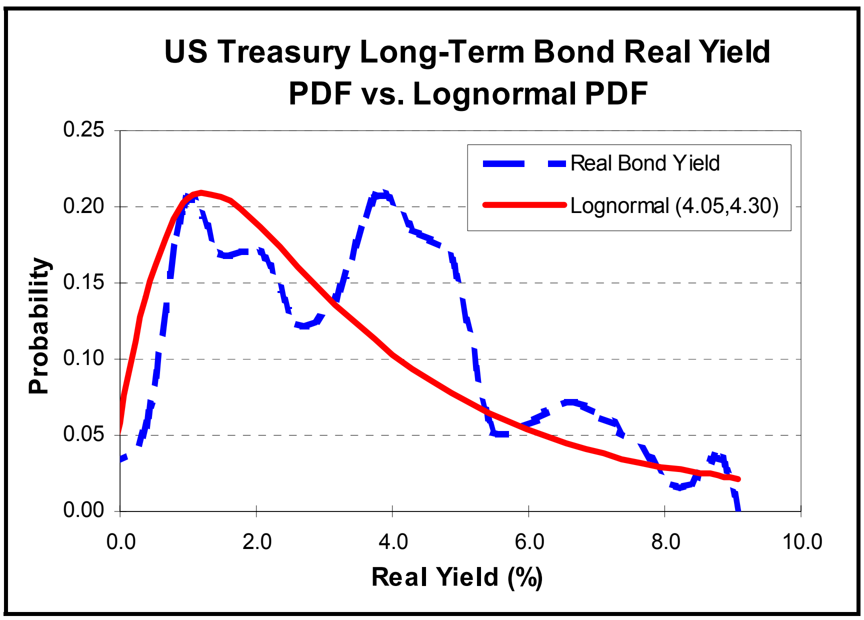


Fig. A.1 Comparison between the US Treasury Long-Term Bond Yield (1966-1998) and the BestFit Lognormal PDF

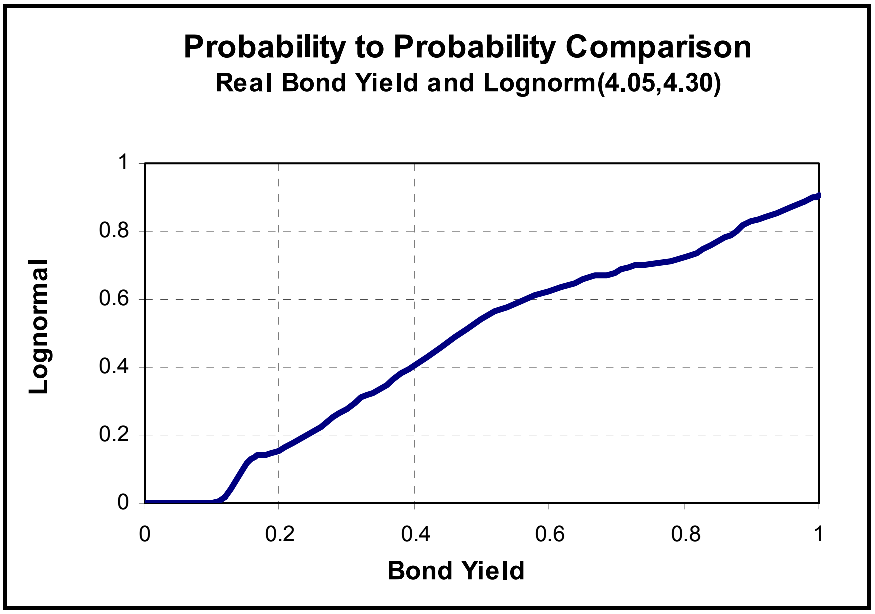


Fig. A.2 Probability to Probability Comparison between the US Treasury Long Term-Bond Yield (1966-1998) and the BestFit Lognormal PDF

REAL PRIME INTEREST RATE

	Real Prime Rate	Lognormal Distribution
Parameter 1 (Mean)		4.42
Parameter 2 (Std. Dev.)		4.36
@RISKFormula		RiskLognorm(4.42,4.36)
Minimum	0.01	
Maximum	9.99	
Mean	4.01	4.42
Mode	2.51	1.60
Median	3.62	3.15
Standard Deviation	2.35	4.36
Variance	5.53	19.02
Skewness	0.53	3.92
Kurtosis	2.15	39.20

Table A.2 Statistics of the Real Prime Interest Rate (1966-1998) and the BestFit Lognormal PDF

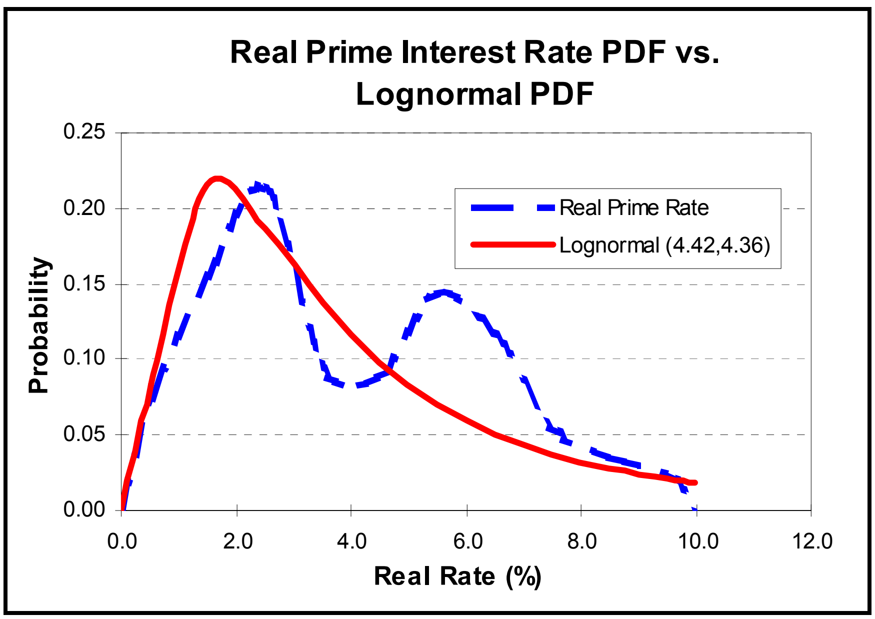


Fig. A.3 Comparison between the Real Prime Interest Rate (1966-1998) and the BestFit Lognormal PDF

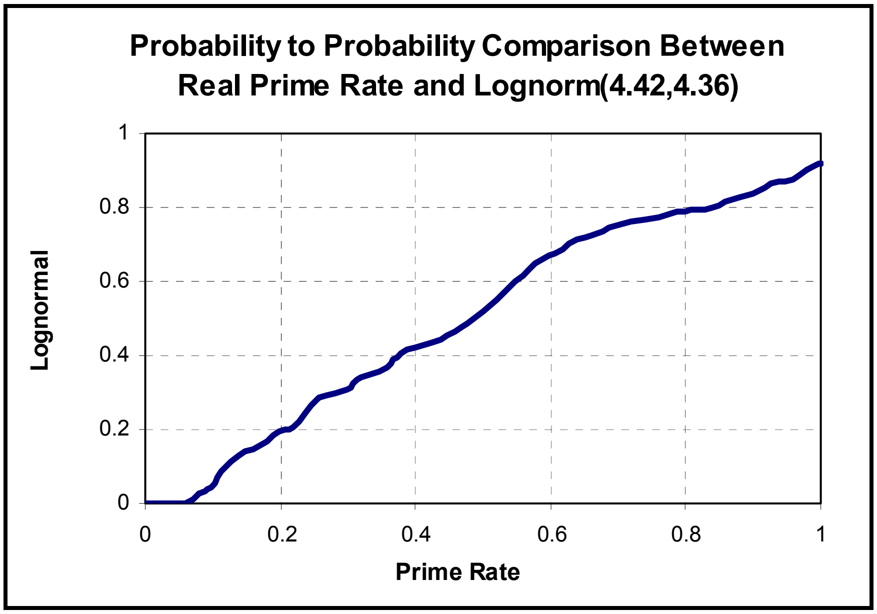


Fig. A.4 Probability to Probability Comparison between the Real Prime Interest Rate (1966-1998) and the BestFit Lognormal PDF

A.3 NOMINAL AND REAL LONDON INTERBANK OFFERED RATE (LIBOR) (1983-1998)

Source Data: Banco de Información Económica del Instituto Nacional de Estadística, Geografía e Informática (1998)

APPENDIX A.3

NOMINAL AND REAL LONDON INTERBANK OFFERED RATE (LIBOR)

Monthly Data (1983-1998)

Month / Year	Inflation in the UK	Nominal LIBOR	Real LIBOR	Month / Year	Inflation in the UK	Nominal LIBOR	Real LIBOR
Jan-83	4.90%	9.44%	4.33%	Jan-87	3.90%	6.25%	2.26%
Feb-83	5.30%	9.31%	3.81%	Feb-87	3.90%	6.44%	2.44%
Mar-83	4.60%	9.25%	4.45%	Mar-87	4.00%	6.56%	2.46%
Apr-83	4.00%	9.50%	5.29%	Apr-87	4.30%	7.13%	2.71%
May-83	3.70%	10.31%	6.37%	May-87	4.20%	7.38%	3.05%
Jun-83	3.70%	10.63%	6.68%	Jun-87	4.30%	7.19%	2.77%
Jul-83	4.20%	10.56%	6.10%	Jul-87	4.50%	7.00%	2.39%
Aug-83	4.60%	9.94%	5.11%	Aug-87	4.50%	7.19%	2.57%
Sep-83	5.10%	9.75%	4.42%	Sep-87	4.30%	8.38%	3.91%
Oct-83	5.00%	9.69%	4.47%	Oct-87	4.50%	7.63%	3.00%
Nov-83	4.80%	9.94%	4.90%	Nov-87	4.10%	8.00%	3.75%
Dec-83	5.30%	9.75%	4.23%	Dec-87	3.70%	8.13%	4.27%
Jan-84	5.10%	9.75%	4.42%	Jan-88	3.40%	7.00%	3.48%
Feb-84	5.10%	10.19%	4.84%	Feb-88	3.30%	6.81%	3.40%
Mar-84	5.20%	10.19%	4.74%	Mar-88	3.50%	6.88%	3.27%
Apr-84	5.20%	10.00%	4.56%	Apr-88	4.00%	7.31%	3.18%
May-84	5.10%	10.50%	5.14%	May-88	4.40%	7.63%	3.09%
Jun-84	5.10%	11.69%	6.27%	Jun-88	4.70%	7.81%	2.97%
Jul-84	4.50%	11.88%	7.06%	Jul-88	4.80%	8.44%	3.47%
Aug-84	5.00%	11.63%	6.31%	Aug-88	5.70%	8.56%	2.71%
Sep-84	4.70%	11.50%	6.49%	Sep-88	5.90%	8.63%	2.58%
Oct-84	5.00%	10.38%	5.12%	Oct-88	6.40%	8.63%	2.10%
Nov-84	4.90%	9.75%	4.62%	Nov-88	6.40%	8.63%	2.10%
Dec-84	4.60%	8.75%	3.97%	Dec-88	6.90%	9.31%	2.25%
Jan-85	5.00%	8.50%	3.33%	Jan-89	7.50%	9.38%	1.75%
Feb-85	5.40%	8.31%	2.76%	Feb-89	7.80%	10.31%	2.33%
Mar-85	6.10%	9.56%	3.26%	Mar-89	7.90%	10.31%	2.23%
Apr-85	6.90%	9.13%	2.09%	Apr-89	8.00%	9.94%	1.80%
May-85	7.00%	7.88%	0.82%	May-89	8.30%	9.56%	1.16%
Jun-85	7.00%	7.81%	0.76%	Jun-89	8.30%	9.31%	0.93%
Jul-85	6.90%	8.31%	1.32%	Jul-89	8.20%	8.56%	0.33%
Aug-85	6.20%	8.06%	1.75%	Aug-89	7.10%	9.00%	1.77%
Sep-85	5.90%	8.25%	2.22%	Sep-89	7.60%	9.18%	1.47%
Oct-85	5.40%	8.13%	2.59%	Oct-89	7.30%	8.68%	1.29%
Nov-85	5.50%	8.19%	2.55%	Nov-89	7.70%	8.50%	0.74%
Dec-85	5.70%	8.06%	2.23%	Dec-89	8.00%	8.37%	0.34%
Jan-86	5.50%	8.06%	2.43%	Jan-90	7.70%	8.37%	0.62%
Feb-86	5.10%	7.94%	2.70%	Feb-90	7.50%	8.37%	0.81%
Mar-86	4.20%	7.44%	3.11%	Mar-90	8.10%	8.50%	0.37%
Apr-86	3.00%	6.88%	3.77%	Apr-90	9.40%	8.75%	-0.59%
May-86	2.80%	7.13%	4.21%	May-90	9.70%	8.37%	-1.21%
Jun-86	2.50%	6.88%	4.27%	Jun-90	9.80%	8.30%	-1.37%
Jul-86	2.40%	6.50%	4.00%	Jul-90	9.80%	7.98%	-1.66%
Aug-86	2.40%	5.81%	3.33%	Aug-90	10.60%	8.05%	-2.31%
Sep-86	3.00%	6.13%	3.04%	Sep-90	10.90%	8.31%	-2.34%
Oct-86	3.00%	5.94%	2.85%	Oct-90	10.90%	7.80%	-2.80%
Nov-86	3.50%	6.13%	2.54%	Nov-90	9.70%	8.43%	-1.16%
Dec-86	3.70%	6.31%	2.52%	Dec-90	9.30%	7.56%	-1.59%

APPENDIX A.3 (Cont.)
NOMINAL AND REAL LONDON INTERBANK OFFERED RATE (LIBOR)
Monthly Data (1983-1998)

Month / Year	Inflation in the UK	Nominal LIBOR	Real LIBOR	Month / Year	Inflation in the UK	Nominal LIBOR	Real LIBOR
Jan-91	9.00%	7.06%	-1.78%	Jan-95	3.40%	6.31%	2.81%
Feb-91	8.90%	6.88%	-1.85%	Feb-95	3.40%	6.25%	2.76%
Mar-91	8.20%	6.56%	-1.52%	Mar-95	3.50%	6.25%	2.66%
Apr-91	6.40%	6.18%	-0.21%	Apr-95	3.30%	6.19%	2.80%
May-91	5.80%	6.06%	0.25%	May-95	3.40%	6.06%	2.57%
Jun-91	5.80%	6.25%	0.43%	Jun-95	3.60%	6.06%	2.37%
Jul-91	5.50%	6.06%	0.53%	Jul-95	3.50%	5.87%	2.29%
Aug-91	4.70%	5.68%	0.94%	Aug-95	3.70%	5.88%	2.10%
Sep-91	4.10%	5.62%	1.46%	Sep-95	3.80%	5.95%	2.07%
Oct-91	3.70%	5.63%	1.86%	Oct-95	3.20%	5.94%	2.66%
Nov-91	4.30%	5.00%	0.67%	Nov-95	3.10%	5.88%	2.70%
Dec-91	4.50%	4.31%	-0.18%	Dec-95	3.20%	5.63%	2.35%
Jan-92	4.10%	4.19%	0.09%	Jan-96	2.80%	5.37%	2.50%
Feb-92	4.10%	4.25%	0.14%	Feb-96	2.70%	5.30%	2.53%
Mar-92	4.00%	4.25%	0.24%	Mar-96	2.70%	5.47%	2.70%
Apr-92	4.30%	4.06%	-0.23%	Apr-96	2.50%	5.48%	2.91%
May-92	4.30%	4.06%	-0.23%	May-96	2.20%	5.50%	3.23%
Jun-92	3.90%	3.94%	0.04%	Jun-96	2.10%	5.58%	3.41%
Jul-92	3.70%	3.44%	-0.25%	Jul-96	2.20%	5.67%	3.40%
Aug-92	3.60%	3.50%	-0.10%	Aug-96	2.10%	5.52%	3.35%
Sep-92	3.60%	3.19%	-0.40%	Sep-96	2.10%	5.62%	3.45%
Oct-92	3.60%	3.05%	-0.53%	Oct-96	2.60%	5.55%	2.88%
Nov-92	3.00%	4.24%	1.20%	Nov-96	2.70%	5.50%	2.73%
Dec-92	2.60%	3.31%	0.69%	Dec-96	2.40%	5.55%	3.08%
Jan-93	1.70%	3.25%	1.52%	Jan-97	2.80%	5.56%	2.68%
Feb-93	1.80%	3.19%	1.37%	Feb-97	2.80%	5.51%	2.64%
Mar-93	1.90%	3.19%	1.27%	Mar-97	2.60%	5.61%	2.93%
Apr-93	1.30%	3.13%	1.81%	Apr-97	2.40%	5.83%	3.35%
May-93	1.30%	3.25%	1.92%	May-97	2.60%	5.82%	3.14%
Jun-93	1.20%	3.19%	1.97%	Jun-97	3.00%	5.79%	2.71%
Jul-93	1.40%	3.31%	1.88%	Jul-97	3.40%	5.75%	2.27%
Aug-93	1.70%	3.25%	1.52%	Aug-97	3.50%	5.72%	2.14%
Sep-93	1.80%	3.38%	1.55%	Sep-97	3.60%	5.72%	2.05%
Oct-93	1.40%	3.19%	1.77%	Oct-97	3.80%	5.77%	1.90%
Nov-93	1.40%	3.50%	2.07%	Nov-97	3.70%	5.84%	2.06%
Dec-93	1.90%	3.38%	1.45%	Dec-97	3.70%	5.91%	2.13%
Jan-94	2.50%	3.25%	0.73%	Jan-98	3.30%	5.64%	2.27%
Feb-94	2.50%	3.75%	1.22%				
Mar-94	2.40%	3.88%	1.45%				
Apr-94	2.50%	4.00%	1.46%				
May-94	2.50%	5.06%	2.50%				
Jun-94	2.60%	5.20%	2.53%				
Jul-94	2.30%	5.61%	3.24%				
Aug-94	2.40%	5.56%	3.09%				
Sep-94	2.20%	5.50%	3.23%				
Oct-94	2.40%	5.63%	3.15%				
Nov-94	2.60%	6.25%	3.56%				
Dec-94	2.90%	6.50%	3.50%				

A.4 STATISTICS AND BESTFIT ANALYSIS RESULTS FOR THE LIBOR (1983-1998)

REAL LIBOR

	Real LIBOR	Lognormal Distribution
Parameter 1 (Mean)		2.98
Parameter 2 (Std. Dev.)		2.75
@RISKFormula		RiskLognorm(2.98,2.75)
Minimum	0.04	
Maximum	7.06	
Mean	2.69	2.98
Mode	2.23	1.18
Median	2.58	2.19
Standard Deviation	1.42	2.75
Variance	2.03	7.56
Skewness	0.88	3.56
Kurtosis	3.54	31.84

Table A.3 Statistics of the LIBOR (1983-1998) and the BestFit Lognormal PDF

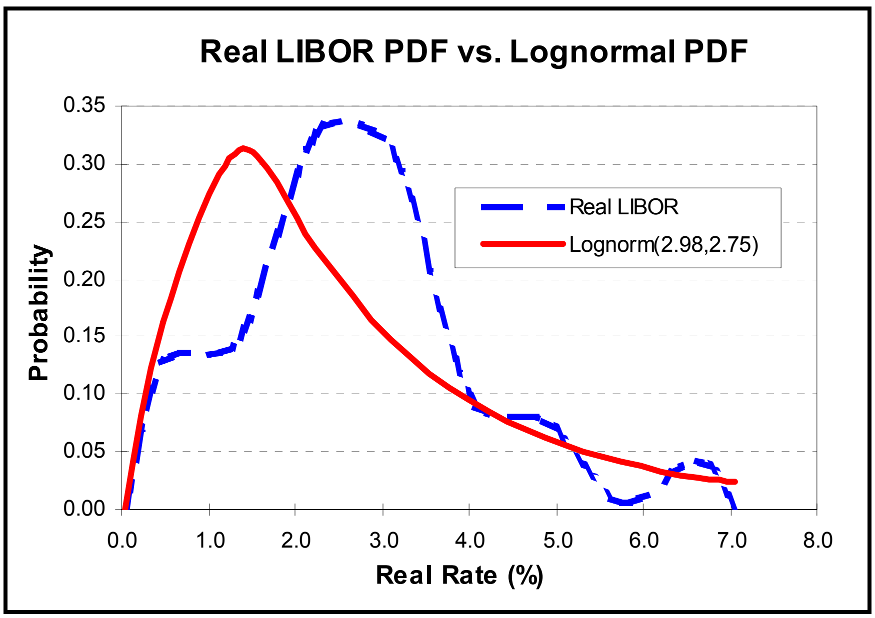


Fig. A.5 Comparison between the LIBOR (1983-1998) and the BestFit Lognormal PDF

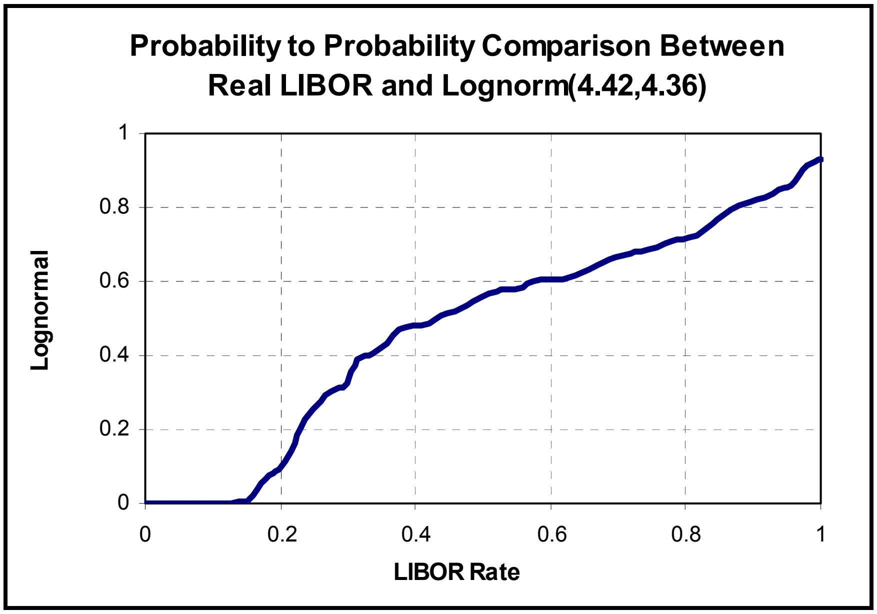


Fig. A.6 Probability to Probability Comparison between the LIBOR (1983-1998) and the BestFit Lognormal PDF

A.5 SIMULATION ANALYSIS USED TO ARRIVE AT THE VARIABLE DISCOUNT RATE

SECURITY	NOMINAL RETURN			
	MEAN	STD DEV	LOW	HIGH
S&P 500	12.45%	22.28%	-29.73%	42.56%
US GOVT BONDS	5.21%	8.00%	-8.41%	15.23%

SECURITY	REAL RETURN			
	MEAN	STD DEV	LOW	HIGH
S&P 500	8.96%	22.28%	-31.91%	38.14%
US GOVT BONDS	1.95%	8.00%	-11.25%	11.66%

SECURITY	LOGNORMAL @RISK PDF
S&P 500	8.96%
US GOVT BONDS	1.95%
RISK PREMIUM	7.02%

Risk Premium = S&P 500 - US Bonds

Average inflation considered = 3.2% (Rao, 1992)

Sources: Goetzmann, 1998 and Rao, 1992

Returns over the period 1926-1995

Table A.4 Input Data Considered to Establish an Uncertain Discount Rate with @RISK

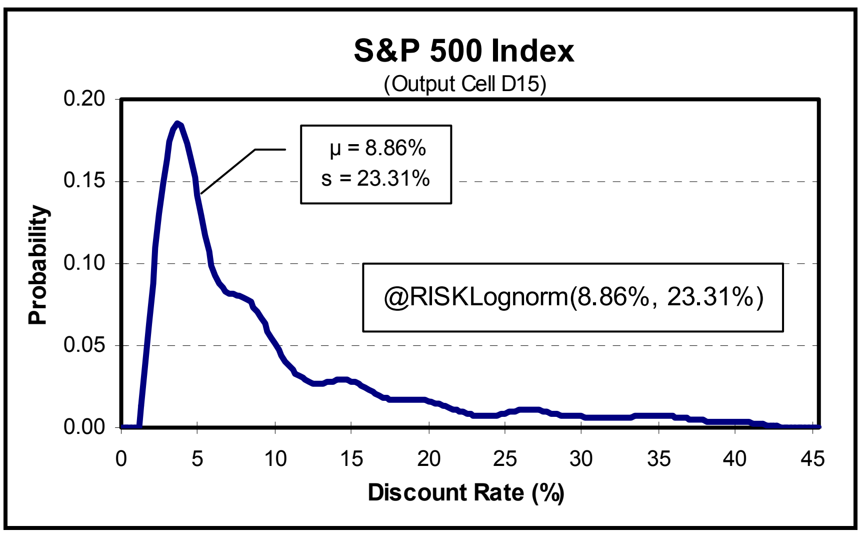


Fig. A.7 @RISK PDF Simulation Results for the S&P 500 Index (or the Discount Rate Used in the FEMTH)

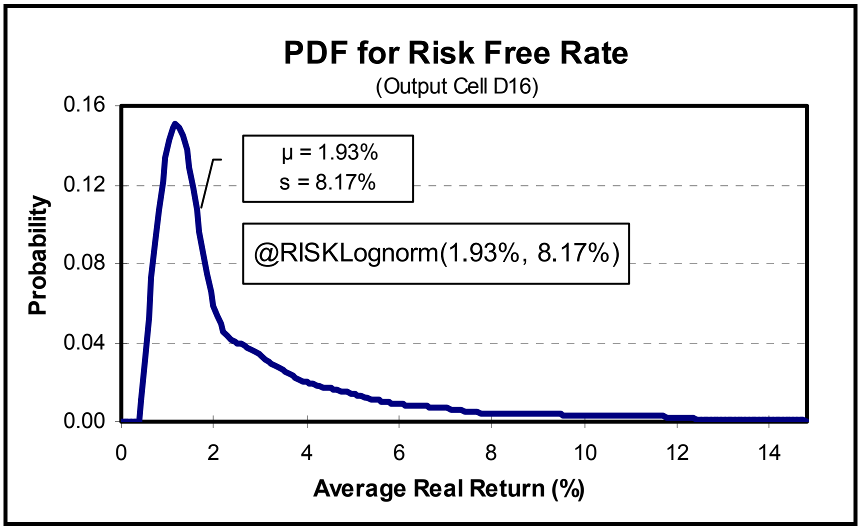


Fig. A.8 @RISK PDF Simulation Results for the US Treasury Long Term Bonds (or Risk Free Rate)

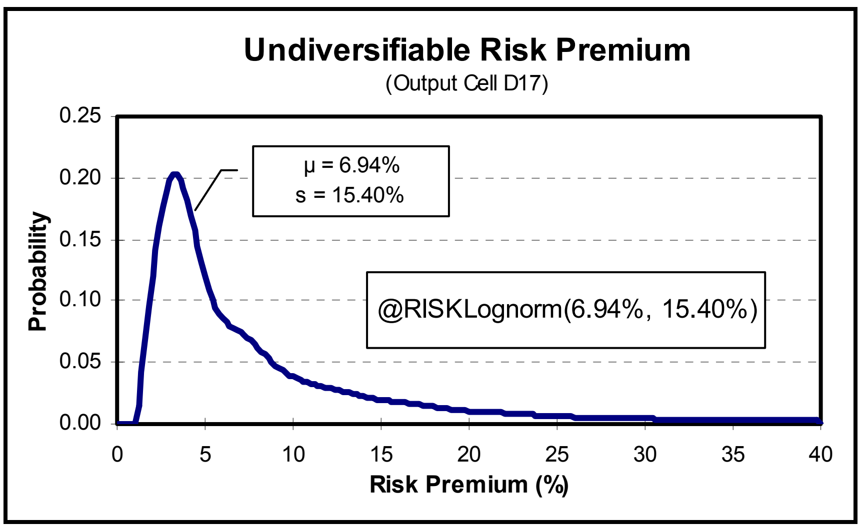


Fig. A.9 @RISK PDF Simulation Results for the Risk Premium (S&P 500 Index Return – Risk Free Return)

SUMMARY OF SIMULATION STATISTICS					
Name	**RISK FREE (26-95)**	**RISK PREMIUM**	**S&P 500**	**S&P 500**	**RISK FREE (26-95)**
Description	Output	Output	Output	Lognorm(D11,E11)	Lognorm(D12,E12)
Cell	D16	D17	D15	D15	D16
Mean =	1.93%	6.94%	8.86%	8.86%	1.93%
Std Deviation =	8.17%	15.40%	23.31%	23.31%	8.17%
Variance =	0.67%	2.37%	5.43%	5.43%	0.67%
Skewness =	28.40	13.62	16.85	16.85	28.40
Kurtosis =	1392.39	460.88	547.31	547.31	1392.39
Errors Calculated =	0	0	0	0	0
Mode =	0.03%	0.29%	0.48%	0.48%	0.03%
5% Perc =	0.03%	-3.89%	0.33%	0.33%	0.03%
10% Perc =	0.05%	-1.18%	0.54%	0.54%	0.05%
15% Perc =	0.08%	-0.32%	0.77%	0.77%	0.08%
20% Perc =	0.11%	0.09%	1.02%	1.02%	0.11%
25% Perc =	0.14%	0.36%	1.30%	1.30%	0.14%
30% Perc =	0.18%	0.68%	1.60%	1.60%	0.18%
35% Perc =	0.24%	1.01%	1.94%	1.94%	0.24%
40% Perc =	0.30%	1.40%	2.34%	2.34%	0.30%
45% Perc =	0.37%	1.84%	2.82%	2.82%	0.37%
50% Perc =	0.46%	2.36%	3.38%	3.38%	0.46%
55% Perc =	0.57%	2.98%	4.00%	4.00%	0.57%
60% Perc =	0.71%	3.73%	4.82%	4.82%	0.71%
65% Perc =	0.88%	4.65%	5.82%	5.82%	0.88%
70% Perc =	1.12%	5.80%	7.02%	7.02%	1.12%
75% Perc =	1.43%	7.43%	8.59%	8.59%	1.43%
80% Perc =	1.90%	9.63%	10.83%	10.83%	1.90%
85% Perc =	2.65%	12.90%	14.12%	14.12%	2.65%
90% Perc =	4.00%	18.74%	20.12%	20.12%	4.00%
95% Perc =	7.64%	32.26%	33.52%	33.52%	7.64%

Table A.5 Summary of Simulation Statistics for the Discount Rate

APPENDIX B.

TYPICAL BOT RISK ANALYSIS RISK MATRIX AND FLOW CHART

Courtesy of Baker and McKenzie (1998)

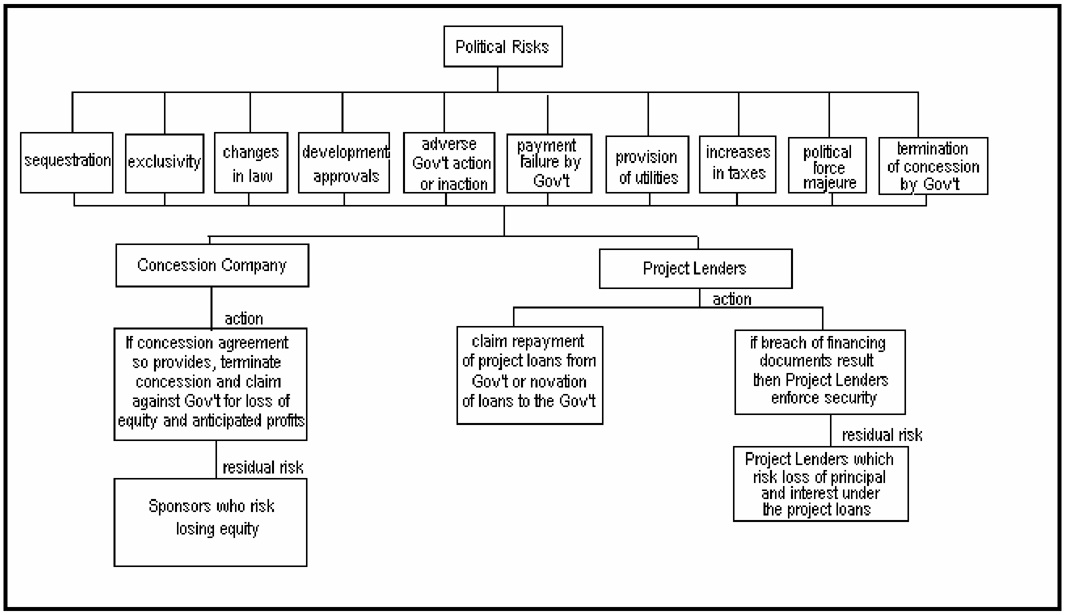


Fig. B.1 BOT Project Political Risks Matrix and Flow Chart (Courtesy of Baker and Mackenzie, 1998)

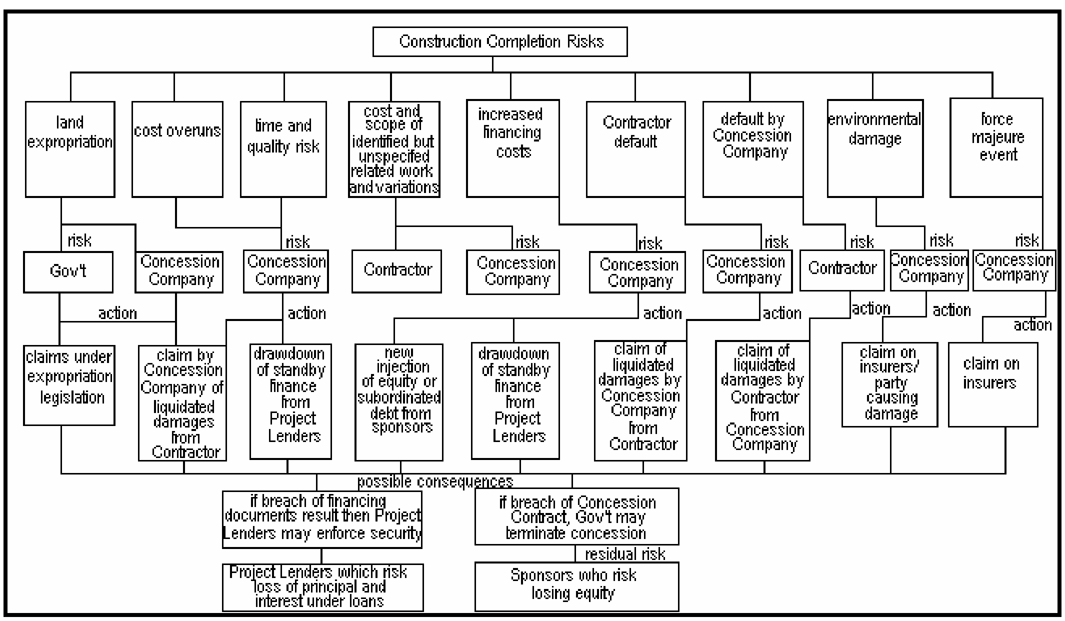


Fig. B.2 BOT Project Construction Completion Risks Matrix and Flow Chart (Courtesy of Baker and Mackenzie, 1998)

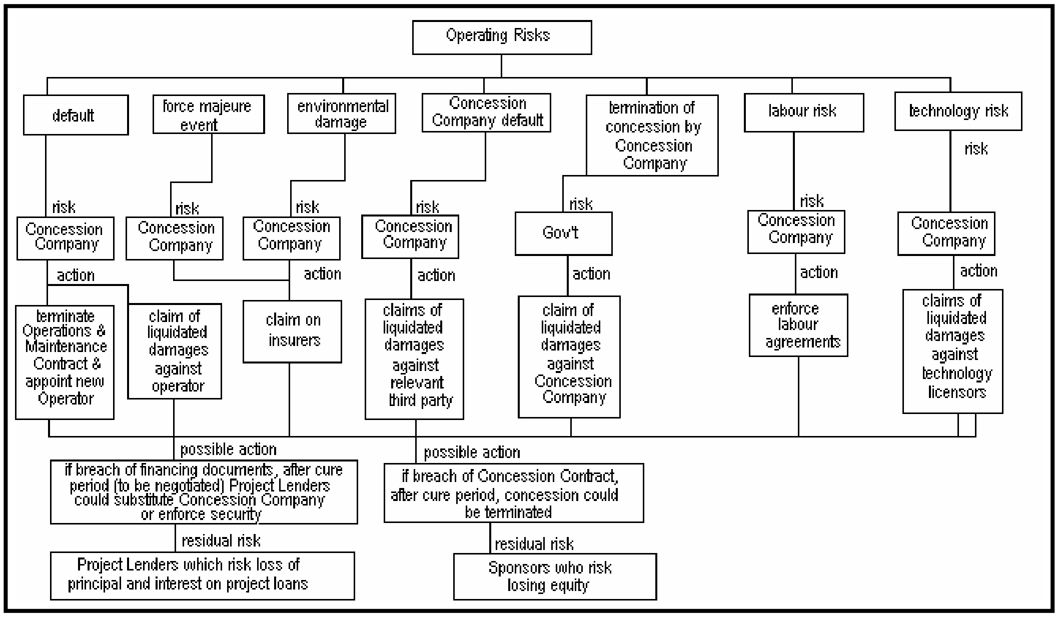


Fig. B.3 BOT Project Operating Risks Matrix and Flow Chart (Courtesy of Baker and Mackenzie, 1998)

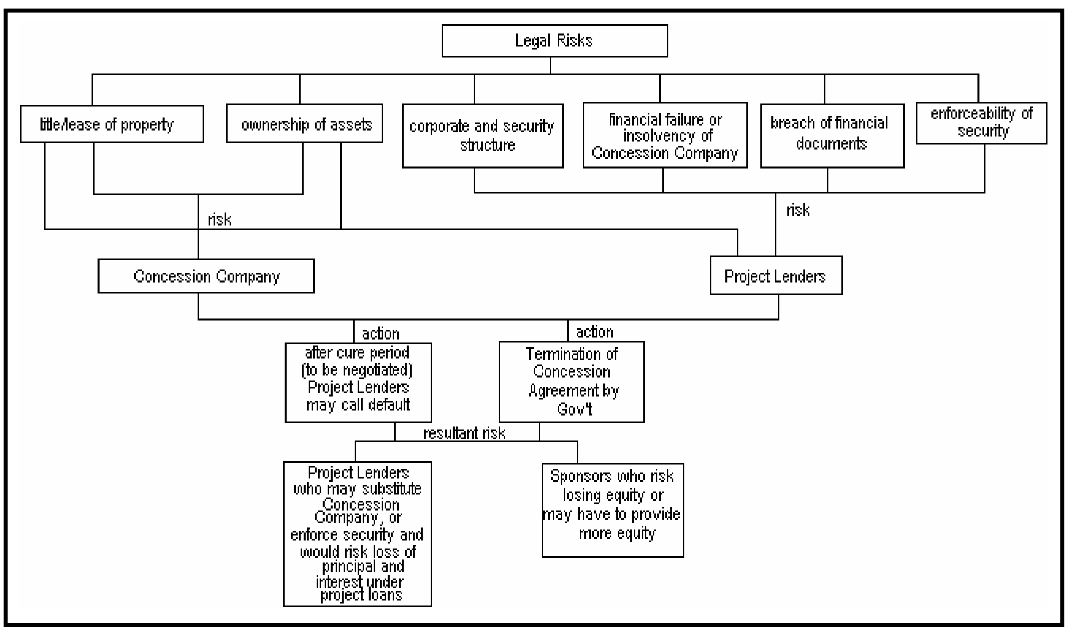


Fig. B.4 BOT Project Legal Risks Matrix and Flow Chart (Courtesy of Baker and Mackenzie, 1998)

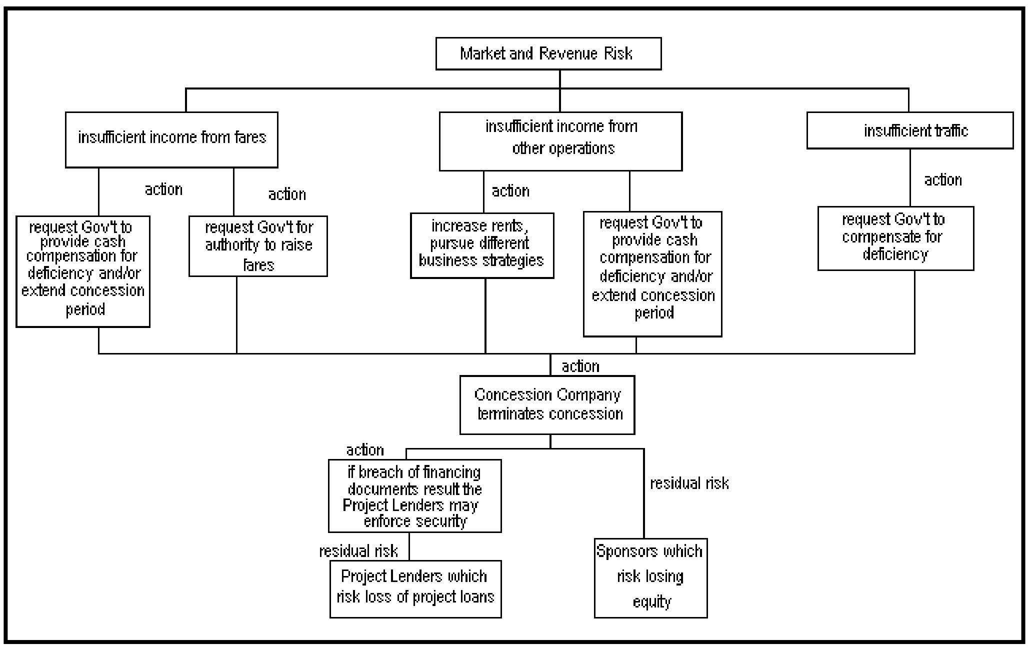


Fig. B.5 BOT Project Market and Revenue Risks Matrix and Flow Chart (Courtesy of Baker and Mackenzie, 1998)

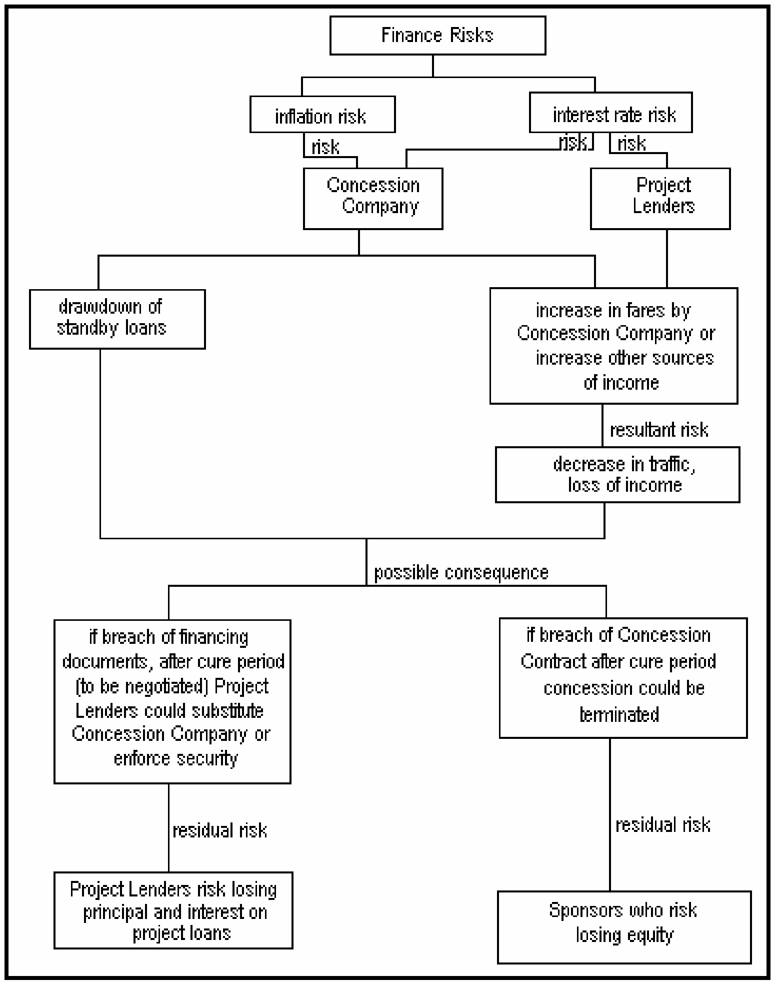


Fig. B.6 BOT Project Finance Risks Matrix and Flow Chart (Courtesy of Baker and Mackenzie, 1998)

APPENDIX C.

DATA FOR THE ADJUSTED EXCHANGE RATE INDEX ANALYSIS (AERI)

Source Data: Banco de Información Económica del Instituto Nacional de Estadística, Geografía e Informática (1998) and Board of Governors of the Federal Reserve System (1998)

ADJUSTED EXCHANGE RATE INDEX (1990/01 = 100)						
PERIOD	NOMINAL PESOS / DOLLAR	CPI MEXICO (1990/01=100)	1990/01 PESOS / DOLLAR	EXCHANGE RATE INDEX (ERI) (1990/01=100)	CPI USA (1990/01=100)	ERI ADJUSTED FOR USA CPI (AERI) (1990/01=100)
1-80	0.0228	0.664	0.00015	0.8412	61.07	0.51
2-80	0.0229	0.683	0.00016	0.8449	61.93	0.52
3-80	0.0229	0.683	0.00016	0.8449	62.87	0.53
4-80	0.0228	0.701	0.00016	0.8412	63.58	0.53
5-80	0.0229	0.720	0.00016	0.8449	64.21	0.54
6-80	0.0229	0.720	0.00016	0.8449	64.91	0.55
7-80	0.0230	0.738	0.00017	0.8486	64.91	0.55
8-80	0.0230	0.757	0.00017	0.8486	65.38	0.55
9-80	0.0231	0.775	0.00018	0.8522	65.93	0.56
10-80	0.0231	0.775	0.00018	0.8522	66.56	0.57
11-80	0.0232	0.794	0.00018	0.8559	67.11	0.57
12-80	0.0233	0.812	0.00019	0.8596	67.74	0.58
1-81	0.0234	0.849	0.00020	0.8633	68.29	0.59
2-81	0.0236	0.867	0.00020	0.8707	69.00	0.60
3-81	0.0238	0.886	0.00021	0.8781	69.47	0.61
4-81	0.0240	0.904	0.00022	0.8854	69.94	0.62
5-81	0.0242	0.923	0.00022	0.8928	70.49	0.63
6-81	0.0244	0.923	0.00023	0.9002	71.11	0.64
7-81	0.0246	0.941	0.00023	0.9076	71.90	0.65
8-81	0.0249	0.960	0.00024	0.9186	72.45	0.67
9-81	0.0252	0.978	0.00025	0.9297	73.16	0.68
10-81	0.0255	0.997	0.00025	0.9408	73.31	0.69
11-81	0.0258	1.015	0.00026	0.9519	73.55	0.70
12-81	0.0262	1.052	0.00028	0.9666	73.78	0.71
1-82	0.0266	1.107	0.00029	0.9814	74.02	0.73
2-82	0.0465	1.144	0.00053	1.7156	74.25	1.27
3-82	0.0453	1.181	0.00054	1.6713	74.18	1.24
4-82	0.0461	1.255	0.00058	1.7008	74.49	1.27
5-82	0.0469	1.329	0.00062	1.7303	75.20	1.30
6-82	0.0478	1.384	0.00066	1.7635	76.14	1.34
7-82	0.0486	1.458	0.00071	1.7930	76.53	1.37
8-82	0.0695	1.624	0.00113	2.5641	76.69	1.97
9-82	0.0700	1.717	0.00120	2.5825	76.84	1.98
10-82	0.0700	1.790	0.00125	2.5825	77.08	1.99
11-82	0.0700	1.883	0.00132	2.5825	76.92	1.99
12-82	0.0963	2.086	0.00201	3.5529	76.61	2.72
1-83	0.1005	2.326	0.00234	3.7078	76.77	2.85
2-83	0.1041	2.436	0.00254	3.8406	76.84	2.95
3-83	0.1080	2.566	0.00277	3.9845	76.84	3.06
4-83	0.1119	2.732	0.00306	4.1284	77.39	3.20
5-83	0.1161	2.842	0.00330	4.2833	77.86	3.34
6-83	0.1200	2.953	0.00354	4.4272	78.10	3.46
7-83	0.1237	3.101	0.00384	4.5637	78.41	3.58
8-83	0.1280	3.212	0.00411	4.7224	78.65	3.71
9-83	0.1319	3.322	0.00438	4.8663	79.04	3.85
10-83	0.1360	3.433	0.00467	5.0175	79.28	3.98
11-83	0.1399	3.618	0.00506	5.1614	79.43	4.10
12-83	0.1436	3.784	0.00543	5.2979	79.51	4.21

ADJUSTED EXCHANGE RATE INDEX (1990/01 = 100)						
PERIOD	NOMINAL PESOS / DOLLAR	CPI MEXICO (1990/01=100)	1990/01 PESOS / DOLLAR	EXCHANGE RATE INDEX (ERI) (1990/01=100)	CPI USA (1990/01=100)	ERI ADJUSTED FOR USA CPI (AERI) (1990/01=100)
1-84	0.1479	4.024	0.00595	5.4566	79.98	4.36
2-84	0.1517	4.227	0.00641	5.5968	80.38	4.50
3-84	0.1556	4.411	0.00686	5.7406	80.53	4.62
4-84	0.1596	4.614	0.00736	5.8882	80.93	4.77
5-84	0.1636	4.762	0.00779	6.0358	81.16	4.90
6-84	0.1674	4.928	0.00825	6.1760	81.40	5.03
7-84	0.1716	5.094	0.00874	6.3309	81.71	5.17
8-84	0.1756	5.242	0.00920	6.4785	82.03	5.31
9-84	0.1792	5.389	0.00966	6.6113	82.42	5.45
10-84	0.1835	5.574	0.01023	6.7700	82.65	5.60
11-84	0.1874	5.777	0.01083	6.9139	82.65	5.71
12-84	0.1920	6.017	0.01155	7.0836	82.65	5.85
1-85	0.1977	6.460	0.01277	7.2939	82.81	6.04
2-85	0.2025	6.737	0.01364	7.4709	83.20	6.22
3-85	0.2084	6.995	0.01458	7.6886	83.52	6.42
4-85	0.2151	7.217	0.01552	7.9358	83.91	6.66
5-85	0.2216	7.383	0.01636	8.1756	84.22	6.89
6-85	0.2275	7.567	0.01722	8.3933	84.46	7.09
7-85	0.3563	7.826	0.02788	13.1452	84.62	11.12
8-85	0.3381	8.176	0.02764	12.4737	84.77	10.57
9-85	0.3690	8.490	0.03133	13.6137	85.01	11.57
10-85	0.4043	8.822	0.03567	14.9161	85.32	12.73
11-85	0.4893	9.228	0.04516	18.0520	85.56	15.44
12-85	0.4657	9.856	0.04590	17.1813	85.79	14.74
1-86	0.4496	10.724	0.04821	16.5873	86.03	14.27
2-86	0.4702	11.203	0.05268	17.3474	85.79	14.88
3-86	0.4791	11.720	0.05615	17.6757	85.40	15.10
4-86	0.5049	12.329	0.06225	18.6276	85.24	15.88
5-86	0.5362	13.031	0.06987	19.7823	85.48	16.91
6-86	0.6314	13.861	0.08752	23.2946	85.95	20.02
7-86	0.6370	14.544	0.09265	23.5012	85.95	20.20
8-86	0.6847	15.707	0.10755	25.2610	86.11	21.75
9-86	0.7458	16.648	0.12416	27.5152	86.50	23.80
10-86	0.8004	17.608	0.14093	29.5296	86.58	25.57
11-86	0.8518	18.789	0.16005	31.4259	86.66	27.23
12-86	0.9003	20.284	0.18262	33.2153	86.73	28.81
1-87	0.9567	21.927	0.20977	35.2961	87.28	30.81
2-87	1.0217	23.496	0.24006	37.6942	87.60	33.02
3-87	1.0923	25.046	0.27358	40.2988	87.99	35.46
4-87	1.1598	27.243	0.31596	42.7892	88.46	37.85
5-87	1.2357	29.291	0.36195	45.5894	88.78	40.47
6-87	1.3179	31.414	0.41400	48.6220	89.09	43.32
7-87	1.3891	33.961	0.47175	51.2488	89.32	45.78
8-87	1.4593	36.748	0.53626	53.8388	89.80	48.35
9-87	1.5351	39.166	0.60123	56.6353	90.27	51.12
10-87	1.6106	42.433	0.68342	59.4208	90.50	53.78
11-87	1.9505	45.792	0.89317	71.9609	90.58	65.18
12-87	2.2739	52.547	1.19487	83.8923	90.58	75.99

ADJUSTED EXCHANGE RATE INDEX (1990/01 = 100)						
PERIOD	NOMINAL PESOS / DOLLAR	CPI MEXICO (1990/01=100)	1990/01 PESOS / DOLLAR	EXCHANGE RATE INDEX (ERI) (1990/01=100)	CPI USA (1990/01=100)	ERI ADJUSTED FOR USA CPI (AERI) (1990/01=100)
1-88	2.2632	60.687	1.37346	83.4975	90.82	75.83
2-88	2.3020	65.744	1.51342	84.9290	91.05	77.33
3-88	2.3300	69.103	1.61010	85.9620	91.44	78.61
4-88	2.3300	71.226	1.65956	85.9620	91.92	79.01
5-88	2.3300	72.610	1.69181	85.9620	92.23	79.28
6-88	2.3300	74.086	1.72621	85.9620	92.62	79.62
7-88	2.3300	75.323	1.75503	85.9620	93.01	79.96
8-88	2.3300	76.024	1.77137	85.9620	93.41	80.29
9-88	2.3300	76.449	1.78126	85.9620	94.03	80.83
10-88	2.3300	77.039	1.79502	85.9620	94.35	81.10
11-88	2.3300	78.073	1.81910	85.9620	94.43	81.17
12-88	2.3300	79.697	1.85695	85.9620	94.58	81.31
1-89	2.3470	81.654	1.91641	86.5892	95.05	82.31
2-89	2.3751	82.761	1.96566	87.6259	95.45	83.64
3-89	2.4044	83.647	2.01121	88.7069	96.00	85.16
4-89	2.4350	84.902	2.06737	89.8358	96.62	86.80
5-89	2.4654	86.083	2.12230	90.9574	97.17	88.39
6-89	2.4961	87.117	2.17453	92.0900	97.41	89.70
7-89	2.5265	87.984	2.22293	93.2116	97.65	91.02
8-89	2.5576	88.834	2.27201	94.3590	97.80	92.29
9-89	2.5881	89.683	2.32107	95.4842	98.12	93.69
10-89	2.6185	91.011	2.38313	96.6058	98.59	95.24
11-89	2.6489	92.285	2.44454	97.7274	98.82	96.58
12-89	2.6793	95.404	2.55616	98.8489	98.98	97.84
1-90	2.7105	100.000	2.71050	100.0000	100.00	100.00
2-90	2.7400	102.270	2.80220	101.0884	100.47	101.56
3-90	2.7695	104.079	2.88247	102.1767	101.02	103.22
4-90	2.7998	105.648	2.95793	103.2946	101.18	104.51
5-90	2.8305	107.494	3.04260	104.4272	101.41	105.90
6-90	2.8572	109.874	3.13933	105.4123	101.96	107.48
7-90	2.8805	111.868	3.22235	106.2719	102.35	108.77
8-90	2.8979	113.769	3.29691	106.9139	103.30	110.44
9-90	2.9077	115.393	3.35529	107.2754	104.16	111.74
10-90	2.9212	117.054	3.41939	107.7735	104.79	112.93
11-90	2.9415	120.155	3.53436	108.5224	105.02	113.97
12-90	2.9543	123.957	3.66207	108.9947	105.02	114.47
1-91	2.9668	127.113	3.77120	109.4558	105.65	115.64
2-91	2.9786	129.328	3.85217	109.8912	105.81	116.27
3-91	2.9903	131.174	3.92249	110.3228	105.97	116.90
4-91	3.0026	132.540	3.97964	110.7766	106.12	117.56
5-91	3.0148	133.850	4.03531	111.2267	106.44	118.39
6-91	3.0270	135.253	4.09410	111.6768	106.75	119.22
7-91	3.0392	136.434	4.14651	112.1269	106.91	119.87
8-91	3.0516	137.394	4.19271	112.5844	107.22	120.71
9-91	3.0638	138.760	4.25132	113.0345	107.69	121.73
10-91	3.0761	140.384	4.31835	113.4883	107.85	122.40
11-91	3.0872	143.854	4.44106	113.8978	108.16	123.20
12-91	3.0932	147.250	4.55473	114.1192	108.24	123.52

ADJUSTED EXCHANGE RATE INDEX (1990/01 = 100)						
PERIOD	NOMINAL PESOS / DOLLAR	CPI MEXICO (1990/01=100)	1990/01 PESOS / DOLLAR	EXCHANGE RATE INDEX (ERI) (1990/01=100)	CPI USA (1990/01=100)	ERI ADJUSTED FOR USA CPI (AERI) (1990/01=100)
1-92	3.1026	149.926	4.65161	114.4660	108.40	124.08
2-92	3.1082	151.698	4.71508	114.6726	108.79	124.75
3-92	3.1146	153.248	4.77308	114.9087	109.34	125.64
4-92	3.1206	154.614	4.82489	115.1300	109.50	126.06
5-92	3.1264	155.629	4.86560	115.3440	109.65	126.48
6-92	3.1328	156.681	4.90852	115.5802	110.05	127.19
7-92	3.1390	157.678	4.94952	115.8089	110.28	127.72
8-92	3.1452	158.638	4.98948	116.0376	110.60	128.33
9-92	3.1512	160.022	5.04262	116.2590	110.91	128.94
10-92	3.1592	161.166	5.09157	116.5541	111.30	129.73
11-92	3.1716	162.514	5.15429	117.0116	111.46	130.42
12-92	3.1718	164.821	5.22779	117.0190	111.38	130.34
1-93	3.1910	166.888	5.32540	117.7274	111.93	131.77
2-93	3.2019	168.254	5.38732	118.1295	112.32	132.69
3-93	3.2139	169.232	5.43895	118.5722	112.72	133.65
4-93	3.2269	170.210	5.49252	119.0518	113.03	134.56
5-93	3.2387	171.189	5.54429	119.4872	113.19	135.24
6-93	3.2505	172.148	5.59568	119.9225	113.34	135.92
7-93	3.2628	172.979	5.64396	120.3763	113.34	136.44
8-93	3.2752	173.902	5.69563	120.8338	113.66	137.34
9-93	3.2876	175.194	5.75967	121.2913	113.89	138.14
10-93	3.2996	175.895	5.80384	121.7340	114.36	139.22
11-93	3.3121	176.689	5.85211	122.1952	114.44	139.84
12-93	3.3239	178.018	5.91713	122.6305	114.44	140.34
1-94	3.3365	179.402	5.98575	123.0954	114.76	141.26
2-94	3.3480	180.325	6.03728	123.5196	115.15	142.23
3-94	3.3594	181.266	6.08946	123.9402	115.54	143.20
4-94	3.3726	182.152	6.14326	124.4272	115.70	143.96
5-94	3.3846	183.020	6.19448	124.8700	115.78	144.57
6-94	3.3967	183.942	6.24797	125.3164	116.17	145.58
7-94	3.4087	184.755	6.29773	125.7591	116.48	146.49
8-94	3.4211	185.622	6.35031	126.2166	116.95	147.62
9-94	3.4336	186.932	6.41851	126.6777	117.27	148.55
10-94	3.4457	187.911	6.47484	127.1241	117.35	149.18
11-94	3.4583	188.926	6.53362	127.5890	117.50	149.92
12-94	3.5499	190.587	6.76565	130.9685	117.50	153.89
1-95	6.2000	197.748	12.26039	228.7401	117.97	269.86
2-95	6.2000	206.128	12.77992	228.7401	118.45	270.93
3-95	6.8000	218.291	14.84378	250.8762	118.84	298.14
4-95	6.1000	235.677	14.37632	225.0507	119.23	268.33
5-95	6.2000	245.533	15.22307	228.7401	119.47	273.27
6-95	6.2800	253.322	15.90864	231.6916	119.70	277.34
7-95	6.2000	258.490	16.02639	228.7401	119.70	273.81
8-95	6.3000	262.772	16.55465	232.4294	120.02	278.95
9-95	6.4000	268.217	17.16589	236.1188	120.25	283.94
10-95	7.2000	273.736	19.70897	265.6336	120.64	320.47
11-95	7.6000	280.472	21.31591	280.3911	120.57	338.05
12-95	7.7500	289.627	22.44611	285.9251	120.49	344.50

ADJUSTED EXCHANGE RATE INDEX (1990/01 = 100)						
PERIOD	NOMINAL PESOS / DOLLAR	CPI MEXICO (1990/01=100)	1990/01 PESOS / DOLLAR	EXCHANGE RATE INDEX (ERI) (1990/01=100)	CPI USA (1990/01=100)	ERI ADJUSTED FOR USA CPI (AERI) (1990/01=100)
1-96	7.4500	300.037	22.35275	274.8570	121.19	333.11
2-96	7.6500	307.032	23.48796	282.2357	121.59	343.16
3-96	7.5500	313.787	23.69095	278.5464	122.21	340.42
4-96	7.4600	322.721	24.07495	275.2260	122.68	337.66
5-96	7.4200	328.590	24.38137	273.7502	122.92	336.49
6-96	7.6000	333.942	25.37962	280.3911	123.00	344.88
7-96	7.6300	338.686	25.84173	281.4979	123.23	346.90
8-96	7.6100	343.189	26.11671	280.7600	123.47	346.65
9-96	7.5600	348.690	26.36093	278.9153	123.86	345.47
10-96	8.0500	353.027	28.41867	296.9932	124.25	369.03
11-96	7.8900	358.379	28.27614	291.0902	124.49	362.38
12-96	7.8900	369.860	29.18193	291.0902	124.49	362.38
1-97	7.8500	379.365	29.78016	289.6145	124.88	361.68
2-97	8.0000	385.751	30.86010	295.1485	125.27	369.75
3-97	7.9800	390.550	31.16589	294.4106	125.59	369.75
4-97	7.9800	394.758	31.50171	294.4106	125.75	370.21
5-97	7.9300	398.357	31.58974	292.5659	125.67	367.66
6-97	7.9700	401.901	32.03152	294.0417	125.82	369.98
7-97	7.8300	405.408	31.74344	288.8766	125.98	363.93
8-97	7.8500	409.007	32.10705	289.6145	126.22	365.54
9-97	7.8200	414.101	32.38271	288.5077	126.53	365.05
10-97	8.6000	417.405	35.89683	317.2846	126.84	402.46
11-97	8.3500	422.075	35.24323	308.0612	126.77	390.52
12-97	8.1500	427.999	34.88194	300.6825	126.61	380.69
1-98	8.6000	437.302	37.60794	317.2846	126.84	402.46
2-98	8.7000	444.961	38.71163	320.9740	127.08	407.89

APPENDIX D.

CODE LISTING FOR THE FEASIBILITY EVALUATION MODEL FOR TOLL HIGHWAYS

This Appendix illustrates the code and formulae listing for the FEMTH Excel spreadsheet template. The column and row headers together with the formulae detail the logic followed throughout the model to express the interrelationships among the variables and arrive at the project's objective function. The two different input forms discussed in Chapter 6 are included in the figures. The listing shows only the first periods (quarters and months) of the analysis, since the subsequent periods follow the same logic and are easily obtained by using the "*Fill*" command in the Excel "*Edit*" menu. Finally, the code further illustrates the use of the @RISK commands throughout the spreadsheet structure.

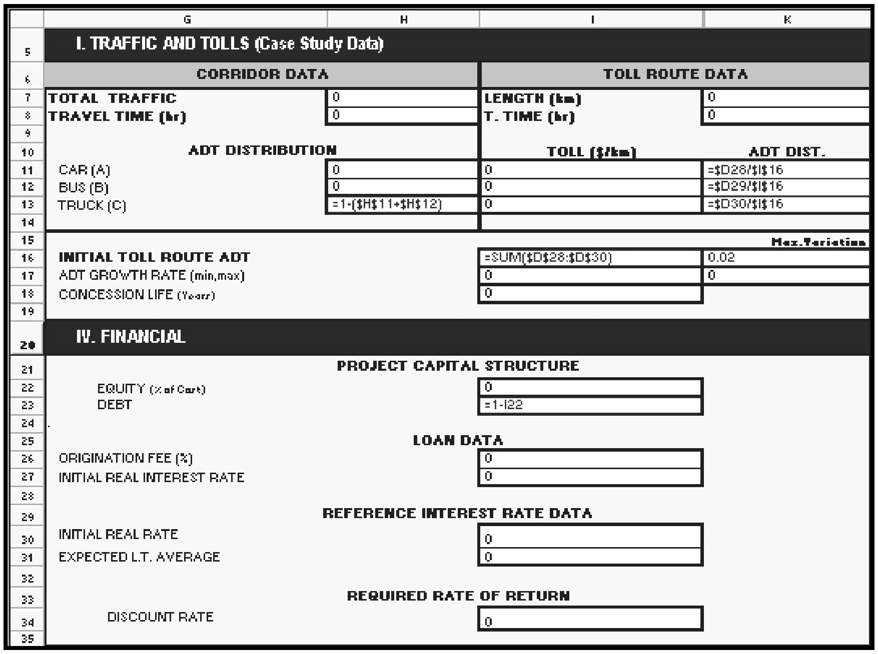


Fig. D.1 Code for Sections I and IV of the Case Study Input Form

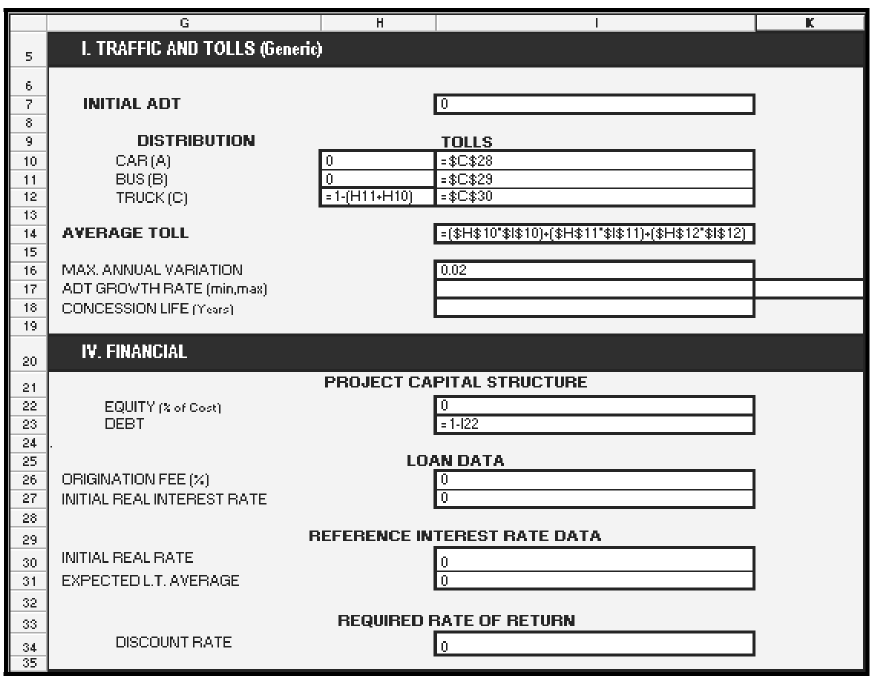
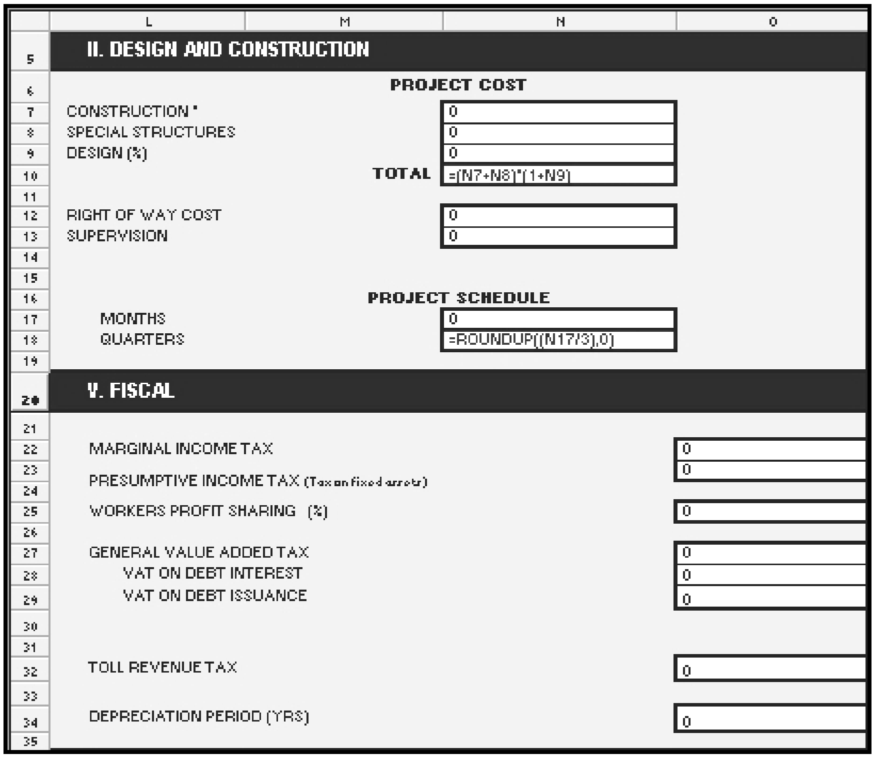


Fig. D.2 Code for Sections I and IV of the Generic Input Form



Row	L	M	N	O
5	II. DESIGN AND CONSTRUCTION			
6		PROJECT COST		
7	CONSTRUCTION *		0	
8	SPECIAL STRUCTURES		0	
9	DESIGN (%)		0	
10		TOTAL	=(N7+N8)*(1+N9)	
11				
12	RIGHT OF WAY COST		0	
13	SUPERVISION		0	
14				
15				
16		PROJECT SCHEDULE		
17	MONTHS		0	
18	QUARTERS		=ROUNDUP((N17/3),0)	
19				
20	V. FISCAL			
21				
22	MARGINAL INCOME TAX			0
23	PRESUMPTIVE INCOME TAX (Tax on fixed assets)			0
24				
25	WORKERS PROFIT SHARING (%)			0
26				
27	GENERAL VALUE ADDED TAX			0
28	VAT ON DEBT INTEREST			0
29	VAT ON DEBT ISSUANCE			0
30				
31				
32	TOLL REVENUE TAX			0
33				
34	DEPRECIATION PERIOD (YRS)			0
35				

Fig. D.3 Code for Sections II and V of the Input Forms

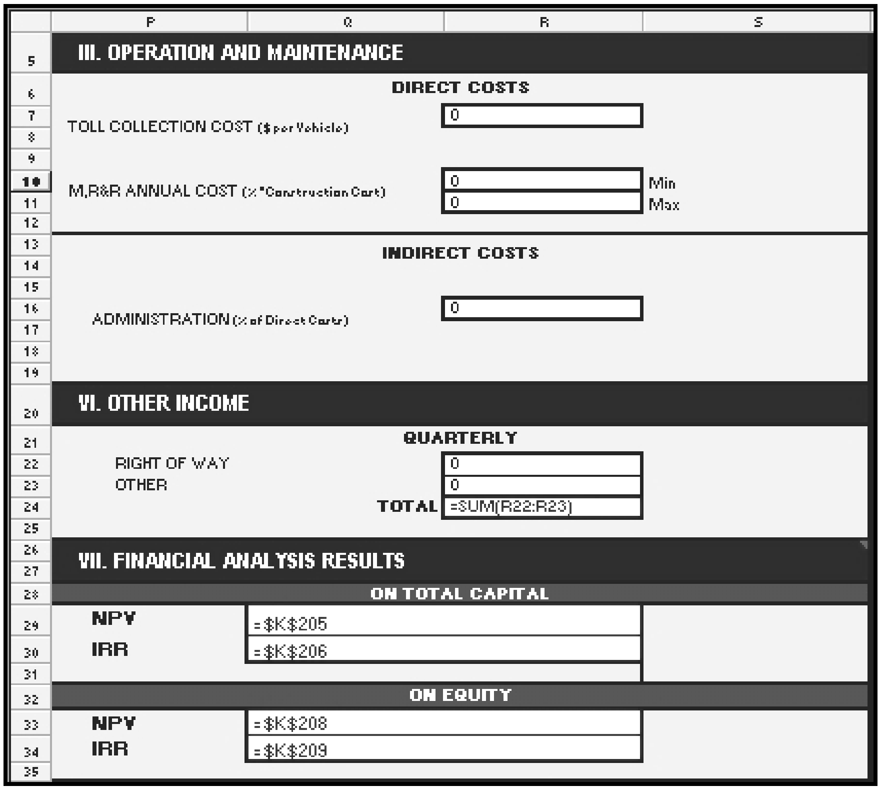


Fig. D.4 Code for Sections III, VI and VII of the Input Forms

	A	B	C	D
5			**I. TRAFFIC AND TOLLS**	
6				
7	**INITIAL ADT**		=I16	
8				
9	**DISTRIBUTION**		**TOLLS**	
10	CAR (A)	=$K$11	=$C$28	
11	BUS (B)	=$K$12	=$C$29	
12	TRUCK (C)	=1-(B11+B10)	=$C$30	
13				
14	**AVERAGE TOLL**		=($B$10*$C$10)+($B$11*$C$11)+($B$12*$C$12)	
15				
16	ADT GROWTH RATE		=$I$17	=$K$17
17	CONCESSION LIFE (Years)		=$I$18	
18				
19				
20				
21	**TOTAL ROUTE TRAFFIC**		**ADT DIV**	**ADT PDF CORRECT**
22				
23	A	=$H$7*$H$11	=IF(($H$8/$K$8)-1<0.6,-43.48*LN($I$11)-73.78,-25.99*LN($I$11)-19.61)	=$C$23*(1+RiskTnormal(-0.1,0.15,-0.4,0.15))
24	B	=$H$7*$H$12	=IF(($H$8/$K$8)-1<0.6,-48.25*LN($I$12)-44.12,-10.31*LN($I$12)+39.47)	=$C$24*(1+RiskTnormal(-0.05,0.25,-0.5,0.5))
25	C	=$H$7*H13	=IF(($H$8/$K$8)-1<0.6,-148.86*LN($I$13)-178.42,-43.22*LN($I$13)-33.26)	=$C$25*(1+(RiskWeibull(1.04,1.02) + -0.8))
26				
27		**TOTAL**	**TOLL**	**ADT**
28		**CAR (A)**	=$I$11*$K$7	=$B$23*$D$23/100
29		**BUS (B)**	=$I$12*$K$7	=$B$24*$D$24/100
30		**TRUCK (C)**	=$I$13*$K$7	=$B$25*D25/100
31				
32	**AVERAGE TOLL**		=($C$28*$K$11)+($C$29*$K$12)+($C$30*$K$13)	
33				

Fig. D.5 Code for the Toll-Traffic Demand Model

Row	Time (%)	Progress (%)
46	0.00%	0.00%
47	1.00%	0.40%
48	2.00%	0.81%
49	3.00%	1.25%
50	4.00%	1.71%
51	5.00%	2.20%
52	6.00%	2.71%
53	7.00%	3.24%
54	8.00%	3.80%
55	9.00%	4.39%
56	10.00%	5.00%
57	11.00%	5.64%
58	12.00%	6.30%
59	13.00%	7.00%
60	14.00%	7.72%
61	15.00%	8.47%
62	16.00%	9.25%
63	17.00%	10.06%
64	18.00%	10.89%
65	19.00%	11.76%
66	20.00%	12.62%
67	21.00%	13.58%
68	22.00%	14.53%
69	23.00%	15.52%
70	24.00%	16.53%
71	25.00%	17.57%
72	26.00%	18.63%
73	27.00%	19.73%
74	28.00%	20.85%
75	29.00%	22.00%
76	30.00%	23.18%
77	31.00%	24.38%
78	32.00%	25.60%
79	33.00%	26.85%
80	34.00%	28.12%
81	35.00%	29.41%
82	36.00%	30.73%
83	37.00%	32.06%
84	38.00%	33.41%
85	39.00%	34.78%
86	40.00%	36.16%
87	41.00%	37.56%
88	42.00%	38.97%
89	43.00%	40.39%
90	44.00%	41.82%
91	45.00%	43.26%
92	46.00%	44.71%
93	47.00%	46.16%
94	48.00%	47.62%
95	49.00%	49.08%
96	50.00%	50.54%
97	51.00%	52.00%
98	52.00%	53.46%
99	53.00%	54.91%
100	54.00%	56.46%
101	55.00%	57.80%
102	56.00%	59.24%
103	57.00%	60.66%
104	58.00%	62.07%
105	59.00%	63.47%
106	60.00%	64.85%
107	61.00%	66.22%
108	62.00%	67.57%
109	63.00%	68.90%
110	64.00%	70.21%
111	65.00%	71.51%
112	66.00%	72.78%
113	67.00%	74.02%
114	68.00%	75.25%
115	69.00%	76.45%
116	70.00%	77.62%
117	71.00%	78.77%
118	72.00%	79.90%
119	73.00%	80.99%
120	74.00%	82.06%
121	75.00%	83.10%
122	76.00%	84.11%
123	77.00%	85.09%
124	78.00%	86.05%
125	79.00%	86.97%
126	80.00%	87.87%
127	81.00%	88.73%
128	82.00%	89.57%
129	83.00%	90.38%
130	84.00%	91.15%
131	85.00%	91.91%
132	86.00%	92.63%
133	87.00%	93.32%
134	88.00%	93.99%
135	89.00%	94.63%
136	90.00%	95.24%
137	91.00%	95.82%
138	92.00%	96.38%
139	93.00%	96.92%
140	94.00%	97.43%
141	95.00%	97.91%
142	96.00%	98.37%
143	97.00%	98.81%
144	98.00%	99.23%
145	99.00%	99.63%
146	100.00%	100.00%

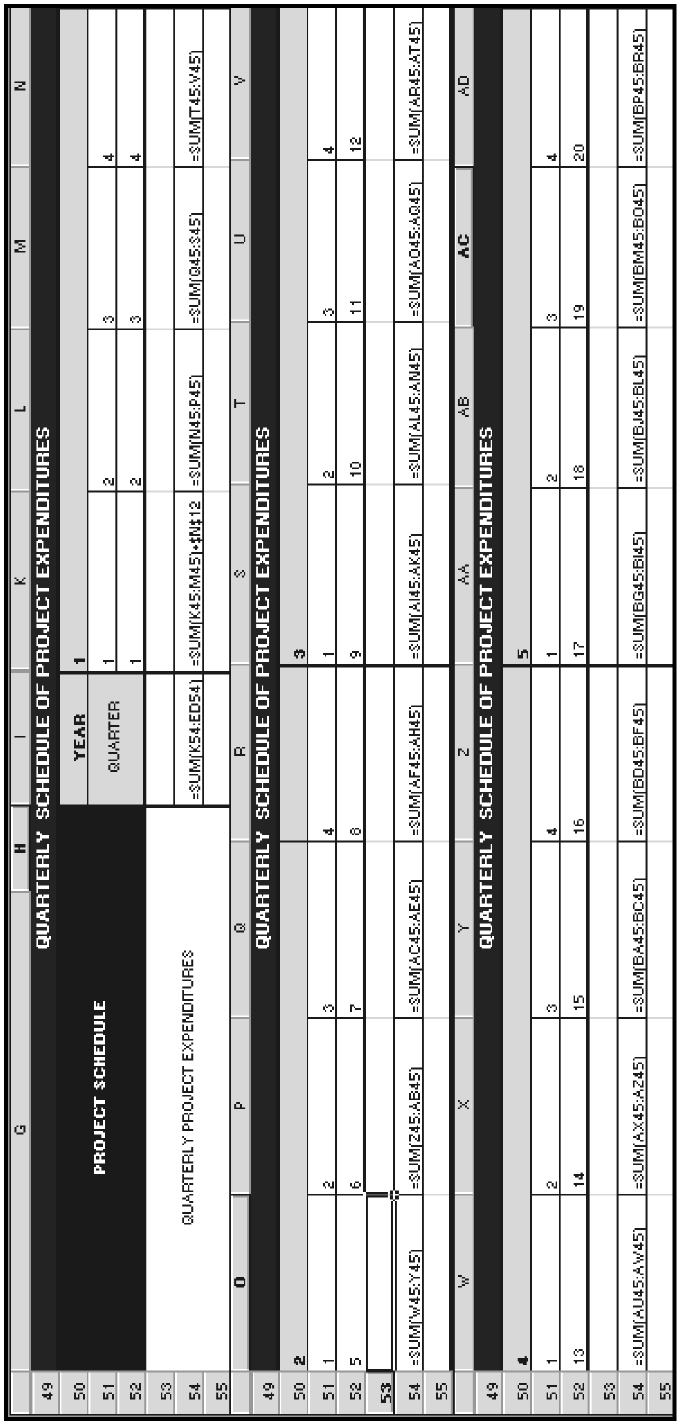
Fig. D.6 Matrix of Project "S" Curve Values

	G	H	I
41	MONTHLY SCHEDULE OF PROJECT EXPENDITURES		
42	PROJECT SCHEDULE		MONTH
43	% SCHEDULE TIME		
44	% EXPENDITURE PROGRESS		
45	MONTHLY EXPENDITURE		
46	CUMULATIVE EXPENDITURES		

	K
41	MONTHLY SCHEDULE OF PROJECT EXPENDITURES
42	1
43	=IF(K$42/$N$17>1,0,K$42/$N$17)
44	=VLOOKUP(ROUNDDOWN(K$43,2),$A$46:$B$146,2,FALSE)+(((VLOOKUP(ROUNDUP(K$43,2),$A$46:$B$146,2)-VLOOKUP(ROUNDDOWN((K$43),2),$A$46:$B$146,2,FALSE))*((K$43)-ROUNDDOWN(K$43,2))*100))
45	=IF(K44=0,0,IF(K$42=1,K$44*$N$10,(K$44-J$44)*$N$10))
46	=$N$10*K$44

	L
41	MONTHLY SCHEDULE OF PROJECT EXPENDITURES
42	2
43	=IF(L$42/$N$17>1,0,L$42/$N$17)
44	=VLOOKUP(ROUNDDOWN(L$43,2),$A$46:$B$146,2,FALSE)+(((VLOOKUP(ROUNDUP(L$43,2),$A$46:$B$146,2)-VLOOKUP(ROUNDDOWN((L$43),2),$A$46:$B$146,2,FALSE))*((L$43)-ROUNDDOWN(L$43,2))*100))
45	=IF(L44=0,0,IF(L$42=1,L$44*$N$10,(L$44-K$44)*$N$10))

Fig. D.7 Code for the Monthly Schedule of Project Expenditures



	G	H	I	K	L	M	N
49	QUARTERLY SCHEDULE OF PROJECT EXPENDITURES						
50	PROJECT SCHEDULE		YEAR	1			
51			QUARTER	1	2	3	4
52				1	2	3	4
53	QUARTERLY PROJECT EXPENDITURES						
54			=SUM(K54:ED54)	=SUM(K45:M45)*$N$12	=SUM(N45:P45)	=SUM(Q45:S45)	=SUM(T45:V45)
55							

	O	P	Q	R	S	T	U	V
49	QUARTERLY SCHEDULE OF PROJECT EXPENDITURES							
50	2				3			
51	1	2	3	4	1	2	3	4
52	5	6	7	8	9	10	11	12
53								
54	=SUM(W45:Y45)	=SUM(Z45:AB45)	=SUM(AC45:AE45)	=SUM(AF45:AH45)	=SUM(AI45:AK45)	=SUM(AL45:AN45)	=SUM(AO45:AQ45)	=SUM(AR45:AT45)
55								

	W	X	Y	Z	AA	AB	AC	AD
49	QUARTERLY SCHEDULE OF PROJECT EXPENDITURES							
50	4				5			
51	1	2	3	4	1	2	3	4
52	13	14	15	16	17	18	19	20
53								
54	=SUM(AU45:AW45)	=SUM(AX45:AZ45)	=SUM(BA45:BC45)	=SUM(BD45:BF45)	=SUM(BG45:BI45)	=SUM(BJ45:BL45)	=SUM(BM45:BO45)	=SUM(BP45:BR45)
55								

Fig. D.8 Code for the Quarterly Schedule of Project Expenditures

	G	H	I	K
59	SCHEDULE OF MAINTENANCE EXPENDITURES			
60	PROJECT SCHEDULE		YEAR	1
61				1
62			QUARTER	1
63	QUARTERLY MAINTENANCE COST RATE			=IF(K$62<=$N$18,0,IF(K$62=($N$18+1),$R$10/4,(J$63+(0.025*(($R$11/4)-J$63)))))
64	TOTAL QUARTERLY EXPENSES			=($N$7+$N$8)*K$63
65				

	L	M
59	SCHEDULE OF MAINTENANCE EXPENDITURES	
60		
61	2	3
62	2	3
63	=IF(L$62<=$N$18,0,IF(L$62=($N$18+1),$R$10/4,(K$63+(0.025*(($R$11/4)-K$63)))))	=IF(M$62<=$N$18,0,IF(M$62=($N$18+1),$R$10/4,(L$63+(0.025*(($R$11/4)-L$63)))))
64	=($N$7+$N$8)*L$63	=($N$7+$N$8)*M$63
65		

	N	O
59	SCHEDULE OF MAINTENANCE EXPENDITURES	
60		2
61	4	1
62	4	5
63	=IF(N$62<=$N$18,0,IF(N$62=($N$18+1),$R$10/4,(M$63+(0.025*(($R$11/4)-M$63)))))	=IF(O$62<=$N$18,0,IF(O$62=($N$18+1),$R$10/4,(N$63+(0.025*(($R$11/4)-N$63)))))
64	=($N$7+$N$8)*N$63	=($N$7+$N$8)*O$63
65		

Fig. D.9 Code for Quarterly Maintenance Expenditures

	G	H	I	K	L
69				TOLL INCOME AND CAPITAL INVESTMENT	
70	PROJECT LIFE		YEAR	1	
71			Quarter/Life	1	2
72			Quarter/year	1	2
73					
74	TRAFFIC VOLUME				
75	*QUARTERLY TRAFFIC GROWTH RATE*			=RiskUniform($I$17,$K$17)/4	=RiskUniform(IF(K$75-$K$16/4<$I$17/4,$I$17/4,K$75-$K$16/4),IF(K$75+$K$16/4>$K$17/4,$K$17/4,K$75+$K$16/4))
76	AVERAGE DAILY TRAFFIC			=$C$7*(1+K$75)	=K$76*(1+L$75)
77	TOTAL VOLUME OF VEHICLES			=K76*90	=L76*90
78	CAR (A)			=K$77*$B$10	=L$77*$B$10
79	BUS (B)			=K$77*$B$11	=L$77*$B$11
80	TRUCK (C)			=K$77*$B$12	=L$77*$B$12
81					
82	GROSS INCOME				
83	TOTAL GROSS INCOME			=K85+K90	=L85+L90
84					
85	TOTAL TOLL INCOME			=IF($N$18>=K$72,0,K77*$C$14)	=IF($N$18>=L$72,0,L77*$C$14)
86	BY CATEGORY				
87	CAR (A)			=IF($N$18>=K$72,0,K78*$C10)	=IF($N$18>=L$72,0,L78*$C10)
88	BUS (B)			=IF($N$18>=K$72,0,K79*$C11)	=IF($N$18>=L$72,0,L79*$C11)
89	TRUCK (C)			=IF($N$18>=K$72,0,K80*$C12)	=IF($N$18>=L$72,0,L80*$C12)
90	OTHER SOURCES			=IF($N$18>=K$72,0,$R$24)	=IF($N$18>=L$72,0,$R$24)
91					
92	CAPITAL EXPENDITURES				
93	TOTAL			=SUM(K95:K97)	=SUM(L95:L97)
94					
95	PROJECT EXECUTION			=K54	=L54
96	RIGHT OF WAY			=$N$12	0
97					

Fig. D.10 Code for the Toll Income Section (Exhibit I)

	M
69	**TOLL INCOME AND CAPITAL INVESTMENT**
70	
71	3
72	**3**
73	
74	
75	=RiskUniform(IF(L$75-$K$16/4<$I$17/4,$I$17/4,L$75-$K$16/4),IF(L$75+$K$16/4>$K$17/4,$K$17/4,L$75+$K$16/4))
76	**=L$76*(1+M$75)**
77	**=M76*90**
78	=M$77*$B$10
79	=M$77*$B$11
80	=M$77*$B$12
81	
82	
83	=M85+M90
84	
85	=IF($N$18>=M$72,0,M77*$C$14)
86	
87	=IF($N$18>=M$72,0,M78*$C10)
88	=IF($N$18>=M$72,0,M79*$C11)
89	=IF($N$18>=M$72,0,M80*$C12)
90	=IF($N$18>=M$72,0,$R$24)
91	
92	
93	=SUM(M95:M97)
94	
95	=M54
96	0
97	

Fig. D.11 Code for the Toll Income Section (Exhibit II)

	G	I	K	L
100			**FUNDS FLOW ANALYSIS**	
101	**PROJECT LIFE**	**YEAR**	1	
102		Quarter/Life	1	2
103		Quarter/year	**1**	**2**
104				
105	**TOTAL REVENUES**		=K106+K107	=L106+L107
106	GROSS INCOME (VAT INCLUDED))		=(1+$O$27)*K83	=(1+$O$27)*L83
107	TOTAL VAT PAID IN PREVIOUS PERIOD FOR:		=SUM(K108:K114)	=SUM(L108:L112)
108	*CAPITAL EXPENDITURES*		0	=K$93*$O$27
109	*SUPERVISION*		0	=$O$27*K156
110	*OPERATION*		0	=$O$27*K153
111	*MAJOR MAINTENANCE*		0	=$O$27*K154
112	*GENERAL ADMINISTRATION*		0	=$O$27*K155
113	*INTEREST PAID ON DEBT*		0	=K163*$O$28
114	*DEBT ORIGINATION FEE*		0	=K164*$O$29
115	**TOTAL EXPENSES**		=SUM(K116:K125)	=SUM(L116:L125)
116	*CAPITAL EXPENDITURES (VAT INC)*		=K$93*(1+$O$27)	=L$93*(1+$O$27)
117	*SUPERVISION (VAT INC)*		=K156*(1+$O$27)	=L156*(1+$O$27)
118	*VAT RECEIVED FROM GROSS INCOME*		=K106-K85	=L106-L85
119	*GOVERNMENT FEE ON TOLLS*		=$O$32*K$85	=$O$32*L$85
120	*OPERATION (VAT INC)*		=K153*(1+$O$27)	=L153*(1+$O$27)
121	*MAINTENANCE (VAT INC)*		=K154*(1+$O$27)	=L154*(1+$O$27)
122	*ADMINISTRATION (VAT INC)*		=K155*(1+$O$27)	=L155*(1+$O$27)
123	*INTEREST PAID ON DEBT (VAT INC.)*		0	=K137*(L$131/4)*(1+$O$28)
124	*DEBT ORIGINATION FEE (VAT INC)*		0	=K135*(1+$O$29)
125	*TAXES PAYABLE*		0	=L171
126	**TOTAL REVENUES - EXPENSES**		=K105-K115	=L105-L115
127	*CUMULATIVE*		=K126	=K127+L126
128				
129	**TOTAL CAPITAL NEEDS**			
130	PROJECT LIFE AVG. DEBT I. RATE	=$I$31+($I$27-$I$30)	=$I$27+RiskNormal(0.2*($I$130-$I$27),0.09*($I$27^0.5))/4	=K$131+RiskNormal(0.2*($I$130-K$131),0.09*(K$131^0.5))/4
131	***ANNUAL INTEREST RATE***		=IF(K$130<0,0.0001,K$130)	=IF(L$130<0,0.0001,L$130)
132	**TOTAL FUNDS REQUIRED**		=IF(K126<0,ABS(K126),0)	=IF(L126<0,ABS(L126),0)
133	FROM STOCKHOLDERS EQUITY		=K95*$I$22	=L95*$I$22
134	FROM DEBT (FUNDS BORROWED)		=IF(J$140<(K$132-K$133),K$132-K$133-J$140,0)	=IF(K$140<(L$132-L$133),L$132-L$133-K$140,0)
135	* ORIGINATION FEE		=K134*$I$26	=L134*$I$26
136	AVAILABLE BEFORE PRINCIPAL REPAYMENT		0	=IF(L126<0,0,L126)
137	**OUTSTANDING DEBT**		=K134	=IF(K137-L136+L134>0,K137-L136+L134,0)
138	AVAILABLE AFTER PRINCIPAL REPAYMENT		=IF(-(J$137-K$136+K$134)<0,0,-(J$137-K$136+K$134))	=IF(-(K$137-L$136+L$134)<0,0,-(K$137-L$136+L$134))
139	LESS: TO WORKING CAPITAL	=75%*$O$22	=$I$139*K$138	=$I$139*L$138
140	CUMULATIVE WORKING CAPITAL FUND		=IF(J$140-K$132+K$139<=0,0,J$140-K$132+K$139)	=IF(K$140-L$132+L$139<=0,0,K$140-L$132+L$139)
141	**AVAILABLE TO STOCKHOLDERS**		=K$138-K$139	=L$138-L$139
142	CUMULATIVE DIVIDEND FUND		0	=K$142+L$138-L$139

Fig. D.12 Code for the Funds Flow Section (Exhibit I)

	M	N	O
100	FUNDS FLOW ANALYSIS		
101			2
102	3	4	1
103	3	4	5
105	=M106+M107	=N106+N107	=O106+O107
106	=(1+$O$27)*M83	=(1+$O$27)*N83	=(1+$O$27)*O83
107	=SUM(M108:M112)	=SUM(N108:N112)	=SUM(O108:O112)
108	=L$93*$O$27	=M$93*$O$27	=N$93*$O$27
109	=$O$27*L156	=$O$27*M156	=$O$27*N156
110	=$O$27*L153	=$O$27*M153	=$O$27*N153
111	=$O$27*L154	=$O$27*M154	=$O$27*N154
112	=$O$27*L155	=$O$27*M155	=$O$27*N155
113	=L163*$O$28	=M163*$O$28	=N163*$O$28
114	=L164*$O$29	=M164*$O$29	=N164*$O$29
115	=SUM(M116:M125)	=SUM(N116:N125)	=SUM(O116:O125)
116	=M$93*(1+$O$27)	=N$93*(1+$O$27)	=O$93*(1+$O$27)
117	=M156*(1+$O$27)	=N156*(1+$O$27)	=O156*(1+$O$27)
118	=M106-M85	=N106-N85	=O106-O85
119	=$O$32*M$85	=$O$32*N$85	=$O$32*O$85
120	=M153*(1+$O$27)	=N153*(1+$O$27)	=O153*(1+$O$27)
121	=M154*(1+$O$27)	=N154*(1+$O$27)	=O154*(1+$O$27)
122	=M155*(1+$O$27)	=N155*(1+$O$27)	=O155*(1+$O$27)
123	=L137*(M$131/4)*(1+$O$28)	=M137*(N$131/4)*(1+$O$28)	=N137*(O$131/4)*(1+$O$28)
124	=L135*(1+$O$29)	=M135*(1+$O$29)	=N135*(1+$O$29)
125	=M171	=N171	=O171
126	=M105-M115	=N105-N115	=O105-O115
127	=L127+M126	=M127+N126	=N127+O126
129			
130	=L$131+RiskNormal(0.2*($I$130-L$131),0.09*(L$131^0.5))/4	=M$131+RiskNormal(0.2*($I$130-M$131),0.09*(M$131^0.5))/4	=N$131+RiskNormal(0.2*($I$130-N$131),0.09*(N$131^0.5))/4
131	=IF(M$130<0,0.0001,M$130)	=IF(N$130<0,0.0001,N$130)	=IF(O$130<0,0.0001,O$130)
132	=IF(M126<0,ABS(M126),0)	=IF(N126<0,ABS(N126),0)	=IF(O126<0,ABS(O126),0)
133	=M95*$I$22	=N95*$I$22	=O95*$I$22
134	=IF(L$140<(M$132-M$133),M$132-M$133-L$140,0)	=IF(M$140<(N$132-N$133),N$132-N$133-M$140,0)	=IF(N$140<(O$132-O$133),O$132-O$133-N$140,0)
135	=M134*$I$26	=N134*$I$26	=O134*$I$26
136	=IF(M126<0,0,M126)	=IF(N126<0,0,N126)	=IF(O126<0,0,O126)
137	=IF(L137-M136+M134>0,L137-M136+M134,0)	=IF(M137-N136+N134>0,M137-N136+N134,0)	=IF(N137-O136+O134>0,N137-O136+O134,0)
138	=IF(-(L$137-M$136+M$134)<0,0,-(L$137-M$136+M$134))	=IF(-(M$137-N$136+N$134)<0,0,-(M$137-N$136+N$134))	=IF(-(N$137-O$136+O$134)<0,0,-(N$137-O$136+O$134))
139	=$I$139*M$138	=$I$139*N$138	=$I$139*O$138
140	=IF(L$140-M$132+M$139<=0,0,L$140-M$132+M$139)	=IF(M$140-N$132+N$139<=0,0,M$140-N$132+N$139)	=IF(N$140-O$132+O$139<=0,0,N$140-O$132+O$139)
141	=M$138-M$139	=N$138-N$139	=O$138-O$139
142	=L$142+M$138-M$139	=M$142+N$138-N$139	=N$142+O$138-O$139

Fig. D.13 Code for the Funds Flow Section (Exhibit II)

	G	H I	K	L
145			INCOME STATEMENT	
146	PROJECT LIFE	YR	1	
147		Qtr	1	2
148		Qtr	1	2
149				
150	**PART 1: EXECUTION AND OPERATION ACTIVITIES**			
151	**GROSS INCOME**		=K83	=L83
152	**LESS: OPERATING EXPENSES**		=SUM(K153:K158)	=SUM(L153:L158)
153	*OPERATION*		=IF($N$18>=K$148,0,($R$7*K77))	=IF($N$18>=L$148,0,($R$7*L77))
154	*MAINTENANCE*		=K$64	=L$64
155	*GENERAL ADMINISTRATION*		=SUM(K153+K154)*$R$16	=SUM(L153+L154)*$R$16
156	*SUPERVISION*		=K$95*$N$13	=L$95*$N$13
157	*DEPRECIATION*		=IF(K$148<=$N$18,0,IF(K$148>($O$34*4+$N$18),0,SLN($N$10,0,$O$34*4)))	=IF(L$148<=$N$18,0,IF(L$148>($O$34*4+$N$18),0,SLN($N$10,0,$O$34*4)))
158	*GOVERNMENT FEE ON TOLLS*		=$O$32*K$85	=$O$32*L$85
159	**NET OPERATING INCOME (NOI)**		=K151-K152	=L151-L152
160				
161	**PART 2: FINANCIAL ACTIVITIES**			
162	**LESS: FINANCIAL EXPENSES**		=SUM(K163:K164)	=SUM(L163:L164)
163	*INTEREST EXPENSES*		0	=K137*($L$131/4)
164	*DEBT ORIGINATION FEE*		0	=K135
165	**NET PROFIT/LOSS BEFORE TAXES**		=K159-K162	=L159-L162
166	YEARLY NET PROFIT/LOSS			
167	CUMULATIVE LOSS (YEARLY)			
168	**TAXABLE PROFIT**			
169				
170	**PART 3: TAXES**			
171	**LESS: TAXES**		=SUM(K172:K174)	=SUM(L172:L174)
172	*INCOME TAX*		=IF(K$168>0,K$168*$O$22,0)	=IF(L$168>0,L$168*$O$22,0)
173	*TAX ON FIXED ASSETS*			
174	*WORKERS PROFIT SHARING*		=IF(K$168>0,K$168*$O$25,0)	=IF(L$168>0,L$168*$O$25,0)
175	**NET PROFIT/LOSS AFTER TAXES**		=K165-K171	=L165-L171

Fig. D.14 Code for the Income Statement Section (Exhibit I)

	M	N
145	INCOME STATEMENT	
146		
147	3	4
148	**3**	**4**
149		
150		
151	=M83	=N83
152	=SUM(M153:M158)	=SUM(N153:N158)
153	=IF($N$18>=M$148,0,($R$7*M77))	=IF($N$18>=N$148,0,($R$7*N77))
154	=M$64	=N$64
155	=SUM(M153+M154)*$R$16	=SUM(N153+N154)*$R$16
156	=M$95*$N$13	=N$95*$N$13
157	=IF(M$148<=$N$18,0,IF(M$148>($O$34*4+$N$18),0,SLN($N$10,0,$O$34*4)))	=IF(N$148<=$N$18,0,IF(N$148>($O$34*4+$N$18),0,SLN($N$10,0,$O$34*4)))
158	=$O$32*M$85	=$O$32*N$85
159	=M151-M152	=N151-N152
160		
161		
162	=SUM(M163:M164)	=SUM(N163:N164)
163	=L137*($L$131/4)	=M137*($L$131/4)
164	=L135	=M135
165	=M159-M162	=N159-N162
166		=SUM(K165:N165)
167		=IF(J$167+N$166<0,J$167+N$166,0)
168		=IF(N$167<0,0,N$166+J$167)
169		
170		
171	=SUM(M172:M174)	=SUM(N172:N174)
172	=IF(M$168>0,M$168*$O$22,0)	=IF(N$168>0,N$168*$O$22,0)
173		=IF(N$148<$N$18+12,0,IF(N$148<$N$18,0,(IF(N$168<=0,$N$10-SUM($K$157:N$157),0))*$O$23))
174	=IF(M$168>0,M$168*$O$25,0)	=IF(N$168>0,N$168*$O$25,0)
175	=M165-M171	=N165-N171

Fig. D.15 Code for the Income Statement Section (Exhibit II)

	G	H	I	K	L
180			ANALYSIS OF PROJECT NET CASH FLOWS AFTER TAXES		
181	PROJECT LIFE		YEAR	1	
182			Quarter/Life	1	2
183			Quarter/year	1	2
184					
185	PROJECT CASH FLOWS				
186	CAPITAL EXPENDITURES			=-K$93	=-L$93
187	PLUS: NET INCOME (LOSS)			=K175	=L175
188	PLUS: DEPRECIATION			=K157	=L157
189					
191					
192	NET CASH FLOWS AFTER TAXES			=SUM(K$186:K$188)	=SUM(L$186:L$188)
193	CUMULATIVE NET CASH FLOW			=K192	=K193+L192
194					
195	EQUITY CASH FLOWS				
196	EQUITY INVESTMENT			=-K$133	=-L$133
197	PLUS: AVAILABLE TO STOCKHOLDERS			=K$141	=L$141
198	NET EQUITY CASH FLOW			=IF($I$18*4=K$183,K$141-K$133+K$140,K$141-K$133)	=IF($I$18*4=L$183,L$141-L$133+L$140,L$141-L$133)
199	CUMULATIVE EQUITY CASH FLOW			=K$198	=K199+L198
200		NET CASH FLOW (YR)			
201		CUMULATIVE YRLY			
202					
203	FINANCIAL ANALYSIS OF NET CASH FLOWS AFTER TAXES				
204				ON TOTAL PROJECT CASH FLOWS	
205	NET PRESENT VALUE AT		=I34	=NPV($I$34/4,$K$192:OFFSET($J$192,0,($I$18*	
206	INTERNAL RATE OF RETURN			=IRR($K$192:OFFSET($J$192,0,$I$18*4),0.01)*4	
207				ON EQUITY CASH FLOWS	
208	NET PRESENT VALUE AT		=I34	=NPV($I$34/4,$K$198:OFFSET($J$198,0,($I$18*	
209	INTERNAL RATE OF RETURN			=IRR($K$198:OFFSET($J$198,0,$I$18*4),0.01)*4	

Fig. D.16 Code for the Cash Flow Analysis Section (Exhibit I)

	G	H	I	K	L
180	ANALYSIS OF PROJECT NET CASH FLOWS AFTER TAXES				
181	**PROJECT LIFE**		**YEAR**	1	
182			Quarter/Life	1	2
183			Quarter/year	**1**	**2**
184					
185	**PROJECT CASH FLOWS**				
186	CAPITAL EXPENDITURES			=-K$93	=-L$93
187	PLUS: NET INCOME (LOSS)			=K175	=L175
188	PLUS: DEPRECIATION			=K157	=L157
189					
191					
192	NET CASH FLOWS AFTER TAXES			=SUM(K$186:K$188)	=SUM(L$186:L$188)
193	CUMULATIVE NET CASH FLOW			=K192	=K193+L192
194					
195	**EQUITY CASH FLOWS**				
196	EQUITY INVESTMENT			=-K$133	=-L$133
197	PLUS: AVAILABLE TO STOCKHOLDERS			=K$141	=L$141
198	NET EQUITY CASH FLOW			=IF($I$18*4=K$183,K$141-K$133+K$140,K$141-K$133)	=IF($I$18*4=L$183,L$141-L$133+L$140,L$141-L$133)
199	CUMULATIVE EQUITY CASH FLOW			=K$198	=K199+L198
200		NET CASH FLOW (YR)			
201		CUMULATIVE YRLY			
202					
203	**FINANCIAL ANALYSIS OF NET CASH FLOWS AFTER TAXES**				
204	**ON TOTAL PROJECT CASH FLOWS**				
205	**NET PRESENT VALUE AT**		**=I34**	**=NPV($I$34/4,$K$192:OFFSET($J$192,0,($I$18***	
206	**INTERNAL RATE OF RETURN**			**=IRR($K$192:OFFSET($J$192,0,$I$18*4),0.01)*4**	
207	**ON EQUITY CASH FLOWS**				
208	**NET PRESENT VALUE AT**		**=I34**	**=NPV($I$34/4,$K$198:OFFSET($J$198,0,($I$18***	
209	**INTERNAL RATE OF RETURN**			**=IRR($K$198:OFFSET($J$198,0,$I$18*4),0.01)*4**	

Fig. D.17 Code for the Cash Flow Analysis Section (Exhibit I)

	M	N	O
180	ANALYSIS OF PROJECT NET CASH FLOWS AFTER TAXES		
181			2
182	3	4	1
183	**3**	**4**	**5**
184			
185			
186	=-M$93	=-N$93	=-O$93
187	=M175	=N175	=O175
188	=M157	=N157	=O157
189			
191			
192	=SUM(M$186:M$188)	=SUM(N$186:N$188)	=SUM(O$186:O$188)
193	=L193+M192	=M193+N192	=N193+O192
194			
195			
196	=-M$133	=-N$133	=-O$133
197	=M$141	=N$141	=O$141
198	=IF($I$18*4=M$183,M$141-M$133+M$140,M$141-M$133)	=IF($I$18*4=N$183,N$141-N$133+N$140,N$141-N$133)	=IF($I$18*4=O$183,O$141-O$133+O$140,O$141-O$133)
199	=L199+M198	=M199+N198	=N199+O198
200		=SUM(K192:N192)	
201		=N200	

Fig. D.18 Code for the Cash Flow Analysis Section (Exhibit II)

APPENDIX E.

DATA TO DEVELOP "S" CURVES FOR MONITORING PROJECT PROGRESS

Based upon the work of Gustavo Marcelo Murmis (1997).

Time (%)	Progress (%)	Time (%)	Progress (%)	Time (%)	Progress (%)
0.00%	0.00%	34.00%	28.12%	68.00%	75.25%
1.00%	0.40%	35.00%	29.41%	69.00%	76.45%
2.00%	0.81%	36.00%	30.73%	70.00%	77.62%
3.00%	1.25%	37.00%	32.06%	71.00%	78.77%
4.00%	1.71%	38.00%	33.41%	72.00%	79.90%
5.00%	2.20%	39.00%	34.78%	73.00%	80.99%
6.00%	2.71%	40.00%	36.16%	74.00%	82.06%
7.00%	3.24%	41.00%	37.56%	75.00%	83.10%
8.00%	3.80%	42.00%	38.97%	76.00%	84.11%
9.00%	4.39%	43.00%	40.39%	77.00%	85.09%
10.00%	5.00%	44.00%	41.82%	78.00%	86.05%
11.00%	5.64%	45.00%	43.26%	79.00%	86.97%
12.00%	6.30%	46.00%	44.71%	80.00%	87.87%
13.00%	7.00%	47.00%	46.16%	81.00%	88.73%
14.00%	7.72%	48.00%	47.62%	82.00%	89.57%
15.00%	8.47%	49.00%	49.08%	83.00%	90.38%
16.00%	9.25%	50.00%	50.54%	84.00%	91.15%
17.00%	10.06%	51.00%	52.00%	85.00%	91.91%
18.00%	10.89%	52.00%	53.46%	86.00%	92.63%
19.00%	11.76%	53.00%	54.91%	87.00%	93.32%
20.00%	12.62%	54.00%	56.46%	88.00%	93.99%
21.00%	13.58%	55.00%	57.80%	89.00%	94.63%
22.00%	14.53%	56.00%	59.24%	90.00%	95.24%
23.00%	15.52%	57.00%	60.66%	91.00%	95.82%
24.00%	16.53%	58.00%	62.07%	92.00%	96.38%
25.00%	17.57%	59.00%	63.47%	93.00%	96.92%
26.00%	18.63%	60.00%	64.85%	94.00%	97.43%
27.00%	19.73%	61.00%	66.22%	95.00%	97.91%
28.00%	20.85%	62.00%	67.57%	96.00%	98.37%
29.00%	22.00%	63.00%	68.90%	97.00%	98.81%
30.00%	23.18%	64.00%	70.21%	98.00%	99.23%
31.00%	24.38%	65.00%	71.51%	99.00%	99.63%
32.00%	25.60%	66.00%	72.78%	100.00%	100.00%
33.00%	26.85%	67.00%	74.02%		

Table E.1 Project "S" Curve Data Points (from Murmis, 1997)

	PROJECT DURATION (PERIODS)													
Period	36	35	34	33	32	31	30	29	28	27	26	25	24	23
1	1.15%	1.19%	1.22%	1.26%	1.31%	1.35%	1.40%	1.46%	1.51%	1.57%	1.64%	1.71%	1.79%	1.88%
2	2.48%	2.56%	2.65%	2.71%	2.71%	2.71%	2.71%	2.71%	3.32%	3.47%	3.63%	3.80%	4.00%	4.21%
3	4.00%	4.14%	4.29%	4.39%	4.39%	4.39%	5.00%	5.22%	5.46%	5.71%	6.00%	6.30%	6.65%	7.03%
4	5.71%	5.92%	6.14%	6.38%	6.65%	6.93%	7.24%	7.57%	7.93%	8.33%	8.77%	9.25%	9.79%	10.38%
5	7.64%	7.93%	8.25%	8.59%	8.96%	9.35%	9.79%	10.26%	10.77%	11.34%	11.96%	12.62%	13.42%	14.28%
6	9.79%	10.18%	10.60%	11.05%	11.54%	12.07%	12.62%	13.28%	13.99%	14.75%	15.60%	16.53%	17.57%	18.73%
7	12.14%	12.62%	13.18%	13.78%	14.41%	15.10%	15.86%	16.67%	17.57%	18.55%	19.65%	20.85%	22.20%	23.70%
8	14.75%	15.38%	16.05%	16.78%	17.57%	18.42%	19.36%	20.39%	21.51%	22.74%	24.10%	25.60%	27.27%	29.13%
9	17.57%	18.33%	19.15%	20.04%	20.99%	22.04%	23.18%	24.42%	25.78%	27.27%	28.91%	30.73%	32.74%	34.96%
10	20.60%	21.51%	22.49%	23.54%	24.69%	25.92%	27.27%	28.74%	30.35%	32.11%	34.04%	36.16%	38.50%	41.07%
11	23.85%	24.90%	26.04%	27.27%	28.60%	30.05%	31.62%	33.32%	35.17%	37.20%	39.41%	41.82%	44.47%	47.37%
12	27.27%	28.49%	29.80%	31.21%	32.74%	34.38%	36.16%	38.09%	40.19%	42.46%	44.93%	47.62%	50.54%	53.71%
13	30.88%	32.25%	33.73%	35.32%	37.04%	38.88%	40.87%	43.01%	45.33%	47.84%	50.54%	53.46%	56.68%	59.98%
14	34.63%	36.16%	37.81%	39.57%	41.46%	43.49%	45.68%	48.02%	50.54%	53.24%	56.22%	59.24%	62.54%	66.04%
15	38.50%	40.19%	41.99%	43.92%	45.98%	48.19%	50.54%	53.06%	55.80%	58.60%	61.64%	64.85%	68.24%	71.79%
16	42.46%	44.30%	46.25%	48.33%	50.54%	52.89%	55.43%	58.05%	60.86%	63.83%	66.95%	70.21%	73.61%	77.11%
17	46.48%	48.45%	50.54%	52.75%	55.10%	57.58%	60.19%	62.94%	65.83%	68.85%	72.00%	75.25%	78.58%	81.97%
18	50.54%	52.63%	54.82%	57.19%	59.60%	62.16%	64.85%	67.66%	70.58%	73.61%	76.72%	79.90%	83.10%	86.29%
19	54.59%	56.84%	59.07%	61.47%	63.99%	66.61%	69.34%	72.17%	75.07%	78.05%	81.07%	84.11%	87.12%	90.06%
20	58.60%	60.86%	63.22%	65.68%	68.24%	70.88%	73.61%	76.41%	79.25%	82.14%	85.01%	87.87%	90.64%	93.29%
21	62.54%	64.85%	67.25%	69.73%	72.30%	74.93%	77.62%	80.35%	83.10%	85.84%	88.53%	91.15%	93.66%	95.99%
22	66.37%	68.71%	71.13%	73.61%	76.15%	78.73%	81.35%	83.97%	86.58%	89.13%	91.62%	93.99%	96.19%	98.21%
23	70.06%	72.42%	74.82%	77.27%	79.76%	82.26%	84.76%	87.25%	89.69%	92.04%	94.29%	96.38%	98.29%	100.00%
24	73.61%	75.94%	78.30%	80.69%	83.10%	85.49%	87.87%	90.18%	92.42%	94.56%	96.55%	98.37%	100.00%	
25	76.97%	79.25%	81.56%	83.87%	86.17%	88.42%	90.64%	92.77%	94.80%	96.70%	98.44%	100.00%		
26	80.14%	82.36%	84.57%	86.77%	88.94%	91.05%	93.09%	95.03%	96.84%	98.50%	100.00%			
27	83.10%	85.23%	87.34%	89.42%	91.44%	93.38%	95.24%	96.97%	98.56%	100.00%				
28	85.84%	87.87%	89.86%	91.79%	93.66%	95.43%	97.09%	98.61%	100.00%					
29	88.35%	90.26%	92.12%	93.91%	95.60%	97.20%	98.66%	100.00%						
30	90.64%	92.42%	94.14%	95.77%	97.30%	98.71%	100.00%							
31	92.71%	94.36%	95.92%	97.40%	98.76%	100.00%								
32	94.56%	96.06%	97.49%	98.80%	100.00%									
33	96.19%	97.57%	98.83%	100.00%										
34	97.64%	98.87%	100.00%											
35	98.90%	100.00%												
36	100.00%													

	PROJECT DURATION (PERIODS)													
Period	22	21	20	19	18	17	16	15	14	13	12	11	10	9
1	1.98%	2.08%	2.20%	2.33%	2.48%	2.65%	2.71%	2.71%	3.32%	3.63%	4.00%	4.39%	5.00%	5.71%
2	4.39%	4.39%	5.00%	5.34%	5.71%	6.14%	6.65%	7.24%	7.93%	8.77%	9.79%	11.05%	12.62%	14.75%
3	7.46%	7.93%	8.47%	9.09%	9.79%	10.60%	11.54%	12.62%	13.99%	15.60%	17.57%	20.04%	23.18%	27.27%
4	11.05%	11.80%	12.62%	13.63%	14.75%	16.05%	17.57%	19.36%	21.51%	24.10%	27.27%	31.21%	36.16%	42.46%
5	15.25%	16.34%	17.57%	18.98%	20.60%	22.49%	24.69%	27.27%	30.35%	34.04%	38.50%	43.92%	50.54%	58.60%
6	20.04%	21.51%	23.18%	25.09%	27.27%	29.80%	32.74%	36.16%	40.19%	44.93%	50.54%	57.19%	64.85%	73.61%
7	25.38%	27.27%	29.41%	31.85%	34.63%	37.81%	41.46%	45.68%	50.54%	56.22%	62.54%	69.73%	77.62%	85.84%
8	31.21%	33.54%	36.16%	39.12%	42.46%	46.25%	50.54%	55.43%	60.86%	66.95%	73.61%	80.69%	87.87%	94.56%
9	37.43%	40.19%	43.26%	46.70%	50.54%	54.82%	59.60%	64.85%	70.58%	76.72%	83.10%	89.42%	95.24%	100.00%
10	43.92%	47.06%	50.54%	54.38%	58.60%	63.22%	68.24%	73.61%	79.25%	85.01%	90.64%	95.77%	100.00%	
11	50.54%	54.01%	57.80%	61.92%	66.37%	71.13%	76.15%	81.35%	86.58%	91.62%	96.19%	100.00%		
12	57.19%	60.86%	64.85%	69.11%	73.61%	78.30%	83.10%	87.87%	92.42%	96.55%	100.00%			
13	63.60%	67.44%	71.51%	75.76%	80.14%	84.57%	88.94%	93.09%	96.84%	100.00%				
14	69.73%	73.61%	77.62%	81.72%	85.84%	89.86%	93.66%	97.09%	100.00%					
15	75.47%	79.25%	83.10%	86.92%	90.64%	94.14%	97.30%	100.00%						
16	80.69%	84.30%	87.87%	91.31%	94.56%	97.49%	100.00%							
17	85.35%	88.69%	91.91%	94.92%	97.64%	100.00%								
18	89.42%	92.42%	95.24%	97.78%	100.00%									
19	92.88%	95.52%	97.91%	100.00%										
20	95.77%	98.02%	100.00%											
21	98.12%	100.00%												
22	100.00%													

Fig. E.1 Accumulated Progress (%) of the "S" Curve for Each Period of Time for Project Duration between 9 and 36 Periods (Murmis, 1997)

APPENDIX F.

MEXICAN TOLL HIGHWAY NETWORK DATA

F.1 PLANNED VS. ACTUAL GENERAL NETWORK DATA

F.2 BESTFIT ANALYSIS FOR THE TOLL-TRAFFIC DEMAND MODEL (CARS, BUSES AND TRUCKS)

Source Data: Secretaría de Comunicaciones y Transportes (SCT) (1996)

F.1 PLANNED VS. ACTUAL GENERAL NETWORK DATA

No.	HIGHWAY	TOTAL LENGTH	LANES	TOTAL BID COST*	TOTAL ACTUAL COST*	BID COST PER KM PER LANE*	ACTUAL COST PER KM PER LANE*	BID ADT	REAL ADT	INITIAL SCHEDULE DURATION (Months)	FINAL SCHEDULE DURATION (Months)	INITIAL CONCESSION PERIOD (years)	FINAL CONCESSION PERIOD (years)
1	ARMERIA - MANZANILLO	47	4	$ 331	$ 481	$ 1.76	$ 2.56	3,824	1,900	12	9	9.25	14.00
2	ATLACOMULCO - MARAVATIO	64	2	$ 690	$ 690	$ 5.39	$ 5.39	5,600	3,300		23		20.00
3	CADEREYTA - REYNOSA	175	4	$ 1,769	$ 1,795	$ 2.53	$ 2.56	2,400	1,830	30	27	9.00	12.00
4	CARBONERA - PUERTO MEXICO "LOS CHORROS"	34	4	$ 228	$ 228	$ 1.68	$ 1.68	3,295	3,595		16		20.00
5	CHAMAPA - LECHERIA	27	4	$ 1,528	$ 1,627	$ 14.15	$ 15.06	12,104	2,559	24	41	18.33	18.33
6	CONSTITUYENTES - LA VENTA - LA MARQUESA	21	6	$ 399	$ 849	$ 3.17	$ 6.74	35,912	18,969	11	12	2.33	25.00
7	CORDOBA - VERACRUZ	108	4	$ 1,026	$ 1,585	$ 2.38	$ 3.67	5,186	2,320	19	22	7.83	30.00
8	CUERNAVACA - ACAPULCO	263	4	$ 4,985	$ 12,886	$ 4.74	$ 12.25	5,040	2,892	36	15	14.67	30.00
9	DELICIAS - CAMARGO	65	4	$ 307	$ 307	$ 1.18	$ 1.18	3,381	1,760		31		20.00
10	DURANGO - YERBANIS	105	4	$ 1,101	$ 852	$ 2.62	$ 2.03	1,975	426		17		30.00
11	ECATEPEC - PIRAMIDES	22	4	$ 166	$ 239	$ 1.89	$ 2.72	10,317	13,098	6	11	3.92	19.00
12	GUADALAJARA - COLIMA	148	3	$ 1,784	$ 2,379	$ 4.02	$ 5.36	3,194	3,194		15		20.00
13	GUADALAJARA-ZAPOTLANEJO	26	4	$ 175	$ 251	$ 1.68	$ 2.41	12,798	11,608		18		20.00
14	LA TINAJA-COSOLEACAQUE	228	4	$ 3,486	$ 4,180	$ 3.82	$ 4.58	5,013	789	36	35	15.92	15.80
15	LEON-LAGOS DE MORENO-AGUASCALIENTES	116	4	$ 1,285	$ 1,789	$ 2.77	$ 3.86	5,154	2,074	13	23	18.50	30.00
16	LIBRAMIENTO PONIENTE DE TAMPICO	14	4	$ 149	$ 204	$ 2.66	$ 3.64	3,054	1,104	14	9	12.00	12.00
17	LIBRAMIENTO DE FRESNILLO	33	4	$ 195	$ 195	$ 1.48	$ 1.48	4,285	1,918		12		14.00
18	LIBRAMIENTO NORORIENTE DE QUERETARO	37	4	$ 497	$ 704	$ 3.36	$ 4.76	7,799	2,827	12	15	12.00	30.00
19	LIBRAMIENTO ORIENTE DE SALTILLO	22	4	$ 136	$ 149	$ 1.55	$ 1.69	3,415	2,717		11		20.00
20	LIBRAMIENTO ORIENTE DE SAN LUIS POTOSI	34	4	$ 342	$ 353	$ 2.51	$ 2.60	4,825	2,445	16	10	8.50	30.00
21	MAZATLAN-CULIACAN	182	4	$ 2,784	$ 3,146	$ 3.82	$ 4.32	4,148	1,158	24	24	17.50	30.00
22	MERIDA-CANCUN	240	4	$ 1,036	$ 1,128	$ 1.08	$ 1.18	1,773	838		12	17.67	17.70
23	MONTERREY-NUEVO LAREDO	146	4	$ 1,104	$ 1,315	$ 1.89	$ 2.25	4,472	2,149	20	21	8.00	23.20
24	SAN MARTIN TEXMELUCAN-TLAXCALA-EL MOLINITO	26	4	$ 110	$ 193	$ 1.06	$ 1.86	5,453	3,075	9	18	7.50	30.00
25	TEPIC-ENTRONQUE SAN BLAS	25	4	$ 262	$ 262	$ 2.62	$ 2.62	3,248	3,248		18		
26	TIJUANA-TECATE-LIB. TECATE	35	4	$ 339	$ 510	$ 2.42	$ 3.64	4,900	2,625	15	22	11.75	30.00
27	TORREON-CUENCAME-YERBANIS	119	4	$ 1,171	$ 1,000	$ 2.46	$ 2.10	3,926	837		13	9.00	30.00
28	ZAPOTLANEJO-LAGOS DE MORENO	152	4	$ 1,407	$ 1,702	$ 2.31	$ 2.80	4,706	1,934	15	12	13.50	13.50
29	CHAMPOTON-CAMPECHE	56	4	$ 372	$ 480	$ 1.66	$ 2.14	1,725	1,337	15	11	12.33	12.33
30	ACATZINGO-ESPERANZA-CD. MENDOZA	97	4	$ 774	$ 998	$ 1.99	$ 2.57	4,366	4,366		29	14.00	14.00
31	MEXICALI-TECATE Y LIB. DE MEXICALI	141	4	$ 1,902	$ 2,454	$ 3.37	$ 4.35	6,481	736	42	31	9.00	19.83
32	CARDEL-VERACRUZ Y LIB. NORPONIENTE DE CARDEL	29	4	$ 175	$ 226	$ 1.51	$ 1.95	5,375	7,861		8		15.00
33	GOMEZ PALACIO-LIM. DE EDOS. DGO./CHIH.	183	4	$ 791	$ 1,015	$ 1.08	$ 1.39	2,244	733		12		25.00
34	GUADALAJARA-TEPIC	194	4	$ 4,012	$ 5,175	$ 5.17	$ 6.67	4,287	2,551	18	24	8.50	20.00
35	MARAVATIO-ZAPOTLANEJO	309	4	$ 7,637	$ 9,852	$ 6.18	$ 7.97	4,744	1,833		12	18.25	18.25
36	PEÑON-TEXCOCO	16	4	$ 248	$ 320	$ 3.88	$ 5.00	4,738	15,151		12		20.00
38	TORREON-SALTILLO	233	4	$ 1,329	$ 1,714	$ 1.43	$ 1.84	3,933	643		7	7.50	7.50

* U.S. DOLLARS (1996)

Table F.1 Planned vs. Actual General Data for the Mexican Toll Road Network

F.2 BESTFIT ANALYSIS FOR THE TOLL-TRAFFIC DEMAND MODEL (CARS, BUSES AND TRUCKS)

% CAR ADT DIVERTED TO TOLL HIGHWAY

	% Change in Car ADT	Normal Distribution
Parameter 1 (Mean)		-12%
Parameter 2 (Std. Dev.)		15%
@RISKFormula		RiskNormal(-12%,15%)
Minimum	-39.7%	
Maximum	11.0%	
Mean	-13.1%	-12.3%
Mode	-10.1%	-12.3%
Median	-14.3%	-12.3%
Standard Deviation	14.7%	14.8%
Variance	2.2%	2.2%
Skewness	0.15	0.00
Kurtosis	1.98	3.00

Table F.2 Statistics of the % Change in Car ADT Diverted Predicted by the Toll-Traffic Demand Model and the BestFit Normal PDF

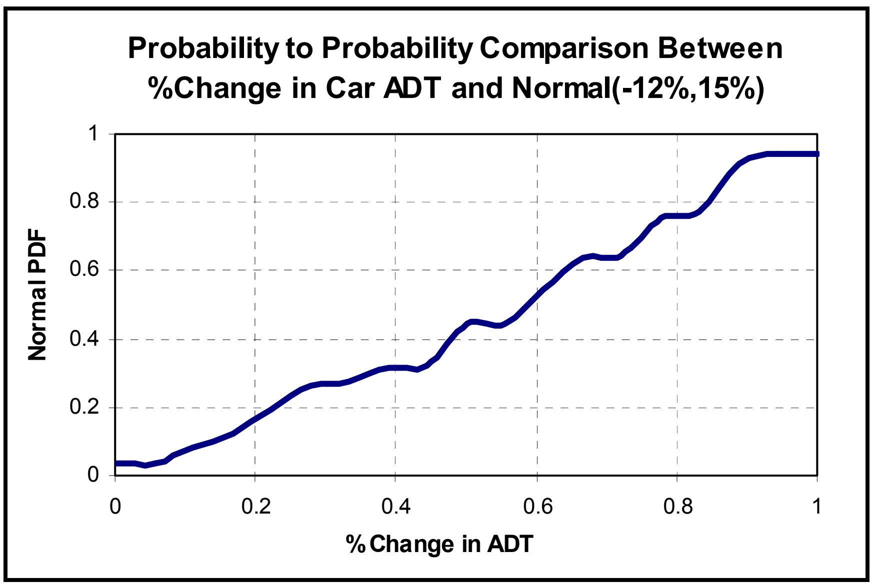


Fig. F.1 Probability to Probability Comparison between the Car ADT Diverted Predicted by the Toll-Traffic Demand Model and the BestFit Normal PDF

% BUS ADT DIVERTED TO TOLL HIGHWAY

	% Change in Bus ADT	Normal Distribution
Parameter 1 (Mean)		-5%
Parameter 2 (Std. Dev.)		25%
@RISKFormula		RiskNormal(-5%,25%)
Minimum	-51.3%	
Maximum	38.7%	
Mean	-5.4%	-5.4%
Mode	1.2%	-5.4%
Median	-3.8%	-5.4%
Standard Deviation	24.6%	24.6%
Variance	6.1%	6.1%
Skewness	0.08	0.00
Kurtosis	1.98	3.00

Table F.3 Statistics of the % Change in Bus ADT Diverted Predicted by the Toll-Traffic Demand Model and the BestFit Normal PDF

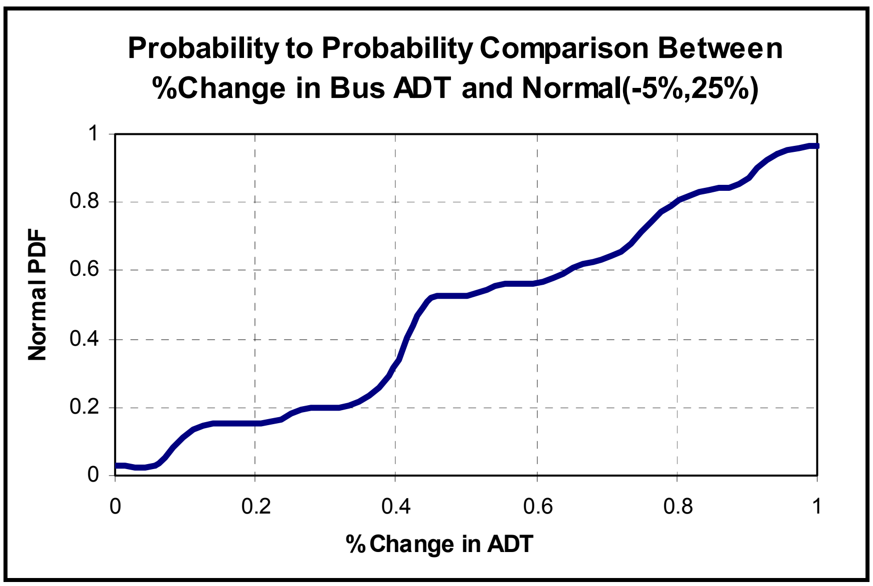


Fig. F.2 Probability to Probability Comparison between the Bus ADT Diverted Predicted by the Toll-Traffic Demand Model and the BestFit Normal PDF

% TRUCK ADT DIVERTED TO TOLL HIGHWAY

	% Change in Truck ADT	Weibull Distribution
Parameter 1 (Mean)		104%
Parameter 2 (Std. Dev.)		102%
@RISKFormula		RiskWeibull(1.04,1.02)+-0.83
Minimum	-82.5%	
Maximum	299.7%	
Mean	14.3%	17.5%
Mode	-50.6%	-78.4%
Median	-5.9%	-11.2%
Standard Deviation	99.3%	96.6%
Variance	98.6%	93.2%
Skewness	2.25	1.67
Kurtosis	4.58	6.25

Table F.4 Statistics of the % Change in Truck ADT Diverted Predicted by the Toll-Traffic Demand Model and the BestFit Normal PDF

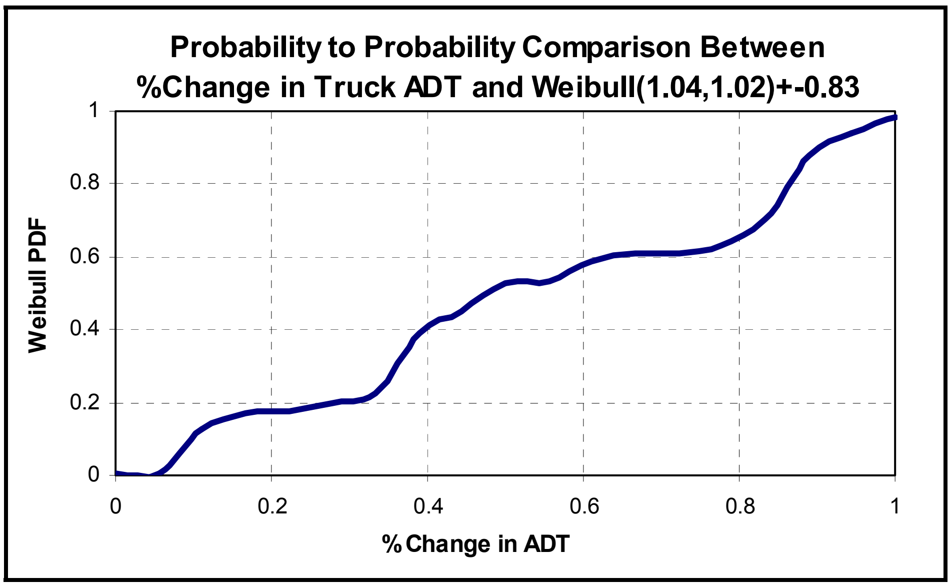


Fig. F.3 Probability to Probability Comparison between the Truck ADT Diverted Predicted by the Toll-Traffic Demand Model and the BestFit Normal PDF

APPENDIX G.

CASE STUDIES SIMULATION OUTPUT DATA AND STATISTICS

G.1 SAN MARTIN TEXMELUCAN-TLAXCALA-EL MOLINITO TOLL ROAD

G.2 MONTERREY-NUEVO LAREDO TOLL ROAD

Only the first fifteen years of simulation results for the quarterly annual interest rates and quarterly traffic growth rates are included in this appendix.

G.1 SAN MARTIN TEXMELUCAN-TLAXCALA-EL MOLINITO TOLL ROAD

Name	PROJECT NET PRESENT VALUE (Fixed Disc.Rate)	EQUITY NET PRESENT VALUE (Fixed Disc.Rate)	PROJECT NET PRESENT VALUE (Variable D.R.)	EQUITY NET PRESENT VALUE (Variable D.R.)	PROJECT INTERNAL RATE OF RETURN	EQUITY INTERNAL RATE OF RETURN	CONSTRUCTION COST	TOLL COLLECTION COST ($ per Vehicle)	M,R&R ANNUAL COST	ADMINISTRATION COST	PROJECT SCHEDULE
Description	Output	Output	Output	Output	Output	Output	Pert(14230000,17000000,22000000)	Triang(0.055,0.06,0.09)	Triang(2.5%,3%,4%)	Triang(0.18,0.225,0.25)	Pert(9,12,18)
Cell	K205	K208	K205	K208	K206	K209	N7	R7	R10	R16	N17
Minimum =	(10,950,320)	(6,690,361)	(15,573,460)	(7,992,536)	2.77%	3.09%	14,316,160	0.055	2.51%	18.10%	9
Maximum =	25,553,180	25,178,160	108,981,000	108,309,200	20.39%	23.28%	21,473,510	0.090	3.98%	24.91%	18
Mean =	842,217	2,413,932	18,773,520	19,702,620	9.28%	10.48%	17,371,690	0.068	3.17%	21.83%	13
Std Deviation =	4,429,869	3,765,930	20,885,430	19,558,590	2.31%	2.53%	1,441,373	0.008	0.31%	1.45%	2
Variance =	1.96E+13	1.42E+13	4.36E+14	3.83E+14	5.35E-04	6.41E-04	2.08E+12	5.97E-05	9.72E-06	2.10E-04	2.751965
Skewness =	8.91E-01	1.15E+00	4.11E-01	5.70E-01	0.7130842	7.83E-01	0.2580082	0.5217334	0.3055394	-0.266406	3.04E-01
Kurtosis =	4.948672	5.676693	2.805249	3.024676	4.263363	4.456233	2.422517	2.400526	2.400498	2.399289	2.463857
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	1,539,682	3,158,968	47,337,480	(5,604,788)	9.48%	9.88%	17,103,140	0.060	3.03%	22.51%	12
5% Perc =	(5,409,049)	(2,624,857)	(10,885,550)	(6,095,452)	5.92%	6.84%	15,158,390	0.058	2.69%	19.25%	10
10% Perc =	(4,336,079)	(1,821,054)	(9,120,741)	(5,112,194)	6.51%	7.51%	15,511,110	0.059	2.77%	19.77%	10
15% Perc =	(3,458,855)	(1,156,945)	(6,182,156)	(3,292,890)	7.02%	8.02%	15,791,540	0.060	2.84%	20.17%	11
20% Perc =	(2,766,736)	(623,588)	(2,674,124)	(608,570)	7.34%	8.39%	16,036,320	0.061	2.89%	20.51%	11
25% Perc =	(2,151,320)	(149,753)	740,164	2,241,602	7.69%	8.75%	16,262,560	0.062	2.93%	20.80%	11
30% Perc =	(1,555,907)	317,951	4,335,907	5,314,682	8.02%	9.09%	16,475,580	0.063	2.97%	21.07%	11
35% Perc =	(990,198)	764,898	8,223,433	8,875,286	8.33%	9.40%	16,681,220	0.064	3.01%	21.32%	12
40% Perc =	(512,188)	1,131,908	12,256,720	12,620,470	8.58%	9.69%	16,882,970	0.065	3.05%	21.55%	12
45% Perc =	(30,332)	1,514,579	15,487,470	15,665,630	8.85%	9.96%	17,082,070	0.066	3.09%	21.76%	12
50% Perc =	410,043	1,927,528	18,525,680	18,589,670	9.07%	10.27%	17,283,870	0.067	3.13%	21.97%	12
55% Perc =	876,711	2,336,366	21,449,290	21,428,630	9.34%	10.54%	17,488,180	0.068	3.18%	22.16%	13
60% Perc =	1,378,182	2,768,755	24,480,900	24,532,390	9.61%	10.81%	17,696,090	0.069	3.23%	22.35%	13
65% Perc =	1,888,429	3,145,790	27,513,980	27,256,880	9.87%	11.10%	17,914,640	0.071	3.28%	22.52%	13
70% Perc =	2,436,988	3,648,530	30,258,370	30,063,670	10.16%	11.44%	18,146,980	0.072	3.33%	22.71%	13
75% Perc =	3,099,428	4,266,828	33,418,430	33,176,020	10.52%	11.84%	18,394,800	0.074	3.39%	22.91%	14
80% Perc =	3,992,289	5,042,344	36,799,990	36,586,350	10.95%	12.31%	18,667,180	0.075	3.45%	23.13%	14
85% Perc =	4,888,328	5,783,170	41,229,110	40,935,840	11.46%	12.84%	18,980,190	0.077	3.53%	23.38%	14
90% Perc =	6,304,548	7,066,002	46,039,170	45,868,230	12.20%	13.63%	19,359,650	0.080	3.61%	23.68%	15
95% Perc =	8,808,242	9,495,992	54,059,460	53,768,720	13.59%	15.25%	19,885,770	0.083	3.72%	24.06%	15

Name	% CHANGE IN CAR ADT DIVERTED	% CHANGE IN BUS ADT DIVERTED	% CHANGE IN TRUCK ADT DIVERTED	DISCOUNT RATE (fixed or variable)	DISCOUNT RATE LOGNORMAL	INITIAL ANNUAL TRAFFIC GROWTH RATE	QUARTERLY TRAFFIC GROWTH RATE 1	QUARTERLY TRAFFIC GROWTH RATE 2	QUARTERLY TRAFFIC GROWTH RATE 3	QUARTERLY TRAFFIC GROWTH RATE 4	QUARTERLY TRAFFIC GROWTH RATE 5
Description	Tnormal(-0.1,0.15,-0.4,0.15)	Tnormal(-0.05,0.25,-0.5,0.5)	Weibull(1.04,1.02)	Simtable(K34:K35)	Lognorm(0.0886,0.23)	Uniform($I$17,$K$17)	Uniform($I$17,$K$17)	Uniform(IF(K$75-$K$16/4<$I$17/4,$I$17/4,K$75-$K$16/4),IF(K$7	Uniform(IF(L$75-$K$16/4<$I$17/4,$I$17/4,L$75-$K$16/4),IF(L$7	Uniform(IF(M$75-$K$16/4<$I$17/4,$I$17/4,M$75-$K$16/4),IF(M$7	Uniform(IF(N$75-$K$16/4<$I$17/4,$I$17/4,N$75-$K$16/4),IF(N$7
Cell	D23	D24	D25	I34	K35	J75	K75	L75	M75	N75	O75
Minimum =	-39.88%	-49.96%	0.00%	8.86%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	15.00%	49.74%	767.79%	8.86%	358.13%	5.00%	5.00%	1.25%	1.25%	1.25%	1.25%
Mean =	-10.73%	-3.86%	100.37%	8.86%	8.77%	2.50%	2.50%	0.62%	0.62%	0.62%	0.62%
Std Deviation =	12.58%	21.88%	96.34%	0.00%	19.82%	1.44%	1.44%	0.33%	0.32%	0.32%	0.33%
Variance =	1.58E-02	4.79E-02	0.9282292	0	3.93E-02	2.08E-04	2.08E-04	1.06E-05	1.05E-05	1.06E-05	1.08E-05
Skewness =	-0.1010252	1.12E-01	1.8475	0	8.012424	-1.33E-07	2.43E-05	2.03E-03	5.82E-02	-5.87E-03	1.62E-02
Kurtosis =	2.295159	2.384267	7.792221	0	98.80527	1.799998	1.800032	2.025491	2.007345	2.049528	1.997749
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	-7.49%	-6.40%	6.44%	8.86%	0.41%	4.93%	1.72%	0.37%	0.50%	0.54%	0.47%
5% Perc =	-32.23%	-39.59%	5.85%	8.86%	0.30%	0.25%	0.25%	0.09%	0.11%	0.09%	0.09%
10% Perc =	-27.98%	-33.05%	11.68%	8.86%	0.51%	0.50%	0.50%	0.17%	0.19%	0.17%	0.17%
15% Perc =	-24.80%	-28.07%	17.73%	8.86%	0.72%	0.75%	0.75%	0.24%	0.25%	0.24%	0.25%
20% Perc =	-22.17%	-23.82%	24.06%	8.86%	0.95%	1.00%	1.00%	0.31%	0.31%	0.30%	0.30%
25% Perc =	-19.89%	-20.09%	30.77%	8.86%	1.21%	1.25%	1.25%	0.36%	0.37%	0.36%	0.36%
30% Perc =	-17.81%	-16.62%	37.81%	8.86%	1.50%	1.50%	1.50%	0.42%	0.42%	0.42%	0.42%
35% Perc =	-15.86%	-13.40%	45.37%	8.86%	1.83%	1.75%	1.75%	0.48%	0.47%	0.48%	0.47%
40% Perc =	-14.03%	-10.32%	53.45%	8.86%	2.21%	2.00%	2.00%	0.52%	0.50%	0.53%	0.51%
45% Perc =	-12.24%	-7.32%	62.11%	8.86%	2.66%	2.25%	2.25%	0.57%	0.55%	0.58%	0.57%
50% Perc =	-10.49%	-4.31%	71.64%	8.86%	3.18%	2.50%	2.50%	0.62%	0.61%	0.63%	0.62%
55% Perc =	-8.73%	-1.33%	82.12%	8.86%	3.81%	2.75%	2.75%	0.67%	0.66%	0.68%	0.67%
60% Perc =	-6.97%	1.71%	93.77%	8.86%	4.57%	3.00%	3.00%	0.72%	0.72%	0.72%	0.73%
65% Perc =	-5.16%	4.85%	106.82%	8.86%	5.52%	3.25%	3.25%	0.78%	0.77%	0.77%	0.78%
70% Perc =	-3.28%	8.19%	121.83%	8.86%	6.74%	3.50%	3.50%	0.83%	0.83%	0.82%	0.83%
75% Perc =	-1.28%	11.73%	139.62%	8.86%	8.34%	3.75%	3.75%	0.88%	0.88%	0.87%	0.89%
80% Perc =	0.90%	15.68%	161.17%	8.86%	10.59%	4.00%	4.00%	0.94%	0.94%	0.93%	0.95%
85% Perc =	3.32%	20.20%	188.67%	8.86%	14.02%	4.25%	4.25%	1.01%	1.00%	0.99%	1.01%
90% Perc =	6.13%	25.76%	227.23%	8.86%	19.89%	4.50%	4.50%	1.07%	1.07%	1.07%	1.09%
95% Perc =	9.69%	33.57%	292.13%	8.86%	33.29%	4.75%	4.75%	1.16%	1.16%	1.16%	1.16%

Name	QUARTERLY TRAFFIC GROWTH RATE 6	QUARTERLY TRAFFIC GROWTH RATE 7	QUARTERLY TRAFFIC GROWTH RATE 8	QUARTERLY TRAFFIC GROWTH RATE 9	QUARTERLY TRAFFIC GROWTH RATE 10	QUARTERLY TRAFFIC GROWTH RATE 11	QUARTERLY TRAFFIC GROWTH RATE 12	QUARTERLY TRAFFIC GROWTH RATE 13	QUARTERLY TRAFFIC GROWTH RATE 14	QUARTERLY TRAFFIC GROWTH RATE 15	QUARTERLY TRAFFIC GROWTH RATE 16
Description	Uniform(IF(O$75-$K$16/4<$I$17/4,$I$17/4,O$75-$K$16/4),IF(O$7	Uniform(IF(P$75-$K$16/4<$I$17/4,$I$17/4,P$75-$K$16/4),IF(P$7	Uniform(IF(Q$75-$K$16/4<$I$17/4,$I$17/4,Q$75-$K$16/4),IF(Q$7	Uniform(IF(R$75-$K$16/4<$I$17/4,$I$17/4,R$75-$K$16/4),IF(R$7	Uniform(IF(S$75-$K$16/4<$I$17/4,$I$17/4,S$75-$K$16/4),IF(S$7	Uniform(IF(T$75-$K$16/4<$I$17/4,$I$17/4,T$75-$K$16/4),IF(T$7	Uniform(IF(U$75-$K$16/4<$I$17/4,$I$17/4,U$75-$K$16/4),IF(U$7	Uniform(IF(V$75-$K$16/4<$I$17/4,$I$17/4,V$75-$K$16/4),IF(V$7	Uniform(IF(W$75-$K$16/4<$I$17/4,$I$17/4,W$75-$K$16/4),IF(W$7	Uniform(IF(X$75-$K$16/4<$I$17/4,$I$17/4,X$75-$K$16/4),IF(X$7	Uniform(IF(Y$75-$K$16/4<$I$17/4,$I$17/4,Y$75-$K$16/4),IF(Y$7
Cell	P75	Q75	R75	S75	T75	U75	V75	W75	X75	Y75	Z75
Minimum =	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.62%	0.62%	0.62%	0.62%	0.63%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%
Std Deviation =	0.33%	0.33%	0.33%	0.33%	0.32%	0.33%	0.33%	0.33%	0.33%	0.33%	0.32%
Variance =	1.06E-05	1.09E-05	1.06E-05	1.09E-05	1.05E-05	1.06E-05	1.07E-05	1.09E-05	1.12E-05	1.06E-05	1.05E-05
Skewness =	1.33E-02	-7.88E-03	2.92E-02	-1.71E-02	-2.35E-02	9.90E-03	-1.35E-02	-4.42E-03	2.11E-02	1.61E-02	-6.92E-03
Kurtosis =	1.997177	2.000322	2.025132	1.970889	2.028162	2.015558	1.987485	1.980148	1.975193	2.045687	2.069228
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.40%	0.49%	0.30%	0.64%	0.62%	0.52%	0.88%	0.76%	0.56%	0.65%	0.67%
5% Perc =	0.09%	0.09%	0.10%	0.08%	0.10%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%
10% Perc =	0.17%	0.16%	0.17%	0.16%	0.17%	0.18%	0.16%	0.16%	0.16%	0.18%	0.17%
15% Perc =	0.24%	0.23%	0.24%	0.23%	0.24%	0.25%	0.24%	0.23%	0.23%	0.25%	0.24%
20% Perc =	0.30%	0.30%	0.30%	0.30%	0.32%	0.30%	0.30%	0.30%	0.30%	0.31%	0.31%
25% Perc =	0.36%	0.36%	0.36%	0.36%	0.37%	0.36%	0.36%	0.36%	0.35%	0.36%	0.37%
30% Perc =	0.41%	0.42%	0.43%	0.42%	0.43%	0.42%	0.43%	0.41%	0.41%	0.42%	0.43%
35% Perc =	0.47%	0.48%	0.47%	0.47%	0.48%	0.47%	0.47%	0.47%	0.46%	0.48%	0.48%
40% Perc =	0.52%	0.52%	0.52%	0.52%	0.53%	0.52%	0.52%	0.52%	0.52%	0.52%	0.53%
45% Perc =	0.57%	0.57%	0.57%	0.57%	0.58%	0.57%	0.57%	0.58%	0.57%	0.58%	0.58%
50% Perc =	0.62%	0.62%	0.62%	0.64%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.63%
55% Perc =	0.67%	0.67%	0.67%	0.68%	0.67%	0.67%	0.67%	0.69%	0.67%	0.67%	0.67%
60% Perc =	0.72%	0.72%	0.72%	0.73%	0.73%	0.72%	0.73%	0.73%	0.72%	0.72%	0.72%
65% Perc =	0.77%	0.77%	0.77%	0.78%	0.78%	0.77%	0.78%	0.78%	0.78%	0.77%	0.77%
70% Perc =	0.83%	0.84%	0.82%	0.83%	0.82%	0.83%	0.84%	0.84%	0.84%	0.82%	0.82%
75% Perc =	0.89%	0.90%	0.88%	0.89%	0.88%	0.89%	0.89%	0.89%	0.90%	0.88%	0.87%
80% Perc =	0.94%	0.95%	0.94%	0.95%	0.95%	0.94%	0.95%	0.95%	0.96%	0.94%	0.94%
85% Perc =	1.00%	1.01%	1.01%	1.01%	1.00%	1.01%	1.01%	1.01%	1.01%	1.00%	1.01%
90% Perc =	1.07%	1.07%	1.08%	1.08%	1.08%	1.07%	1.07%	1.08%	1.09%	1.08%	1.08%
95% Perc =	1.16%	1.15%	1.16%	1.15%	1.15%	1.16%	1.15%	1.16%	1.17%	1.16%	1.15%

Name	QUARTERLY TRAFFIC GROWTH RATE 17	QUARTERLY TRAFFIC GROWTH RATE 18	QUARTERLY TRAFFIC GROWTH RATE 19	QUARTERLY TRAFFIC GROWTH RATE 20	QUARTERLY TRAFFIC GROWTH RATE 21	QUARTERLY TRAFFIC GROWTH RATE 22	QUARTERLY TRAFFIC GROWTH RATE 23	QUARTERLY TRAFFIC GROWTH RATE 24	QUARTERLY TRAFFIC GROWTH RATE 25	QUARTERLY TRAFFIC GROWTH RATE 26	QUARTERLY TRAFFIC GROWTH RATE 27
Description	Uniform(IF(Z$75-$K$16/4<$I$17/4,$I$17/4,Z$75-$K$16/4),IF(Z$7	Uniform(IF(AA$75-$K$16/4<$I$17/4,$I$17/4,AA$75-$K$16/4),IF(A	Uniform(IF(AB$75-$K$16/4<$I$17/4,$I$17/4,AB$75-$K$16/4),IF(A	Uniform(IF(AC$75-$K$16/4<$I$17/4,$I$17/4,AC$75-$K$16/4),IF(A	Uniform(IF(AD$75-$K$16/4<$I$17/4,$I$17/4,AD$75-$K$16/4),IF(A	Uniform(IF(AE$75-$K$16/4<$I$17/4,$I$17/4,AE$75-$K$16/4),IF(A	Uniform(IF(AF$75-$K$16/4<$I$17/4,$I$17/4,AF$75-$K$16/4),IF(A	Uniform(IF(AG$75-$K$16/4<$I$17/4,$I$17/4,AG$75-$K$16/4),IF(A	Uniform(IF(AH$75-$K$16/4<$I$17/4,$I$17/4,AH$75-$K$16/4),IF(A	Uniform(IF(AI$75-$K$16/4<$I$17/4,$I$17/4,AI$75-$K$16/4),IF(A	Uniform(IF(AJ$75-$K$16/4<$I$17/4,$I$17/4,AJ$75-$K$16/4),IF(A
Cell	AA75	AB75	AC75	AD75	AE75	AF75	AG75	AH75	AI75	AJ75	AK75
Minimum =	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.62%	0.62%	0.63%	0.62%	0.63%	0.63%	0.63%	0.63%	0.62%	0.62%	0.62%
Std Deviation =	0.33%	0.33%	0.33%	0.33%	0.33%	0.32%	0.33%	0.33%	0.33%	0.33%	0.33%
Variance =	1.11E-05	1.07E-05	1.09E-05	1.07E-05	1.09E-05	1.06E-05	1.08E-05	1.07E-05	1.08E-05	1.12E-05	1.11E-05
Skewness =	3.71E-02	-2.75E-02	7.90E-03	9.02E-03	-1.82E-02	2.54E-02	-1.46E-02	-1.74E-02	3.17E-02	8.76E-03	-7.53E-03
Kurtosis =	1.975463	1.998267	1.9767	2.040025	2.01309	2.027877	2.007207	1.986189	2.030016	1.964402	1.985114
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.44%	0.56%	0.70%	0.87%	0.40%	0.69%	0.84%	1.25%	0.70%	0.38%	0.56%
5% Perc =	0.09%	0.08%	0.09%	0.09%	0.08%	0.10%	0.09%	0.09%	0.09%	0.08%	0.08%
10% Perc =	0.17%	0.17%	0.16%	0.16%	0.16%	0.18%	0.16%	0.17%	0.18%	0.16%	0.15%
15% Perc =	0.24%	0.24%	0.25%	0.24%	0.23%	0.25%	0.24%	0.24%	0.25%	0.24%	0.23%
20% Perc =	0.30%	0.31%	0.30%	0.30%	0.31%	0.31%	0.31%	0.31%	0.31%	0.29%	0.29%
25% Perc =	0.36%	0.36%	0.36%	0.37%	0.37%	0.37%	0.36%	0.37%	0.36%	0.35%	0.36%
30% Perc =	0.40%	0.42%	0.41%	0.42%	0.42%	0.42%	0.42%	0.42%	0.42%	0.41%	0.41%
35% Perc =	0.45%	0.48%	0.46%	0.48%	0.48%	0.47%	0.47%	0.48%	0.46%	0.46%	0.47%
40% Perc =	0.51%	0.54%	0.52%	0.53%	0.52%	0.52%	0.53%	0.53%	0.52%	0.51%	0.52%
45% Perc =	0.56%	0.57%	0.57%	0.57%	0.58%	0.57%	0.58%	0.58%	0.57%	0.57%	0.57%
50% Perc =	0.62%	0.62%	0.62%	0.63%	0.62%	0.62%	0.63%	0.63%	0.62%	0.62%	0.62%
55% Perc =	0.67%	0.68%	0.67%	0.68%	0.67%	0.67%	0.68%	0.68%	0.67%	0.68%	0.68%
60% Perc =	0.72%	0.72%	0.73%	0.72%	0.72%	0.72%	0.73%	0.73%	0.71%	0.73%	0.72%
65% Perc =	0.77%	0.78%	0.79%	0.78%	0.78%	0.77%	0.78%	0.78%	0.77%	0.79%	0.77%
70% Perc =	0.84%	0.84%	0.84%	0.82%	0.83%	0.82%	0.83%	0.83%	0.82%	0.84%	0.83%
75% Perc =	0.90%	0.89%	0.90%	0.87%	0.89%	0.88%	0.88%	0.89%	0.88%	0.89%	0.89%
80% Perc =	0.95%	0.95%	0.95%	0.94%	0.95%	0.95%	0.95%	0.95%	0.94%	0.95%	0.95%
85% Perc =	1.02%	1.00%	1.02%	1.00%	1.02%	1.01%	1.01%	1.01%	1.02%	1.02%	1.02%
90% Perc =	1.09%	1.07%	1.08%	1.09%	1.08%	1.09%	1.08%	1.08%	1.08%	1.10%	1.08%
95% Perc =	1.17%	1.15%	1.16%	1.16%	1.15%	1.16%	1.15%	1.15%	1.16%	1.16%	1.16%

Name	QUARTERLY TRAFFIC GROWTH RATE 28	QUARTERLY TRAFFIC GROWTH RATE 29	QUARTERLY TRAFFIC GROWTH RATE 30	QUARTERLY TRAFFIC GROWTH RATE 31	QUARTERLY TRAFFIC GROWTH RATE 32	QUARTERLY TRAFFIC GROWTH RATE 33	QUARTERLY TRAFFIC GROWTH RATE 34	QUARTERLY TRAFFIC GROWTH RATE 35	QUARTERLY TRAFFIC GROWTH RATE 36	QUARTERLY TRAFFIC GROWTH RATE 37	QUARTERLY TRAFFIC GROWTH RATE 38
Description	Uniform(IF(AK$75-$K$16/4<$I$17/4,$I$17/4,AK$75-$K$16/4),IF(A	Uniform(IF(AL$75-$K$16/4<$I$17/4,$I$17/4,AL$75-$K$16/4),IF(A	Uniform(IF(AM$75-$K$16/4<$I$17/4,$I$17/4,AM$75-$K$16/4),IF(A	Uniform(IF(AN$75-$K$16/4<$I$17/4,$I$17/4,AN$75-$K$16/4),IF(A	Uniform(IF(AO$75-$K$16/4<$I$17/4,$I$17/4,AO$75-$K$16/4),IF(A	Uniform(IF(AP$75-$K$16/4<$I$17/4,$I$17/4,AP$75-$K$16/4),IF(A	Uniform(IF(AQ$75-$K$16/4<$I$17/4,$I$17/4,AQ$75-$K$16/4),IF(A	Uniform(IF(AR$75-$K$16/4<$I$17/4,$I$17/4,AR$75-$K$16/4),IF(A	Uniform(IF(AS$75-$K$16/4<$I$17/4,$I$17/4,AS$75-$K$16/4),IF(A	Uniform(IF(AT$75-$K$16/4<$I$17/4,$I$17/4,AT$75-$K$16/4),IF(A	Uniform(IF(AU$75-$K$16/4<$I$17/4,$I$17/4,AU$75-$K$16/4),IF(A
Cell	AL75	AM75	AN75	AO75	AP75	AQ75	AR75	AS75	AT75	AU75	AV75
Minimum =	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.62%	0.62%	0.63%	0.63%	0.63%	0.62%	0.62%	0.63%	0.62%	0.62%	0.62%
Std Deviation =	0.33%	0.33%	0.33%	0.33%	0.33%	0.33%	0.33%	0.33%	0.32%	0.33%	0.33%
Variance =	1.07E-05	1.07E-05	1.06E-05	1.07E-05	1.07E-05	1.06E-05	1.06E-05	1.08E-05	1.06E-05	1.07E-05	1.10E-05
Skewness =	-1.43E-02	1.53E-02	-1.48E-02	-2.80E-02	3.02E-02	1.37E-02	7.28E-03	-8.05E-03	5.92E-03	8.73E-04	3.67E-02
Kurtosis =	2.033387	2.035885	2.009274	1.991569	2.004412	2.042576	2.016085	2.03211	2.024437	2.004179	2.005006
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.82%	0.67%	0.73%	0.58%	0.51%	0.46%	0.69%	0.68%	0.77%	0.51%	0.44%
5% Perc =	0.08%	0.09%	0.09%	0.09%	0.10%	0.09%	0.09%	0.09%	0.10%	0.10%	0.09%
10% Perc =	0.17%	0.18%	0.16%	0.17%	0.17%	0.17%	0.17%	0.16%	0.17%	0.17%	0.17%
15% Perc =	0.23%	0.24%	0.24%	0.24%	0.24%	0.25%	0.25%	0.23%	0.24%	0.23%	0.24%
20% Perc =	0.30%	0.31%	0.31%	0.30%	0.31%	0.31%	0.31%	0.30%	0.30%	0.31%	0.30%
25% Perc =	0.37%	0.36%	0.37%	0.37%	0.37%	0.37%	0.37%	0.37%	0.37%	0.36%	0.36%
30% Perc =	0.42%	0.41%	0.42%	0.43%	0.42%	0.42%	0.42%	0.42%	0.43%	0.42%	0.41%
35% Perc =	0.48%	0.46%	0.47%	0.48%	0.47%	0.47%	0.46%	0.48%	0.48%	0.48%	0.46%
40% Perc =	0.52%	0.52%	0.53%	0.53%	0.52%	0.52%	0.52%	0.53%	0.52%	0.52%	0.51%
45% Perc =	0.57%	0.57%	0.59%	0.57%	0.56%	0.57%	0.57%	0.58%	0.57%	0.57%	0.56%
50% Perc =	0.62%	0.62%	0.63%	0.62%	0.61%	0.62%	0.62%	0.63%	0.62%	0.62%	0.62%
55% Perc =	0.67%	0.67%	0.68%	0.67%	0.67%	0.67%	0.68%	0.67%	0.67%	0.67%	0.67%
60% Perc =	0.72%	0.72%	0.72%	0.73%	0.72%	0.72%	0.73%	0.72%	0.71%	0.72%	0.71%
65% Perc =	0.77%	0.77%	0.78%	0.78%	0.77%	0.77%	0.78%	0.77%	0.77%	0.78%	0.77%
70% Perc =	0.82%	0.82%	0.82%	0.84%	0.83%	0.83%	0.83%	0.83%	0.83%	0.83%	0.83%
75% Perc =	0.88%	0.87%	0.89%	0.89%	0.89%	0.87%	0.89%	0.89%	0.88%	0.89%	0.89%
80% Perc =	0.94%	0.94%	0.95%	0.95%	0.95%	0.94%	0.94%	0.94%	0.95%	0.94%	0.95%
85% Perc =	1.01%	1.01%	1.01%	1.01%	1.01%	1.00%	0.99%	1.00%	1.01%	1.00%	1.02%
90% Perc =	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%	1.09%
95% Perc =	1.15%	1.16%	1.15%	1.14%	1.16%	1.16%	1.15%	1.17%	1.15%	1.15%	1.17%

Name	QUARTERLY TRAFFIC GROWTH RATE 39	QUARTERLY TRAFFIC GROWTH RATE 40	QUARTERLY TRAFFIC GROWTH RATE 41	QUARTERLY TRAFFIC GROWTH RATE 42	QUARTERLY TRAFFIC GROWTH RATE 43	QUARTERLY TRAFFIC GROWTH RATE 44	QUARTERLY TRAFFIC GROWTH RATE 45	QUARTERLY TRAFFIC GROWTH RATE 46	QUARTERLY TRAFFIC GROWTH RATE 47	QUARTERLY TRAFFIC GROWTH RATE 48	QUARTERLY TRAFFIC GROWTH RATE 49
Description	Uniform(IF(AV$75-$K$16/4<$I$17/4,$I$17/4,AV$75-$K$16/4),IF(A	Uniform(IF(AW$75-$K$16/4<$I$17/4,$I$17/4,AW$75-$K$16/4),IF(A	Uniform(IF(AX$75-$K$16/4<$I$17/4,$I$17/4,AX$75-$K$16/4),IF(A	Uniform(IF(AY$75-$K$16/4<$I$17/4,$I$17/4,AY$75-$K$16/4),IF(A	Uniform(IF(AZ$75-$K$16/4<$I$17/4,$I$17/4,AZ$75-$K$16/4),IF(A	Uniform(IF(BA$75-$K$16/4<$I$17/4,$I$17/4,BA$75-$K$16/4),IF(B	Uniform(IF(BB$75-$K$16/4<$I$17/4,$I$17/4,BB$75-$K$16/4),IF(B	Uniform(IF(BC$75-$K$16/4<$I$17/4,$I$17/4,BC$75-$K$16/4),IF(B	Uniform(IF(BD$75-$K$16/4<$I$17/4,$I$17/4,BD$75-$K$16/4),IF(B	Uniform(IF(BE$75-$K$16/4<$I$17/4,$I$17/4,BE$75-$K$16/4),IF(B	Uniform(IF(BF$75-$K$16/4<$I$17/4,$I$17/4,BF$75-$K$16/4),IF(B
Cell	AW75	AX75	AY75	AZ75	BA75	BB75	BC75	BD75	BE75	BF75	BG75
Minimum =	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.63%
Std Deviation =	0.33%	0.33%	0.33%	0.33%	0.33%	0.33%	0.33%	0.32%	0.33%	0.32%	0.32%
Variance =	1.07E-05	1.08E-05	1.08E-05	1.07E-05	1.08E-05	1.06E-05	1.06E-05	1.03E-05	1.06E-05	1.05E-05	1.04E-05
Skewness =	2.10E-02	1.62E-02	2.01E-02	9.48E-03	3.68E-02	3.60E-02	3.40E-02	2.07E-03	1.13E-02	-7.55E-03	2.21E-03
Kurtosis =	2.050074	2.010023	2.001494	2.033758	2.003585	2.04741	2.038408	2.07848	1.997736	2.035893	2.065388
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.45%	0.64%	0.50%	0.70%	0.60%	0.68%	0.72%	0.87%	0.58%	0.68%	0.71%
5% Perc =	0.08%	0.08%	0.09%	0.09%	0.09%	0.09%	0.09%	0.10%	0.10%	0.11%	0.09%
10% Perc =	0.17%	0.17%	0.16%	0.17%	0.18%	0.17%	0.17%	0.17%	0.18%	0.17%	0.18%
15% Perc =	0.24%	0.24%	0.24%	0.24%	0.24%	0.24%	0.24%	0.24%	0.25%	0.23%	0.26%
20% Perc =	0.30%	0.30%	0.30%	0.31%	0.30%	0.31%	0.31%	0.31%	0.31%	0.31%	0.31%
25% Perc =	0.36%	0.37%	0.36%	0.36%	0.36%	0.37%	0.36%	0.36%	0.36%	0.37%	0.37%
30% Perc =	0.42%	0.41%	0.41%	0.42%	0.42%	0.43%	0.42%	0.43%	0.41%	0.43%	0.43%
35% Perc =	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.48%	0.47%	0.48%	0.48%
40% Perc =	0.52%	0.52%	0.52%	0.52%	0.51%	0.51%	0.52%	0.52%	0.53%	0.53%	0.53%
45% Perc =	0.57%	0.57%	0.57%	0.58%	0.57%	0.56%	0.57%	0.57%	0.58%	0.58%	0.58%
50% Perc =	0.62%	0.62%	0.62%	0.63%	0.62%	0.61%	0.62%	0.62%	0.62%	0.63%	0.62%
55% Perc =	0.67%	0.67%	0.67%	0.68%	0.67%	0.67%	0.67%	0.68%	0.67%	0.67%	0.67%
60% Perc =	0.72%	0.72%	0.72%	0.72%	0.72%	0.71%	0.72%	0.72%	0.73%	0.73%	0.71%
65% Perc =	0.77%	0.77%	0.77%	0.77%	0.77%	0.76%	0.77%	0.77%	0.78%	0.77%	0.77%
70% Perc =	0.82%	0.83%	0.83%	0.82%	0.83%	0.82%	0.82%	0.82%	0.84%	0.83%	0.83%
75% Perc =	0.87%	0.89%	0.89%	0.88%	0.88%	0.88%	0.88%	0.86%	0.89%	0.88%	0.88%
80% Perc =	0.93%	0.94%	0.94%	0.94%	0.94%	0.94%	0.94%	0.92%	0.95%	0.93%	0.94%
85% Perc =	1.00%	1.01%	1.01%	1.00%	1.01%	1.00%	1.00%	0.99%	1.01%	1.00%	1.00%
90% Perc =	1.09%	1.08%	1.08%	1.08%	1.09%	1.08%	1.08%	1.07%	1.07%	1.08%	1.07%
95% Perc =	1.16%	1.16%	1.16%	1.16%	1.17%	1.17%	1.16%	1.16%	1.16%	1.15%	1.16%

Name	QUARTERLY TRAFFIC GROWTH RATE 50	QUARTERLY TRAFFIC GROWTH RATE 51	QUARTERLY TRAFFIC GROWTH RATE 52	QUARTERLY TRAFFIC GROWTH RATE 53	QUARTERLY TRAFFIC GROWTH RATE 54	QUARTERLY TRAFFIC GROWTH RATE 55	QUARTERLY TRAFFIC GROWTH RATE 56	QUARTERLY TRAFFIC GROWTH RATE 57	QUARTERLY TRAFFIC GROWTH RATE 58	QUARTERLY TRAFFIC GROWTH RATE 59	QUARTERLY TRAFFIC GROWTH RATE 60
Description	Uniform(IF(BG$75-$K$16/4<$I$17/4,$I$17/4,BG$75-$K$16/4),IF(B	Uniform(IF(BH$75-$K$16/4<$I$17/4,$I$17/4,BH$75-$K$16/4),IF(B	Uniform(IF(BI$75-$K$16/4<$I$17/4,$I$17/4,BI$75-$K$16/4),IF(B	Uniform(IF(BJ$75-$K$16/4<$I$17/4,$I$17/4,BJ$75-$K$16/4),IF(B	Uniform(IF(BK$75-$K$16/4<$I$17/4,$I$17/4,BK$75-$K$16/4),IF(B	Uniform(IF(BL$75-$K$16/4<$I$17/4,$I$17/4,BL$75-$K$16/4),IF(B	Uniform(IF(BM$75-$K$16/4<$I$17/4,$I$17/4,BM$75-$K$16/4),IF(B	Uniform(IF(BN$75-$K$16/4<$I$17/4,$I$17/4,BN$75-$K$16/4),IF(B	Uniform(IF(BO$75-$K$16/4<$I$17/4,$I$17/4,BO$75-$K$16/4),IF(B	Uniform(IF(BP$75-$K$16/4<$I$17/4,$I$17/4,BP$75-$K$16/4),IF(B	Uniform(IF(BQ$75-$K$16/4<$I$17/4,$I$17/4,BQ$75-$K$16/4),IF(B
Cell	BH75	BI75	BJ75	BK75	BL75	BM75	BN75	BO75	BP75	BQ75	BR75
Minimum =	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.62%	0.62%	0.63%	0.63%	0.63%	0.62%	0.62%	0.62%	0.63%	0.63%	0.63%
Std Deviation =	0.32%	0.33%	0.33%	0.33%	0.32%	0.33%	0.33%	0.33%	0.33%	0.34%	0.33%
Variance =	1.05E-05	1.06E-05	1.07E-05	1.06E-05	1.05E-05	1.10E-05	1.09E-05	1.09E-05	1.11E-05	1.13E-05	1.07E-05
Skewness =	-2.65E-02	-1.62E-02	-1.18E-02	-2.68E-02	1.62E-02	8.33E-03	1.67E-02	-3.96E-03	-1.73E-02	-1.63E-02	-1.98E-02
Kurtosis =	2.016102	1.986481	2.042248	2.018001	2.053754	1.965471	1.998174	1.975594	1.978314	1.979718	2.025074
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.70%	0.87%	0.39%	0.89%	0.75%	0.50%	0.63%	0.60%	0.58%	0.79%	0.54%
5% Perc =	0.10%	0.09%	0.09%	0.09%	0.10%	0.09%	0.09%	0.09%	0.08%	0.08%	0.09%
10% Perc =	0.17%	0.17%	0.16%	0.17%	0.17%	0.17%	0.17%	0.17%	0.16%	0.16%	0.17%
15% Perc =	0.23%	0.24%	0.23%	0.24%	0.25%	0.23%	0.24%	0.23%	0.23%	0.23%	0.24%
20% Perc =	0.30%	0.30%	0.31%	0.30%	0.32%	0.30%	0.30%	0.30%	0.30%	0.30%	0.31%
25% Perc =	0.36%	0.36%	0.38%	0.37%	0.37%	0.36%	0.36%	0.36%	0.37%	0.36%	0.37%
30% Perc =	0.43%	0.41%	0.42%	0.43%	0.43%	0.41%	0.41%	0.41%	0.42%	0.42%	0.42%
35% Perc =	0.48%	0.46%	0.47%	0.48%	0.48%	0.46%	0.47%	0.47%	0.47%	0.47%	0.48%
40% Perc =	0.53%	0.53%	0.53%	0.53%	0.53%	0.51%	0.52%	0.52%	0.51%	0.52%	0.53%
45% Perc =	0.58%	0.58%	0.58%	0.58%	0.57%	0.56%	0.57%	0.58%	0.58%	0.57%	0.58%
50% Perc =	0.63%	0.63%	0.63%	0.63%	0.62%	0.63%	0.63%	0.62%	0.63%	0.63%	0.63%
55% Perc =	0.68%	0.69%	0.68%	0.68%	0.67%	0.68%	0.67%	0.67%	0.68%	0.68%	0.68%
60% Perc =	0.73%	0.73%	0.73%	0.73%	0.72%	0.73%	0.72%	0.73%	0.74%	0.74%	0.74%
65% Perc =	0.77%	0.78%	0.77%	0.78%	0.76%	0.78%	0.77%	0.78%	0.78%	0.80%	0.78%
70% Perc =	0.83%	0.83%	0.82%	0.83%	0.82%	0.83%	0.83%	0.84%	0.85%	0.85%	0.83%
75% Perc =	0.88%	0.88%	0.88%	0.88%	0.88%	0.89%	0.90%	0.90%	0.90%	0.90%	0.88%
80% Perc =	0.94%	0.95%	0.94%	0.94%	0.94%	0.95%	0.96%	0.95%	0.96%	0.95%	0.94%
85% Perc =	1.00%	1.00%	1.02%	1.01%	1.01%	1.02%	1.01%	1.01%	1.01%	1.02%	1.00%
90% Perc =	1.06%	1.07%	1.08%	1.08%	1.08%	1.08%	1.08%	1.07%	1.08%	1.09%	1.08%
95% Perc =	1.14%	1.15%	1.16%	1.15%	1.16%	1.16%	1.17%	1.15%	1.16%	1.17%	1.16%

Name	ANNUAL INTEREST RATE QUARTER 1	ANNUAL INTEREST RATE QUARTER 2	ANNUAL INTEREST RATE QUARTER 3	ANNUAL INTEREST RATE QUARTER 4	ANNUAL INTEREST RATE QUARTER 5	ANNUAL INTEREST RATE QUARTER 6	ANNUAL INTEREST RATE QUARTER 7	ANNUAL INTEREST RATE QUARTER 8	ANNUAL INTEREST RATE QUARTER 9	ANNUAL INTEREST RATE QUARTER 10	ANNUAL INTEREST RATE QUARTER 11
Description	Output	Output	Output	Output	Output	Output	Output	Output	Output	Output	Output
Cell	K131	L131	M131	N131	O131	P131	Q131	R131	S131	T131	U131
Minimum =	3.25%	2.72%	2.14%	1.96%	1.82%	1.78%	1.69%	1.68%	1.27%	1.16%	0.90%
Maximum =	6.67%	7.36%	7.93%	8.16%	8.41%	9.37%	9.22%	9.18%	9.28%	9.08%	9.56%
Mean =	4.94%	4.88%	4.82%	4.77%	4.72%	4.67%	4.63%	4.58%	4.54%	4.51%	4.47%
Std Deviation =	0.50%	0.69%	0.82%	0.91%	1.00%	1.05%	1.12%	1.15%	1.21%	1.25%	1.28%
Variance =	2.53E-05	4.76E-05	6.74E-05	8.32E-05	9.93E-05	1.11E-04	1.25E-04	1.32E-04	1.46E-04	1.57E-04	1.64E-04
Skewness =	2.15E-03	1.63E-01	1.81E-01	2.55E-01	2.83E-01	2.99E-01	2.69E-01	2.88E-01	3.49E-01	3.80E-01	4.09E-01
Kurtosis =	2.983688	2.97164	3.169235	3.150316	3.21091	3.213469	3.085135	2.965744	3.011236	3.015731	3.107974
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	4.92%	5.16%	4.63%	3.86%	5.27%	4.39%	4.37%	5.18%	4.18%	4.03%	5.12%
5% Perc =	4.11%	3.79%	3.50%	3.35%	3.14%	3.03%	2.88%	2.75%	2.68%	2.58%	2.56%
10% Perc =	4.29%	4.01%	3.79%	3.62%	3.50%	3.35%	3.22%	3.11%	3.04%	2.96%	2.91%
15% Perc =	4.42%	4.18%	4.00%	3.83%	3.73%	3.59%	3.46%	3.37%	3.26%	3.21%	3.16%
20% Perc =	4.51%	4.30%	4.14%	3.98%	3.89%	3.76%	3.66%	3.60%	3.50%	3.44%	3.36%
25% Perc =	4.60%	4.41%	4.26%	4.11%	4.04%	3.91%	3.83%	3.75%	3.71%	3.62%	3.54%
30% Perc =	4.67%	4.49%	4.38%	4.24%	4.15%	4.08%	4.02%	3.93%	3.87%	3.78%	3.74%
35% Perc =	4.74%	4.58%	4.49%	4.37%	4.29%	4.23%	4.17%	4.08%	4.05%	3.94%	3.89%
40% Perc =	4.81%	4.68%	4.59%	4.51%	4.42%	4.38%	4.30%	4.23%	4.17%	4.11%	4.07%
45% Perc =	4.88%	4.77%	4.71%	4.63%	4.54%	4.51%	4.44%	4.37%	4.30%	4.27%	4.22%
50% Perc =	4.94%	4.86%	4.81%	4.74%	4.67%	4.63%	4.59%	4.51%	4.45%	4.41%	4.38%
55% Perc =	5.00%	4.95%	4.91%	4.87%	4.79%	4.75%	4.73%	4.68%	4.59%	4.58%	4.53%
60% Perc =	5.07%	5.04%	5.00%	5.01%	4.94%	4.89%	4.87%	4.83%	4.77%	4.75%	4.69%
65% Perc =	5.13%	5.13%	5.11%	5.13%	5.05%	5.01%	5.02%	5.01%	4.94%	4.91%	4.87%
70% Perc =	5.20%	5.23%	5.21%	5.25%	5.19%	5.19%	5.19%	5.17%	5.12%	5.06%	5.07%
75% Perc =	5.28%	5.32%	5.37%	5.38%	5.36%	5.35%	5.37%	5.34%	5.31%	5.26%	5.26%
80% Perc =	5.36%	5.44%	5.51%	5.52%	5.55%	5.52%	5.55%	5.55%	5.56%	5.54%	5.52%
85% Perc =	5.46%	5.59%	5.68%	5.70%	5.75%	5.72%	5.78%	5.76%	5.81%	5.84%	5.82%
90% Perc =	5.58%	5.79%	5.87%	5.92%	6.01%	6.09%	6.12%	6.09%	6.18%	6.18%	6.18%
95% Perc =	5.76%	6.07%	6.19%	6.29%	6.44%	6.48%	6.49%	6.57%	6.65%	6.75%	6.74%

Name	ANNUAL INTEREST RATE QUARTER 12	ANNUAL INTEREST RATE QUARTER 13	ANNUAL INTEREST RATE QUARTER 14	ANNUAL INTEREST RATE QUARTER 15	ANNUAL INTEREST RATE QUARTER 16	ANNUAL INTEREST RATE QUARTER 17	ANNUAL INTEREST RATE QUARTER 18	ANNUAL INTEREST RATE QUARTER 19	ANNUAL INTEREST RATE QUARTER 20	ANNUAL INTEREST RATE QUARTER 21	ANNUAL INTEREST RATE QUARTER 22
Description	Output	Output	Output	Output	Output	Output	Output	Output	Output	Output	Output
Cell	V131	W131	X131	Y131	Z131	AA131	AB131	AC131	AD131	AE131	AF131
Minimum =	1.05%	0.85%	0.78%	1.03%	1.17%	1.20%	1.14%	1.07%	0.92%	0.87%	0.64%
Maximum =	9.39%	9.83%	9.56%	9.89%	9.89%	10.18%	10.16%	10.10%	10.97%	10.37%	10.58%
Mean =	4.43%	4.40%	4.37%	4.34%	4.31%	4.29%	4.27%	4.24%	4.22%	4.20%	4.18%
Std Deviation =	1.30%	1.31%	1.32%	1.34%	1.37%	1.42%	1.45%	1.46%	1.47%	1.47%	1.47%
Variance =	1.68E-04	1.71E-04	1.74E-04	1.81E-04	1.88E-04	2.03E-04	2.10E-04	2.12E-04	2.15E-04	2.17E-04	2.17E-04
Skewness =	0.3844235	0.4028138	0.4162761	0.4753439	0.4813297	5.26E-01	5.89E-01	0.5955553	6.34E-01	0.6578531	0.6319824
Kurtosis =	3.066153	3.0491	3.10212	3.240275	3.197105	3.259816	3.409191	3.376874	3.484213	3.531953	3.66309
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	5.15%	3.71%	4.33%	4.02%	4.57%	3.86%	4.00%	3.23%	3.84%	3.72%	3.21%
5% Perc =	2.49%	2.46%	2.41%	2.34%	2.24%	2.15%	2.11%	2.11%	2.10%	2.12%	2.02%
10% Perc =	2.84%	2.76%	2.75%	2.71%	2.65%	2.55%	2.51%	2.48%	2.46%	2.46%	2.44%
15% Perc =	3.09%	3.05%	2.97%	2.96%	2.90%	2.83%	2.79%	2.78%	2.73%	2.68%	2.71%
20% Perc =	3.28%	3.24%	3.19%	3.16%	3.12%	3.05%	3.02%	3.02%	2.96%	2.94%	2.93%
25% Perc =	3.48%	3.45%	3.39%	3.34%	3.33%	3.29%	3.23%	3.22%	3.18%	3.15%	3.12%
30% Perc =	3.70%	3.61%	3.55%	3.53%	3.49%	3.47%	3.44%	3.38%	3.35%	3.33%	3.29%
35% Perc =	3.88%	3.80%	3.73%	3.73%	3.67%	3.68%	3.63%	3.54%	3.53%	3.52%	3.48%
40% Perc =	4.02%	3.97%	3.93%	3.91%	3.87%	3.83%	3.78%	3.74%	3.73%	3.71%	3.69%
45% Perc =	4.19%	4.13%	4.10%	4.07%	4.01%	3.98%	3.94%	3.92%	3.91%	3.86%	3.88%
50% Perc =	4.34%	4.31%	4.27%	4.23%	4.19%	4.14%	4.09%	4.11%	4.05%	4.05%	4.06%
55% Perc =	4.51%	4.48%	4.45%	4.42%	4.37%	4.30%	4.29%	4.27%	4.24%	4.22%	4.24%
60% Perc =	4.69%	4.64%	4.62%	4.59%	4.56%	4.54%	4.50%	4.45%	4.43%	4.40%	4.42%
65% Perc =	4.86%	4.83%	4.81%	4.76%	4.72%	4.73%	4.68%	4.64%	4.60%	4.58%	4.59%
70% Perc =	5.05%	5.00%	5.01%	4.96%	4.92%	4.91%	4.89%	4.89%	4.83%	4.79%	4.78%
75% Perc =	5.23%	5.24%	5.26%	5.18%	5.17%	5.17%	5.15%	5.12%	5.08%	5.02%	5.01%
80% Perc =	5.49%	5.51%	5.48%	5.41%	5.43%	5.42%	5.44%	5.46%	5.40%	5.32%	5.29%
85% Perc =	5.81%	5.81%	5.79%	5.73%	5.77%	5.77%	5.78%	5.72%	5.76%	5.71%	5.68%
90% Perc =	6.18%	6.16%	6.11%	6.14%	6.15%	6.24%	6.15%	6.17%	6.18%	6.18%	6.15%
95% Perc =	6.70%	6.69%	6.58%	6.72%	6.77%	6.83%	6.91%	6.93%	6.92%	6.95%	6.82%

Name	ANNUAL INTEREST RATE QUARTER 23	ANNUAL INTEREST RATE QUARTER 24	ANNUAL INTEREST RATE QUARTER 25	ANNUAL INTEREST RATE QUARTER 26	ANNUAL INTEREST RATE QUARTER 27	ANNUAL INTEREST RATE QUARTER 28	ANNUAL INTEREST RATE QUARTER 29	ANNUAL INTEREST RATE QUARTER 30	ANNUAL INTEREST RATE QUARTER 31	ANNUAL INTEREST RATE QUARTER 32	ANNUAL INTEREST RATE QUARTER 33
Description	Output	Output	Output	Output	Output	Output	Output	Output	Output	Output	Output
Cell	AG131	AH131	AI131	AJ131	AK131	AL131	AM131	AN131	AO131	AP131	AQ131
Minimum =	0.79%	0.51%	0.55%	0.59%	0.79%	0.79%	0.54%	0.66%	0.74%	0.83%	0.81%
Maximum =	11.30%	11.44%	11.69%	10.66%	10.06%	10.45%	10.06%	10.41%	9.78%	10.10%	10.97%
Mean =	4.16%	4.14%	4.12%	4.10%	4.09%	4.07%	4.06%	4.05%	4.03%	4.02%	4.01%
Std Deviation =	1.49%	1.48%	1.47%	1.47%	1.47%	1.47%	1.49%	1.50%	1.50%	1.49%	1.49%
Variance =	2.22E-04	2.20E-04	2.17E-04	2.17E-04	2.16E-04	2.17E-04	2.23E-04	2.24E-04	2.24E-04	2.21E-04	2.23E-04
Skewness =	0.6624376	0.6799409	0.6098803	0.5895946	0.5876331	0.5999251	0.6259793	0.645427	0.6127849	0.5850543	0.6304231
Kurtosis =	3.78487	3.872573	3.628243	3.455782	3.333179	3.347916	3.277849	3.392087	3.301586	3.299834	3.537756
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	4.80%	3.33%	3.98%	4.19%	3.57%	5.41%	3.34%	3.92%	3.64%	3.25%	3.67%
5% Perc =	2.00%	1.96%	1.93%	1.96%	1.95%	1.93%	1.94%	1.89%	1.88%	1.88%	1.86%
10% Perc =	2.37%	2.34%	2.34%	2.31%	2.31%	2.30%	2.26%	2.24%	2.26%	2.21%	2.24%
15% Perc =	2.67%	2.66%	2.63%	2.59%	2.57%	2.60%	2.57%	2.51%	2.51%	2.49%	2.45%
20% Perc =	2.89%	2.88%	2.86%	2.84%	2.83%	2.81%	2.80%	2.76%	2.70%	2.72%	2.68%
25% Perc =	3.09%	3.11%	3.11%	3.08%	3.06%	3.03%	2.98%	2.99%	2.93%	2.93%	2.90%
30% Perc =	3.28%	3.29%	3.29%	3.28%	3.25%	3.19%	3.16%	3.14%	3.12%	3.10%	3.11%
35% Perc =	3.46%	3.47%	3.48%	3.45%	3.44%	3.37%	3.35%	3.34%	3.33%	3.30%	3.32%
40% Perc =	3.64%	3.64%	3.66%	3.61%	3.59%	3.54%	3.51%	3.52%	3.52%	3.49%	3.51%
45% Perc =	3.81%	3.82%	3.82%	3.79%	3.75%	3.71%	3.66%	3.71%	3.68%	3.69%	3.68%
50% Perc =	4.03%	4.01%	3.99%	3.97%	3.93%	3.90%	3.84%	3.89%	3.86%	3.87%	3.88%
55% Perc =	4.22%	4.17%	4.13%	4.15%	4.10%	4.10%	4.03%	4.03%	4.05%	4.06%	4.05%
60% Perc =	4.37%	4.35%	4.32%	4.30%	4.29%	4.28%	4.25%	4.22%	4.24%	4.27%	4.26%
65% Perc =	4.58%	4.53%	4.53%	4.51%	4.47%	4.49%	4.49%	4.43%	4.46%	4.49%	4.45%
70% Perc =	4.82%	4.79%	4.71%	4.73%	4.72%	4.71%	4.74%	4.66%	4.70%	4.70%	4.67%
75% Perc =	5.07%	5.03%	4.98%	4.94%	4.98%	5.00%	4.98%	4.95%	4.97%	4.93%	4.89%
80% Perc =	5.32%	5.30%	5.22%	5.29%	5.27%	5.29%	5.27%	5.27%	5.27%	5.25%	5.17%
85% Perc =	5.65%	5.61%	5.63%	5.61%	5.62%	5.62%	5.64%	5.62%	5.62%	5.54%	5.55%
90% Perc =	6.08%	6.07%	6.12%	6.11%	6.07%	6.03%	6.10%	6.09%	6.02%	6.01%	6.04%
95% Perc =	6.90%	6.79%	6.78%	6.77%	6.83%	6.84%	6.83%	6.79%	6.69%	6.70%	6.65%

Name	ANNUAL INTEREST RATE QUARTER 34	ANNUAL INTEREST RATE QUARTER 35	ANNUAL INTEREST RATE QUARTER 36	ANNUAL INTEREST RATE QUARTER 37	ANNUAL INTEREST RATE QUARTER 38	ANNUAL INTEREST RATE 39	ANNUAL INTEREST RATE QUARTER 40	% CHANGE INTEREST RATE QTR 41	% CHANGE INTEREST RATE QTR 42	% CHANGE INTEREST RATE QTR 43	% CHANGE INTEREST RATE QTR 44
Description	Output	Output	Output	Output	Output	Output	Output	Normal(0.2*($I$130-AX$131),0.09*(AX$131^0.5))	Normal(0.2*($I$130-AY$131),0.09*(AY$131^0.5))	Normal(0.2*($I$130-AZ$131),0.09*(AZ$131^0.5))	Normal(0.2*($I$130-BA$131),0.09*(BA$131^0.5))
Cell	AR131	AS131	AT131	AU131	AV131	AW131	AX131	AY130	AZ130	BA130	BB130
Minimum =	0.82%	0.75%	0.53%	0.56%	0.54%	0.44%	0.70%	-7.47%	-6.88%	-8.22%	-8.78%
Maximum =	11.06%	11.16%	11.06%	9.43%	10.12%	9.54%	10.74%	7.31%	7.22%	6.65%	6.92%
Mean =	4.00%	3.99%	3.98%	3.96%	3.96%	3.95%	3.95%	-0.04%	-0.02%	-0.04%	-0.02%
Std Deviation =	1.49%	1.49%	1.48%	1.46%	1.49%	1.49%	1.49%	1.82%	1.80%	1.83%	1.82%
Variance =	2.21E-04	2.22E-04	2.18E-04	2.14E-04	2.23E-04	2.22E-04	2.23E-04	3.30E-04	3.24E-04	3.36E-04	3.30E-04
Skewness =	0.641736	0.6599019	0.6329781	0.5900317	0.6407306	0.6357306	0.6348908	-0.1482248	-8.59E-02	-0.2697248	-0.2251531
Kurtosis =	3.491708	3.421994	3.326143	3.163836	3.290295	3.288317	3.39507	3.408608	3.486928	3.568588	3.74879
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	3.68%	3.73%	3.46%	2.51%	4.29%	2.96%	3.70%	0.26%	-0.34%	0.47%	-0.73%
5% Perc =	1.83%	1.87%	1.86%	1.89%	1.84%	1.87%	1.82%	-3.07%	-3.05%	-3.17%	-3.13%
10% Perc =	2.21%	2.22%	2.22%	2.22%	2.21%	2.20%	2.17%	-2.30%	-2.34%	-2.37%	-2.28%
15% Perc =	2.47%	2.47%	2.46%	2.50%	2.45%	2.44%	2.41%	-1.90%	-1.84%	-1.88%	-1.73%
20% Perc =	2.70%	2.69%	2.69%	2.69%	2.64%	2.64%	2.60%	-1.52%	-1.52%	-1.45%	-1.36%
25% Perc =	2.91%	2.90%	2.89%	2.89%	2.84%	2.83%	2.82%	-1.23%	-1.18%	-1.16%	-1.09%
30% Perc =	3.10%	3.09%	3.08%	3.07%	3.03%	3.01%	3.03%	-0.94%	-0.92%	-0.90%	-0.86%
35% Perc =	3.32%	3.28%	3.28%	3.23%	3.24%	3.21%	3.23%	-0.65%	-0.64%	-0.68%	-0.68%
40% Perc =	3.51%	3.47%	3.44%	3.40%	3.41%	3.39%	3.40%	-0.43%	-0.39%	-0.43%	-0.42%
45% Perc =	3.67%	3.64%	3.61%	3.59%	3.61%	3.58%	3.61%	-0.18%	-0.18%	-0.18%	-0.19%
50% Perc =	3.86%	3.80%	3.77%	3.78%	3.76%	3.79%	3.80%	0.04%	0.01%	0.04%	0.00%
55% Perc =	4.04%	3.97%	3.98%	4.00%	3.96%	3.96%	4.00%	0.24%	0.23%	0.23%	0.26%
60% Perc =	4.19%	4.17%	4.20%	4.18%	4.17%	4.17%	4.20%	0.44%	0.43%	0.45%	0.44%
65% Perc =	4.41%	4.38%	4.38%	4.40%	4.38%	4.38%	4.39%	0.68%	0.69%	0.65%	0.67%
70% Perc =	4.62%	4.62%	4.60%	4.64%	4.60%	4.61%	4.58%	0.93%	0.92%	0.92%	0.92%
75% Perc =	4.88%	4.85%	4.87%	4.87%	4.84%	4.87%	4.84%	1.16%	1.16%	1.16%	1.16%
80% Perc =	5.17%	5.19%	5.18%	5.16%	5.16%	5.16%	5.13%	1.45%	1.44%	1.44%	1.45%
85% Perc =	5.50%	5.56%	5.54%	5.53%	5.57%	5.53%	5.45%	1.77%	1.79%	1.76%	1.79%
90% Perc =	6.00%	6.04%	6.00%	5.96%	5.96%	5.93%	5.99%	2.23%	2.19%	2.22%	2.20%
95% Perc =	6.71%	6.74%	6.63%	6.63%	6.73%	6.71%	6.74%	2.84%	2.83%	2.84%	2.85%

Name	% CHANGE INTEREST RATE QTR 45	% CHANGE INTEREST RATE QTR 46	% CHANGE INTEREST RATE QTR 47	% CHANGE INTEREST RATE QTR 48	% CHANGE INTEREST RATE QTR 49	% CHANGE INTEREST RATE QTR 50	% CHANGE INTEREST RATE QTR 51	% CHANGE INTEREST RATE QTR 52	% CHANGE INTEREST RATE QTR 53	% CHANGE INTEREST RATE QTR 54	% CHANGE INTEREST RATE QTR 55
Description	Normal(0.2*($I$130-BB$131),0.09*(BB$131^0.5))	Normal(0.2*($I$130-BC$131),0.09*(BC$131^0.5))	Normal(0.2*($I$130-BD$131),0.09*(BD$131^0.5))	Normal(0.2*($I$130-BE$131),0.09*(BE$131^0.5))	Normal(0.2*($I$130-BF$131),0.09*(BF$131^0.5))	Normal(0.2*($I$130-BG$131),0.09*(BG$131^0.5))	Normal(0.2*($I$130-BH$131),0.09*(BH$131^0.5))	Normal(0.2*($I$130-BI$131),0.09*(BI$131^0.5))	Normal(0.2*($I$130-BJ$131),0.09*(BJ$131^0.5))	Normal(0.2*($I$130-BK$131),0.09*(BK$131^0.5))	Normal(0.2*($I$130-BL$131),0.09*(BL$131^0.5))
Cell	BC130	BD130	BE130	BF130	BG130	BH130	BI130	BJ130	BK130	BL130	BM130
Minimum =	-7.75%	-6.74%	-7.74%	-6.88%	-8.77%	-7.01%	-8.46%	-9.01%	-8.18%	-6.65%	-7.80%
Maximum =	5.56%	6.20%	6.29%	5.53%	7.37%	5.45%	6.58%	7.26%	6.99%	8.16%	6.36%
Mean =	-0.03%	-0.03%	-0.03%	-0.03%	-0.02%	-0.03%	-0.01%	-0.03%	-0.01%	-0.01%	-0.02%
Std Deviation =	1.81%	1.80%	1.81%	1.79%	1.79%	1.80%	1.79%	1.81%	1.79%	1.79%	1.80%
Variance =	3.28E-04	3.24E-04	3.29E-04	3.21E-04	3.22E-04	3.25E-04	3.21E-04	3.28E-04	3.20E-04	3.19E-04	3.22E-04
Skewness =	-0.2342829	-0.1425568	-0.2468915	-0.1683056	-0.1891126	-0.2250345	-0.1549646	-0.2109745	-0.1922187	-0.1378653	-0.1909086
Kurtosis =	3.482119	3.266287	3.514861	3.210395	3.674036	3.306161	3.595747	3.669681	3.520065	3.57745	3.394001
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.20%	-0.61%	0.47%	-0.04%	-0.18%	0.46%	-0.07%	-0.02%	0.80%	-0.24%	1.06%
5% Perc =	-3.10%	-3.07%	-3.12%	-3.14%	-2.95%	-3.10%	-2.97%	-3.03%	-2.92%	-2.87%	-3.16%
10% Perc =	-2.34%	-2.37%	-2.34%	-2.37%	-2.32%	-2.32%	-2.27%	-2.40%	-2.24%	-2.26%	-2.33%
15% Perc =	-1.88%	-1.86%	-1.86%	-1.87%	-1.87%	-1.88%	-1.80%	-1.87%	-1.81%	-1.77%	-1.78%
20% Perc =	-1.46%	-1.55%	-1.49%	-1.44%	-1.48%	-1.52%	-1.48%	-1.49%	-1.51%	-1.43%	-1.39%
25% Perc =	-1.16%	-1.20%	-1.16%	-1.16%	-1.17%	-1.17%	-1.17%	-1.17%	-1.16%	-1.16%	-1.14%
30% Perc =	-0.87%	-0.90%	-0.89%	-0.88%	-0.88%	-0.88%	-0.91%	-0.89%	-0.89%	-0.90%	-0.86%
35% Perc =	-0.65%	-0.63%	-0.63%	-0.63%	-0.62%	-0.59%	-0.62%	-0.64%	-0.67%	-0.60%	-0.64%
40% Perc =	-0.39%	-0.43%	-0.38%	-0.39%	-0.39%	-0.38%	-0.40%	-0.42%	-0.43%	-0.37%	-0.40%
45% Perc =	-0.17%	-0.20%	-0.17%	-0.17%	-0.19%	-0.18%	-0.18%	-0.19%	-0.16%	-0.18%	-0.19%
50% Perc =	0.04%	0.05%	0.04%	0.01%	0.00%	0.05%	0.04%	0.02%	0.06%	0.01%	0.00%
55% Perc =	0.25%	0.25%	0.25%	0.21%	0.26%	0.24%	0.27%	0.27%	0.27%	0.24%	0.24%
60% Perc =	0.48%	0.46%	0.45%	0.44%	0.45%	0.47%	0.45%	0.50%	0.47%	0.44%	0.47%
65% Perc =	0.66%	0.66%	0.68%	0.68%	0.67%	0.69%	0.67%	0.67%	0.70%	0.70%	0.68%
70% Perc =	0.90%	0.94%	0.92%	0.92%	0.91%	0.92%	0.91%	0.92%	0.91%	0.91%	0.92%
75% Perc =	1.17%	1.17%	1.16%	1.17%	1.16%	1.17%	1.16%	1.18%	1.16%	1.17%	1.19%
80% Perc =	1.43%	1.44%	1.44%	1.45%	1.45%	1.44%	1.44%	1.44%	1.44%	1.44%	1.44%
85% Perc =	1.78%	1.76%	1.77%	1.78%	1.77%	1.80%	1.75%	1.77%	1.78%	1.78%	1.77%
90% Perc =	2.20%	2.20%	2.19%	2.20%	2.16%	2.16%	2.20%	2.16%	2.17%	2.19%	2.18%
95% Perc =	2.79%	2.82%	2.85%	2.80%	2.86%	2.84%	2.83%	2.81%	2.84%	2.84%	2.85%

G.2 MONTERREY-NUEVO LAREDO TOLL ROAD

Name	PROJECT NPV	EQUITY NPV	PROJECT IRR	EQUITY IRR	CONSTRUCTION COST	TOLL COLLECTION COST ($ per Vehicle)	M,R&R ANNUAL COST	ADMINISTRATION COST	PROJECT SCHEDULE	% CHANGE IN CAR ADT DIVERTED	% CHANGE IN BUS ADT DIVERTED
Description	Output	Output	Output	Output	Pert(141538500,167000000,168589000)	Triang(0.055,0.06,0.09)	Triang(2.5%,3%,4%)	Triang(0.18,0.225,0.25)	Pert(19,21,23)	Tnormal(-0.12,0.15,-0.4,0.11)	Tnormal(-0.054,0.25,-0.5,0.4)
Cell	K205	K208	K206	K209	N7	R7	R10	R16	N17	D23	D24
Minimum =	(262,020,400)	(76,921,420)	-3.97%	-3.62%	145,100,500	0.055	2.52%	18.11%	19	-39.99%	-49.98%
Maximum =	46,018,300	57,666,500	11.19%	12.70%	168,585,400	0.090	3.98%	24.95%	23	10.98%	39.98%
Mean =	(90,941,910)	(46,903,470)	3.03%	3.94%	163,020,900	0.068	3.17%	21.83%	21	-12.88%	-5.28%
Std Deviation =	34,213,750	18,382,810	2.31%	2.41%	4,135,178	0.008	0.31%	1.45%	1	12.04%	20.82%
Variance =	1.17E+15	3.38E+14	0.05%	0.06%	1.70997E+13	5.97E-05	9.72E-06	2.10E-04	0.5713918	0.0144983	0.0433604
Skewness =	7.71E-02	1.147062	1.67E-02	3.07E-03	-0.9653215	0.5218571	0.3056127	-0.2661403	9.92E-05	-0.105522	9.82E-03
Kurtosis =	3.614857	5.010804	3.14823	3.174392	3.584831	2.400775	2.400193	2.399093	2.332642	2.230941	2.263224
Errors Calculated =	0	0	23	52	0	0	0	0	0	0	0
Mode =	(95,557,820)	(54,447,840)	2.34%	3.37%	167,368,200	0.060	3.02%	22.47%	21	-12.43%	-7.36%
5% Perc =	(144,228,700)	(70,409,650)	-0.55%	-0.04%	154,886,200	0.058	2.69%	19.25%	20	-33.47%	-39.99%
10% Perc =	(132,981,700)	(67,130,860)	0.14%	0.83%	157,068,800	0.059	2.77%	19.77%	20	-29.52%	-33.56%
15% Perc =	(125,565,800)	(64,718,030)	0.64%	1.53%	158,538,400	0.060	2.84%	20.17%	20	-26.52%	-28.63%
20% Perc =	(119,173,100)	(62,294,570)	1.03%	1.96%	159,669,100	0.061	2.89%	20.51%	20	-24.00%	-24.47%
25% Perc =	(113,286,600)	(60,422,160)	1.49%	2.33%	160,604,400	0.062	2.93%	20.81%	20	-21.78%	-20.78%
30% Perc =	(108,528,800)	(58,485,320)	1.83%	2.69%	161,411,200	0.063	2.97%	21.07%	21	-19.75%	-17.41%
35% Perc =	(104,252,800)	(56,126,720)	2.12%	3.07%	162,128,200	0.064	3.01%	21.32%	21	-17.86%	-14.23%
40% Perc =	(100,295,800)	(54,337,520)	2.43%	3.39%	162,772,400	0.065	3.05%	21.55%	21	-16.05%	-11.20%
45% Perc =	(95,853,690)	(52,145,640)	2.76%	3.69%	163,374,000	0.066	3.09%	21.76%	21	-14.31%	-8.26%
50% Perc =	(91,835,220)	(50,214,840)	3.01%	3.95%	163,923,900	0.067	3.13%	21.97%	21	-12.61%	-5.34%
55% Perc =	(87,735,950)	(48,226,310)	3.33%	4.25%	164,444,600	0.068	3.18%	22.16%	21	-10.90%	-2.41%
60% Perc =	(83,613,360)	(45,766,340)	3.57%	4.53%	164,938,000	0.070	3.22%	22.35%	21	-9.18%	0.53%
65% Perc =	(79,002,000)	(43,135,430)	3.88%	4.83%	165,408,200	0.071	3.28%	22.52%	21	-7.42%	3.58%
70% Perc =	(74,076,130)	(40,179,080)	4.20%	5.19%	165,860,400	0.072	3.33%	22.71%	21	-5.59%	6.75%
75% Perc =	(68,861,460)	(37,189,430)	4.57%	5.54%	166,299,300	0.074	3.39%	22.91%	22	-3.67%	10.15%
80% Perc =	(61,861,680)	(33,049,790)	5.00%	5.93%	166,726,200	0.075	3.45%	23.13%	22	-1.60%	13.87%
85% Perc =	(56,224,360)	(28,841,030)	5.39%	6.35%	167,151,300	0.077	3.53%	23.38%	22	0.68%	18.03%
90% Perc =	(48,067,330)	(23,274,430)	5.94%	6.88%	167,581,100	0.080	3.61%	23.67%	22	3.33%	23.01%
95% Perc =	(34,106,270)	(12,657,210)	6.85%	7.84%	168,030,200	0.083	3.73%	24.06%	22	6.56%	29.47%

Name	% CHANGE IN TRUCK ADT DIVERTED	DISCOUNT RATE (fixed or variable)	DISCOUNT RATE LOGNORMAL	INITIAL ANNUAL TRAFFIC GROWTH RATE	QUARTERLY TRAFFIC GROWTH RATE 1	QUARTERLY TRAFFIC GROWTH RATE 2	QUARTERLY TRAFFIC GROWTH RATE 3	QUARTERLY TRAFFIC GROWTH RATE 4	QUARTERLY TRAFFIC GROWTH RATE 5	QUARTERLY TRAFFIC GROWTH RATE 6	QUARTERLY TRAFFIC GROWTH RATE 7
Description	Weibull(1.04,1.02)	Simtable(K34:K35)	Lognorm(0.0886,0.23)	Uniform($I$17,$K$17)	Uniform($I$17,$K$17)	Uniform(IF(K$75-$K$16/4<$I$17/4,$I$17/4,K$75-$K$16/4),IF(K$7	Uniform(IF(L$75-$K$16/4<$I$17/4,$I$17/4,L$75-$K$16/4),IF(L$7	Uniform(IF(M$75-$K$16/4<$I$17/4,$I$17/4,M$75-$K$16/4),IF(M$7	Uniform(IF(N$75-$K$16/4<$I$17/4,$I$17/4,N$75-$K$16/4),IF(N$7	Uniform(IF(O$75-$K$16/4<$I$17/4,$I$17/4,O$75-$K$16/4),IF(O$7	Uniform(IF(P$75-$K$16/4<$I$17/4,$I$17/4,P$75-$K$16/4),IF(P$7
Cell	D25	I34	K35	J75	K75	L75	M75	N75	O75	P75	Q75
Minimum =	0.04%	8.86%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	726.12%	8.86%	443.63%	5.00%	5.00%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	100.37%	8.86%	8.80%	2.50%	2.50%	0.63%	0.63%	0.62%	0.62%	0.62%	0.62%
Std Deviation =	96.29%	0.00%	20.61%	1.44%	1.44%	0.33%	0.33%	0.32%	0.33%	0.33%	0.32%
Variance =	0.9271507	0	4.25E-02	2.08E-04	2.08E-04	1.09E-05	1.06E-05	1.05E-05	1.10E-05	1.08E-05	1.05E-05
Skewness =	1.835986	0	9.346926	1.40E-05	1.51E-05	-0.0184392	1.19E-02	1.95E-02	1.36E-02	-1.79E-02	-2.61E-03
Kurtosis =	7.652669	0	142.2353	1.799977	1.800041	2.023524	1.972745	2.033141	1.998708	1.989431	2.049068
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	4.13%	8.86%	0.41%	2.42%	2.23%	0.63%	0.34%	0.74%	0.65%	0.79%	0.33%
5% Perc =	5.86%	8.86%	0.30%	0.25%	0.25%	0.08%	0.10%	0.10%	0.09%	0.09%	0.10%
10% Perc =	11.69%	8.86%	0.51%	0.50%	0.50%	0.16%	0.18%	0.18%	0.16%	0.16%	0.17%
15% Perc =	17.76%	8.86%	0.72%	0.75%	0.75%	0.24%	0.25%	0.25%	0.24%	0.24%	0.24%
20% Perc =	24.11%	8.86%	0.96%	1.00%	1.00%	0.30%	0.31%	0.31%	0.31%	0.30%	0.31%
25% Perc =	30.77%	8.86%	1.21%	1.25%	1.25%	0.36%	0.36%	0.36%	0.36%	0.36%	0.36%
30% Perc =	37.82%	8.86%	1.50%	1.50%	1.50%	0.42%	0.42%	0.42%	0.41%	0.42%	0.43%
35% Perc =	45.38%	8.86%	1.83%	1.75%	1.75%	0.47%	0.47%	0.47%	0.47%	0.47%	0.48%
40% Perc =	53.42%	8.86%	2.21%	2.00%	2.00%	0.52%	0.52%	0.53%	0.52%	0.52%	0.54%
45% Perc =	62.17%	8.86%	2.66%	2.25%	2.25%	0.58%	0.57%	0.58%	0.57%	0.58%	0.58%
50% Perc =	71.66%	8.86%	3.18%	2.50%	2.50%	0.63%	0.61%	0.62%	0.62%	0.62%	0.62%
55% Perc =	82.12%	8.86%	3.81%	2.75%	2.75%	0.68%	0.68%	0.67%	0.67%	0.68%	0.67%
60% Perc =	93.67%	8.86%	4.57%	3.00%	3.00%	0.74%	0.73%	0.72%	0.72%	0.72%	0.72%
65% Perc =	106.83%	8.86%	5.52%	3.25%	3.25%	0.78%	0.78%	0.77%	0.78%	0.78%	0.77%
70% Perc =	121.85%	8.86%	6.74%	3.50%	3.50%	0.84%	0.84%	0.83%	0.83%	0.83%	0.82%
75% Perc =	139.48%	8.86%	8.35%	3.75%	3.75%	0.89%	0.89%	0.88%	0.89%	0.89%	0.88%
80% Perc =	161.13%	8.86%	10.59%	4.00%	4.00%	0.94%	0.94%	0.94%	0.95%	0.94%	0.94%
85% Perc =	188.68%	8.86%	13.99%	4.25%	4.25%	1.00%	1.00%	1.00%	1.02%	1.01%	1.01%
90% Perc =	227.04%	8.86%	19.89%	4.50%	4.50%	1.08%	1.08%	1.07%	1.09%	1.08%	1.07%
95% Perc =	292.88%	8.86%	33.31%	4.75%	4.75%	1.17%	1.16%	1.16%	1.17%	1.15%	1.15%

Name	QUARTERLY TRAFFIC GROWTH RATE 8	QUARTERLY TRAFFIC GROWTH RATE 9	QUARTERLY TRAFFIC GROWTH RATE 10	QUARTERLY TRAFFIC GROWTH RATE 11	QUARTERLY TRAFFIC GROWTH RATE 12	QUARTERLY TRAFFIC GROWTH RATE 13	QUARTERLY TRAFFIC GROWTH RATE 14	QUARTERLY TRAFFIC GROWTH RATE 15	QUARTERLY TRAFFIC GROWTH RATE 16	QUARTERLY TRAFFIC GROWTH RATE 17	QUARTERLY TRAFFIC GROWTH RATE 18
Description	Uniform(IF(Q$75-$K$16/4<$I$17/4,$I$17/4,Q$75-$K$16/4),IF(Q$7	Uniform(IF(R$75-$K$16/4<$I$17/4,$I$17/4,R$75-$K$16/4),IF(R$7	Uniform(IF(S$75-$K$16/4<$I$17/4,$I$17/4,S$75-$K$16/4),IF(S$7	Uniform(IF(T$75-$K$16/4<$I$17/4,$I$17/4,T$75-$K$16/4),IF(T$7	Uniform(IF(U$75-$K$16/4<$I$17/4,$I$17/4,U$75-$K$16/4),IF(U$7	Uniform(IF(V$75-$K$16/4<$I$17/4,$I$17/4,V$75-$K$16/4),IF(V$7	Uniform(IF(W$75-$K$16/4<$I$17/4,$I$17/4,W$75-$K$16/4),IF(W$7	Uniform(IF(X$75-$K$16/4<$I$17/4,$I$17/4,X$75-$K$16/4),IF(X$7	Uniform(IF(Y$75-$K$16/4<$I$17/4,$I$17/4,Y$75-$K$16/4),IF(Y$7	Uniform(IF(Z$75-$K$16/4<$I$17/4,$I$17/4,Z$75-$K$16/4),IF(Z$7	Uniform(IF(AA$75-$K$16/4<$I$17/4,$I$17/4,AA$75-$K$16/4),IF(A
Cell	R75	S75	T75	U75	V75	W75	X75	Y75	Z75	AA75	AB75
Minimum =	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.63%	0.63%	0.63%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.63%
Std Deviation =	0.33%	0.33%	0.32%	0.32%	0.32%	0.33%	0.33%	0.33%	0.33%	0.33%	0.33%
Variance =	1.08E-05	1.08E-05	1.05E-05	1.04E-05	1.05E-05	1.08E-05	1.09E-05	1.10E-05	1.07E-05	1.09E-05	1.09E-05
Skewness =	8.86E-03	-4.47E-02	5.23E-02	5.70E-03	0.0177661	-1.43E-03	2.23E-03	2.00E-02	-4.42E-02	-2.43E-02	-2.72E-02
Kurtosis =	2.010365	2.000413	2.046322	2.020371	2.04523	2.013235	2.021205	1.963796	2.0025	2.029016	2.002764
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.47%	0.68%	0.60%	0.52%	0.73%	0.84%	0.73%	0.63%	0.59%	0.63%	0.73%
5% Perc =	0.09%	0.09%	0.10%	0.10%	0.10%	0.08%	0.09%	0.09%	0.08%	0.08%	0.08%
10% Perc =	0.17%	0.15%	0.19%	0.18%	0.18%	0.16%	0.17%	0.17%	0.16%	0.16%	0.17%
15% Perc =	0.23%	0.23%	0.26%	0.25%	0.24%	0.25%	0.23%	0.24%	0.24%	0.23%	0.23%
20% Perc =	0.30%	0.31%	0.31%	0.31%	0.31%	0.31%	0.30%	0.30%	0.29%	0.31%	0.30%
25% Perc =	0.36%	0.37%	0.37%	0.37%	0.36%	0.37%	0.37%	0.36%	0.36%	0.37%	0.37%
30% Perc =	0.42%	0.42%	0.43%	0.42%	0.42%	0.42%	0.42%	0.41%	0.42%	0.43%	0.42%
35% Perc =	0.47%	0.48%	0.47%	0.48%	0.48%	0.46%	0.47%	0.46%	0.47%	0.48%	0.47%
40% Perc =	0.53%	0.53%	0.52%	0.52%	0.53%	0.51%	0.53%	0.52%	0.53%	0.53%	0.52%
45% Perc =	0.58%	0.59%	0.57%	0.56%	0.58%	0.57%	0.57%	0.57%	0.58%	0.58%	0.58%
50% Perc =	0.63%	0.64%	0.62%	0.62%	0.63%	0.62%	0.63%	0.62%	0.63%	0.62%	0.63%
55% Perc =	0.68%	0.68%	0.66%	0.68%	0.68%	0.68%	0.68%	0.67%	0.68%	0.66%	0.68%
60% Perc =	0.72%	0.72%	0.71%	0.72%	0.72%	0.73%	0.73%	0.73%	0.73%	0.72%	0.73%
65% Perc =	0.77%	0.78%	0.77%	0.77%	0.77%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%
70% Perc =	0.82%	0.84%	0.82%	0.82%	0.81%	0.83%	0.83%	0.85%	0.84%	0.85%	0.84%
75% Perc =	0.89%	0.89%	0.88%	0.88%	0.87%	0.89%	0.88%	0.90%	0.89%	0.89%	0.89%
80% Perc =	0.95%	0.95%	0.95%	0.95%	0.94%	0.95%	0.94%	0.95%	0.94%	0.95%	0.94%
85% Perc =	1.02%	1.01%	1.01%	1.00%	1.00%	1.00%	1.01%	1.01%	0.99%	1.00%	1.00%
90% Perc =	1.09%	1.08%	1.09%	1.07%	1.08%	1.07%	1.09%	1.08%	1.06%	1.08%	1.08%
95% Perc =	1.16%	1.16%	1.17%	1.15%	1.16%	1.16%	1.17%	1.16%	1.15%	1.16%	1.16%

Name	QUARTERLY TRAFFIC GROWTH RATE 19	QUARTERLY TRAFFIC GROWTH RATE 20	QUARTERLY TRAFFIC GROWTH RATE 21	QUARTERLY TRAFFIC GROWTH RATE 22	QUARTERLY TRAFFIC GROWTH RATE 23	QUARTERLY TRAFFIC GROWTH RATE 24	QUARTERLY TRAFFIC GROWTH RATE 25	QUARTERLY TRAFFIC GROWTH RATE 26	QUARTERLY TRAFFIC GROWTH RATE 27	QUARTERLY TRAFFIC GROWTH RATE 28	QUARTERLY TRAFFIC GROWTH RATE 29
Description	Uniform(IF(AB$75-$K$16/4<$I$17/4,$I$17/4,AB$75-$K$16/4),IF(A	Uniform(IF(AC$75-$K$16/4<$I$17/4,$I$17/4,AC$75-$K$16/4),IF(A	Uniform(IF(AD$75-$K$16/4<$I$17/4,$I$17/4,AD$75-$K$16/4),IF(A	Uniform(IF(AE$75-$K$16/4<$I$17/4,$I$17/4,AE$75-$K$16/4),IF(A	Uniform(IF(AF$75-$K$16/4<$I$17/4,$I$17/4,AF$75-$K$16/4),IF(A	Uniform(IF(AG$75-$K$16/4<$I$17/4,$I$17/4,AG$75-$K$16/4),IF(A	Uniform(IF(AH$75-$K$16/4<$I$17/4,$I$17/4,AH$75-$K$16/4),IF(A	Uniform(IF(AI$75-$K$16/4<$I$17/4,$I$17/4,AI$75-$K$16/4),IF(A	Uniform(IF(AJ$75-$K$16/4<$I$17/4,$I$17/4,AJ$75-$K$16/4),IF(A	Uniform(IF(AK$75-$K$16/4<$I$17/4,$I$17/4,AK$75-$K$16/4),IF(A	Uniform(IF(AL$75-$K$16/4<$I$17/4,$I$17/4,AL$75-$K$16/4),IF(A
Cell	AC75	AD75	AE75	AF75	AG75	AH75	AI75	AJ75	AK75	AL75	AM75
Minimum =	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%	0.62%	0.62%
Std Deviation =	0.33%	0.33%	0.32%	0.33%	0.32%	0.32%	0.33%	0.33%	0.33%	0.33%	0.32%
Variance =	1.09E-05	1.07E-05	1.05E-05	1.08E-05	1.06E-05	1.03E-05	1.06E-05	1.09E-05	1.06E-05	1.09E-05	1.05E-05
Skewness =	-3.12E-02	-1.49E-02	1.04E-02	4.07E-02	-0.0173362	-2.50E-02	-1.95E-02	8.46E-03	-0.0064253	2.20E-02	0.0323154
Kurtosis =	2.008361	2.014223	2.036592	2.037468	2.075533	2.057327	2.039762	1.986158	2.05891	2.018872	2.051027
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	1.23%	0.63%	0.82%	0.55%	0.85%	0.63%	0.95%	0.79%	0.51%	0.76%	0.61%
5% Perc =	0.08%	0.09%	0.10%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%
10% Perc =	0.16%	0.17%	0.18%	0.17%	0.18%	0.18%	0.16%	0.17%	0.16%	0.17%	0.18%
15% Perc =	0.23%	0.25%	0.25%	0.25%	0.24%	0.27%	0.24%	0.24%	0.24%	0.24%	0.25%
20% Perc =	0.30%	0.31%	0.32%	0.31%	0.31%	0.31%	0.31%	0.31%	0.32%	0.30%	0.32%
25% Perc =	0.36%	0.36%	0.37%	0.37%	0.37%	0.37%	0.38%	0.36%	0.37%	0.36%	0.36%
30% Perc =	0.42%	0.41%	0.43%	0.42%	0.43%	0.43%	0.43%	0.42%	0.43%	0.42%	0.42%
35% Perc =	0.48%	0.47%	0.48%	0.47%	0.48%	0.48%	0.48%	0.47%	0.48%	0.47%	0.47%
40% Perc =	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%	0.52%	0.51%	0.53%	0.52%	0.52%
45% Perc =	0.58%	0.58%	0.58%	0.57%	0.59%	0.58%	0.58%	0.56%	0.57%	0.57%	0.57%
50% Perc =	0.63%	0.64%	0.62%	0.62%	0.64%	0.63%	0.63%	0.62%	0.63%	0.62%	0.62%
55% Perc =	0.69%	0.68%	0.68%	0.67%	0.68%	0.67%	0.68%	0.68%	0.68%	0.67%	0.67%
60% Perc =	0.73%	0.74%	0.73%	0.72%	0.72%	0.73%	0.73%	0.73%	0.72%	0.72%	0.72%
65% Perc =	0.79%	0.78%	0.78%	0.76%	0.77%	0.78%	0.78%	0.78%	0.77%	0.77%	0.78%
70% Perc =	0.83%	0.83%	0.83%	0.82%	0.82%	0.83%	0.83%	0.84%	0.83%	0.83%	0.82%
75% Perc =	0.88%	0.89%	0.88%	0.88%	0.87%	0.88%	0.89%	0.89%	0.87%	0.88%	0.87%
80% Perc =	0.95%	0.94%	0.94%	0.95%	0.94%	0.93%	0.94%	0.95%	0.94%	0.94%	0.94%
85% Perc =	1.02%	1.01%	1.00%	1.03%	1.01%	1.00%	1.00%	1.02%	1.02%	1.02%	1.00%
90% Perc =	1.08%	1.08%	1.08%	1.10%	1.08%	1.06%	1.07%	1.08%	1.08%	1.09%	1.08%
95% Perc =	1.16%	1.15%	1.17%	1.17%	1.16%	1.14%	1.16%	1.16%	1.17%	1.17%	1.16%

Name	QUARTERLY TRAFFIC GROWTH RATE 30	QUARTERLY TRAFFIC GROWTH RATE 31	QUARTERLY TRAFFIC GROWTH RATE 32	QUARTERLY TRAFFIC GROWTH RATE 33	QUARTERLY TRAFFIC GROWTH RATE 34	QUARTERLY TRAFFIC GROWTH RATE 35	QUARTERLY TRAFFIC GROWTH RATE 36	QUARTERLY TRAFFIC GROWTH RATE 37	QUARTERLY TRAFFIC GROWTH RATE 38	QUARTERLY TRAFFIC GROWTH RATE 39	QUARTERLY TRAFFIC GROWTH RATE 40
Description	Uniform(IF(AM$75-$K$16/4<$I$17/4,$I$17/4,AM$75-$K$16/4),IF(A	Uniform(IF(AN$75-$K$16/4<$I$17/4,$I$17/4,AN$75-$K$16/4),IF(A	Uniform(IF(AO$75-$K$16/4<$I$17/4,$I$17/4,AO$75-$K$16/4),IF(A	Uniform(IF(AP$75-$K$16/4<$I$17/4,$I$17/4,AP$75-$K$16/4),IF(A	Uniform(IF(AQ$75-$K$16/4<$I$17/4,$I$17/4,AQ$75-$K$16/4),IF(A	Uniform(IF(AR$75-$K$16/4<$I$17/4,$I$17/4,AR$75-$K$16/4),IF(A	Uniform(IF(AS$75-$K$16/4<$I$17/4,$I$17/4,AS$75-$K$16/4),IF(A	Uniform(IF(AT$75-$K$16/4<$I$17/4,$I$17/4,AT$75-$K$16/4),IF(A	Uniform(IF(AU$75-$K$16/4<$I$17/4,$I$17/4,AU$75-$K$16/4),IF(A	Uniform(IF(AV$75-$K$16/4<$I$17/4,$I$17/4,AV$75-$K$16/4),IF(A	Uniform(IF(AW$75-$K$16/4<$I$17/4,$I$17/4,AW$75-$K$16/4),IF(A
Cell	AN75	AO75	AP75	AQ75	AR75	AS75	AT75	AU75	AV75	AW75	AX75
Minimum =	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.63%	0.62%	0.62%	0.62%	0.62%
Std Deviation =	0.32%	0.33%	0.32%	0.33%	0.33%	0.33%	0.33%	0.32%	0.32%	0.33%	0.33%
Variance =	1.03E-05	1.07E-05	1.05E-05	1.08E-05	1.08E-05	1.07E-05	1.10E-05	1.05E-05	1.04E-05	1.06E-05	1.09E-05
Skewness =	1.10E-02	-1.54E-02	0.0252171	1.94E-02	-6.92E-05	-4.95E-03	-1.96E-02	-2.52E-02	2.83E-02	1.47E-02	4.31E-02
Kurtosis =	2.062909	2.018451	2.020682	2.008078	1.966466	1.997145	2.009883	2.061027	2.061202	2.018058	1.99733
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.68%	0.65%	0.47%	0.43%	0.82%	0.54%	0.48%	0.61%	0.69%	0.38%	1.04%
5% Perc =	0.11%	0.08%	0.09%	0.08%	0.10%	0.10%	0.08%	0.09%	0.10%	0.09%	0.09%
10% Perc =	0.18%	0.17%	0.18%	0.16%	0.17%	0.17%	0.16%	0.17%	0.18%	0.18%	0.17%
15% Perc =	0.24%	0.24%	0.25%	0.25%	0.23%	0.23%	0.23%	0.24%	0.25%	0.25%	0.24%
20% Perc =	0.31%	0.30%	0.31%	0.31%	0.30%	0.30%	0.30%	0.31%	0.31%	0.31%	0.30%
25% Perc =	0.37%	0.36%	0.37%	0.36%	0.36%	0.36%	0.37%	0.37%	0.37%	0.36%	0.36%
30% Perc =	0.42%	0.42%	0.42%	0.42%	0.41%	0.42%	0.42%	0.43%	0.42%	0.41%	0.41%
35% Perc =	0.48%	0.48%	0.47%	0.46%	0.47%	0.48%	0.48%	0.48%	0.47%	0.47%	0.47%
40% Perc =	0.52%	0.52%	0.51%	0.52%	0.52%	0.52%	0.52%	0.53%	0.52%	0.52%	0.52%
45% Perc =	0.58%	0.58%	0.56%	0.57%	0.57%	0.57%	0.57%	0.58%	0.57%	0.57%	0.57%
50% Perc =	0.63%	0.62%	0.62%	0.62%	0.63%	0.63%	0.63%	0.63%	0.62%	0.62%	0.62%
55% Perc =	0.67%	0.68%	0.67%	0.67%	0.68%	0.67%	0.68%	0.68%	0.67%	0.67%	0.66%
60% Perc =	0.72%	0.73%	0.73%	0.72%	0.73%	0.72%	0.72%	0.73%	0.72%	0.72%	0.71%
65% Perc =	0.77%	0.78%	0.78%	0.78%	0.78%	0.77%	0.79%	0.78%	0.76%	0.77%	0.77%
70% Perc =	0.82%	0.83%	0.83%	0.83%	0.82%	0.83%	0.84%	0.83%	0.81%	0.83%	0.83%
75% Perc =	0.87%	0.89%	0.88%	0.89%	0.89%	0.88%	0.89%	0.88%	0.88%	0.88%	0.88%
80% Perc =	0.92%	0.93%	0.94%	0.94%	0.95%	0.95%	0.95%	0.93%	0.94%	0.94%	0.95%
85% Perc =	0.99%	1.01%	1.00%	1.01%	1.01%	1.01%	1.01%	0.98%	1.00%	1.00%	1.02%
90% Perc =	1.07%	1.07%	1.07%	1.08%	1.08%	1.07%	1.08%	1.07%	1.08%	1.08%	1.09%
95% Perc =	1.16%	1.16%	1.17%	1.16%	1.15%	1.15%	1.16%	1.16%	1.15%	1.15%	1.16%

Name	QUARTERLY TRAFFIC GROWTH RATE 41	QUARTERLY TRAFFIC GROWTH RATE 42	QUARTERLY TRAFFIC GROWTH RATE 43	QUARTERLY TRAFFIC GROWTH RATE 44	QUARTERLY TRAFFIC GROWTH RATE 45	QUARTERLY TRAFFIC GROWTH RATE 46	QUARTERLY TRAFFIC GROWTH RATE 47	QUARTERLY TRAFFIC GROWTH RATE 48	QUARTERLY TRAFFIC GROWTH RATE 49	QUARTERLY TRAFFIC GROWTH RATE 50	QUARTERLY TRAFFIC GROWTH RATE 51
Description	Uniform(IF(AX$75-$K$16/4<$I$17/4,$I$17/4,AX$75-$K$16/4),IF(A	Uniform(IF(AY$75-$K$16/4<$I$17/4,$I$17/4,AY$75-$K$16/4),IF(A	Uniform(IF(AZ$75-$K$16/4<$I$17/4,$I$17/4,AZ$75-$K$16/4),IF(A	Uniform(IF(BA$75-$K$16/4<$I$17/4,$I$17/4,BA$75-$K$16/4),IF(B	Uniform(IF(BB$75-$K$16/4<$I$17/4,$I$17/4,BB$75-$K$16/4),IF(B	Uniform(IF(BC$75-$K$16/4<$I$17/4,$I$17/4,BC$75-$K$16/4),IF(B	Uniform(IF(BD$75-$K$16/4<$I$17/4,$I$17/4,BD$75-$K$16/4),IF(B	Uniform(IF(BE$75-$K$16/4<$I$17/4,$I$17/4,BE$75-$K$16/4),IF(B	Uniform(IF(BF$75-$K$16/4<$I$17/4,$I$17/4,BF$75-$K$16/4),IF(B	Uniform(IF(BG$75-$K$16/4<$I$17/4,$I$17/4,BG$75-$K$16/4),IF(B	Uniform(IF(BH$75-$K$16/4<$I$17/4,$I$17/4,BH$75-$K$16/4),IF(B
Cell	AY75	AZ75	BA75	BB75	BC75	BD75	BE75	BF75	BG75	BH75	BI75
Minimum =	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.62%	0.62%	0.63%	0.63%	0.63%	0.62%	0.62%	0.62%	0.63%	0.62%	0.62%
Std Deviation =	0.33%	0.33%	0.32%	0.33%	0.33%	0.33%	0.32%	0.33%	0.33%	0.33%	0.33%
Variance =	1.08E-05	1.08E-05	1.05E-05	1.06E-05	1.08E-05	1.06E-05	1.04E-05	1.08E-05	1.06E-05	1.07E-05	1.07E-05
Skewness =	0.0330967	-2.09E-02	1.13E-02	-3.38E-03	-8.79E-03	1.73E-02	-1.80E-02	1.76E-02	-1.09E-02	-1.34E-02	6.69E-03
Kurtosis =	2.046892	2.036345	2.016769	2.025345	1.987853	2.050923	2.018484	2.026597	2.017218	2.014573	2.012322
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.78%	0.68%	0.60%	0.60%	0.73%	0.56%	0.61%	0.60%	0.64%	0.57%	0.67%
5% Perc =	0.09%	0.08%	0.10%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%
10% Perc =	0.17%	0.16%	0.17%	0.18%	0.17%	0.17%	0.17%	0.17%	0.17%	0.16%	0.17%
15% Perc =	0.25%	0.23%	0.25%	0.24%	0.24%	0.25%	0.24%	0.24%	0.24%	0.24%	0.24%
20% Perc =	0.31%	0.30%	0.31%	0.31%	0.31%	0.32%	0.32%	0.31%	0.30%	0.31%	0.30%
25% Perc =	0.37%	0.36%	0.38%	0.36%	0.36%	0.38%	0.37%	0.37%	0.37%	0.36%	0.36%
30% Perc =	0.42%	0.42%	0.43%	0.42%	0.42%	0.42%	0.42%	0.42%	0.43%	0.42%	0.42%
35% Perc =	0.47%	0.48%	0.48%	0.48%	0.47%	0.47%	0.47%	0.47%	0.48%	0.48%	0.46%
40% Perc =	0.51%	0.53%	0.52%	0.53%	0.52%	0.52%	0.52%	0.52%	0.52%	0.53%	0.52%
45% Perc =	0.57%	0.58%	0.57%	0.58%	0.57%	0.57%	0.57%	0.57%	0.57%	0.57%	0.57%
50% Perc =	0.62%	0.63%	0.62%	0.63%	0.62%	0.61%	0.62%	0.62%	0.62%	0.62%	0.63%
55% Perc =	0.67%	0.68%	0.67%	0.67%	0.67%	0.67%	0.68%	0.67%	0.67%	0.68%	0.67%
60% Perc =	0.72%	0.73%	0.72%	0.73%	0.72%	0.71%	0.73%	0.73%	0.73%	0.72%	0.73%
65% Perc =	0.78%	0.77%	0.77%	0.77%	0.78%	0.77%	0.78%	0.77%	0.78%	0.78%	0.77%
70% Perc =	0.82%	0.83%	0.83%	0.82%	0.83%	0.83%	0.83%	0.82%	0.82%	0.83%	0.83%
75% Perc =	0.87%	0.89%	0.88%	0.88%	0.90%	0.88%	0.88%	0.88%	0.88%	0.89%	0.89%
80% Perc =	0.94%	0.94%	0.94%	0.94%	0.96%	0.94%	0.93%	0.95%	0.95%	0.94%	0.94%
85% Perc =	1.01%	1.00%	1.01%	1.00%	1.01%	1.01%	1.00%	1.01%	1.01%	1.00%	1.00%
90% Perc =	1.09%	1.08%	1.08%	1.08%	1.08%	1.08%	1.06%	1.08%	1.06%	1.09%	1.08%
95% Perc =	1.17%	1.16%	1.15%	1.16%	1.16%	1.16%	1.14%	1.16%	1.15%	1.15%	1.16%

Name	QUARTERLY TRAFFIC GROWTH RATE 52	QUARTERLY TRAFFIC GROWTH RATE 53	QUARTERLY TRAFFIC GROWTH RATE 54	QUARTERLY TRAFFIC GROWTH RATE 55	QUARTERLY TRAFFIC GROWTH RATE 56	QUARTERLY TRAFFIC GROWTH RATE 57	QUARTERLY TRAFFIC GROWTH RATE 58	QUARTERLY TRAFFIC GROWTH RATE 59	QUARTERLY TRAFFIC GROWTH RATE 60	QUARTERLY TRAFFIC GROWTH RATE 61	QUARTERLY TRAFFIC GROWTH RATE 62
Description	Uniform(IF(BI$75-$K$16/4<$I$17/4,$I$17/4,BI$75-$K$16/4),IF(B	Uniform(IF(BJ$75-$K$16/4<$I$17/4,$I$17/4,BJ$75-$K$16/4),IF(B	Uniform(IF(BK$75-$K$16/4<$I$17/4,$I$17/4,BK$75-$K$16/4),IF(B	Uniform(IF(BL$75-$K$16/4<$I$17/4,$I$17/4,BL$75-$K$16/4),IF(B	Uniform(IF(BM$75-$K$16/4<$I$17/4,$I$17/4,BM$75-$K$16/4),IF(B	Uniform(IF(BN$75-$K$16/4<$I$17/4,$I$17/4,BN$75-$K$16/4),IF(B	Uniform(IF(BO$75-$K$16/4<$I$17/4,$I$17/4,BO$75-$K$16/4),IF(B	Uniform(IF(BP$75-$K$16/4<$I$17/4,$I$17/4,BP$75-$K$16/4),IF(B	Uniform(IF(BQ$75-$K$16/4<$I$17/4,$I$17/4,BQ$75-$K$16/4),IF(B	Uniform(IF(BR$75-$K$16/4<$I$17/4,$I$17/4,BR$75-$K$16/4),IF(B	Uniform(IF(BS$75-$K$16/4<$I$17/4,$I$17/4,BS$75-$K$16/4),IF(B
Cell	BJ75	BK75	BL75	BM75	BN75	BO75	BP75	BQ75	BR75	BS75	BT75
Minimum =	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Maximum =	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%	1.25%
Mean =	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%
Std Deviation =	0.33%	0.33%	0.33%	0.32%	0.32%	0.33%	0.32%	0.33%	0.33%	0.33%	0.33%
Variance =	1.08E-05	1.06E-05	1.08E-05	1.03E-05	1.05E-05	1.10E-05	1.05E-05	1.08E-05	1.07E-05	1.07E-05	1.08E-05
Skewness =	0.0283569	-9.57E-03	-2.11E-02	4.08E-02	-7.10E-03	-2.55E-02	2.07E-02	-1.13E-02	0.038565	-2.09E-02	4.19E-04
Kurtosis =	2.016788	2.028255	1.987927	2.061564	2.063177	1.988199	2.03483	2.015824	2.0088	2.017144	1.998227
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.39%	0.50%	0.57%	0.68%	0.56%	0.83%	0.69%	0.57%	0.80%	0.82%	0.79%
5% Perc =	0.09%	0.09%	0.08%	0.10%	0.09%	0.07%	0.09%	0.08%	0.10%	0.08%	0.09%
10% Perc =	0.18%	0.17%	0.16%	0.17%	0.17%	0.16%	0.18%	0.16%	0.18%	0.16%	0.16%
15% Perc =	0.24%	0.24%	0.23%	0.25%	0.24%	0.23%	0.25%	0.23%	0.25%	0.24%	0.22%
20% Perc =	0.30%	0.31%	0.30%	0.32%	0.31%	0.30%	0.31%	0.31%	0.30%	0.30%	0.30%
25% Perc =	0.36%	0.37%	0.36%	0.37%	0.37%	0.36%	0.37%	0.37%	0.36%	0.36%	0.36%
30% Perc =	0.41%	0.43%	0.42%	0.43%	0.43%	0.42%	0.42%	0.41%	0.42%	0.41%	0.41%
35% Perc =	0.47%	0.48%	0.47%	0.48%	0.48%	0.47%	0.47%	0.47%	0.47%	0.47%	0.48%
40% Perc =	0.52%	0.52%	0.51%	0.52%	0.53%	0.52%	0.52%	0.53%	0.51%	0.53%	0.52%
45% Perc =	0.57%	0.57%	0.57%	0.56%	0.58%	0.57%	0.57%	0.57%	0.57%	0.58%	0.57%
50% Perc =	0.61%	0.62%	0.63%	0.61%	0.62%	0.62%	0.63%	0.62%	0.62%	0.64%	0.62%
55% Perc =	0.67%	0.67%	0.68%	0.66%	0.67%	0.68%	0.67%	0.67%	0.67%	0.68%	0.68%
60% Perc =	0.72%	0.72%	0.74%	0.71%	0.72%	0.73%	0.72%	0.73%	0.72%	0.72%	0.73%
65% Perc =	0.77%	0.77%	0.79%	0.76%	0.78%	0.79%	0.77%	0.78%	0.78%	0.77%	0.77%
70% Perc =	0.83%	0.83%	0.83%	0.82%	0.83%	0.84%	0.82%	0.83%	0.83%	0.82%	0.82%
75% Perc =	0.88%	0.89%	0.88%	0.87%	0.87%	0.90%	0.88%	0.88%	0.88%	0.88%	0.88%
80% Perc =	0.95%	0.94%	0.94%	0.94%	0.93%	0.95%	0.94%	0.95%	0.94%	0.95%	0.95%
85% Perc =	1.02%	1.01%	1.00%	1.00%	0.99%	1.01%	1.00%	1.01%	1.00%	1.01%	1.01%
90% Perc =	1.08%	1.07%	1.07%	1.08%	1.08%	1.08%	1.07%	1.07%	1.09%	1.07%	1.08%
95% Perc =	1.16%	1.15%	1.15%	1.15%	1.16%	1.16%	1.15%	1.16%	1.16%	1.15%	1.16%

Name	% CHANGE INTEREST RATE QTR 1	% CHANGE INTEREST RATE QTR 2	% CHANGE INTEREST RATE QTR 3	% CHANGE INTEREST RATE QTR 4	% CHANGE INTEREST RATE QTR 5	% CHANGE INTEREST RATE QTR 6	% CHANGE INTEREST RATE QTR 7	% CHANGE INTEREST RATE QTR 8	% CHANGE INTEREST RATE QTR 9	% CHANGE INTEREST RATE QTR 10	% CHANGE INTEREST RATE QTR 11
Description	Normal(0.2*($I$130-$I$27),0.09*($I$27^0.5))	Normal(0.2*($I$130-K$131),0.09*(K$131^0.5))	Normal(0.2*($I$130-L$131),0.09*(L$131^0.5))	Normal(0.2*($I$130-M$131),0.09*(M$131^0.5))	Normal(0.2*($I$130-N$131),0.09*(N$131^0.5))	Normal(0.2*($I$130-O$131),0.09*(O$131^0.5))	Normal(0.2*($I$130-P$131),0.09*(P$131^0.5))	Normal(0.2*($I$130-Q$131),0.09*(Q$131^0.5))	Normal(0.2*($I$130-R$131),0.09*(R$131^0.5))	Normal(0.2*($I$130-S$131),0.09*(S$131^0.5))	Normal(0.2*($I$130-T$131),0.09*(T$131^0.5))
Cell	K130	L130	M130	N130	O130	P130	Q130	R130	S130	T130	U130
Minimum =	-8.86%	-8.24%	-7.71%	-7.06%	-7.12%	-6.47%	-7.93%	-7.85%	-7.33%	-6.96%	-7.17%
Maximum =	6.64%	6.96%	7.78%	7.08%	7.11%	6.07%	6.36%	6.13%	8.25%	6.53%	6.20%
Mean =	-0.25%	-0.23%	-0.22%	-0.21%	-0.20%	-0.18%	-0.18%	-0.17%	-0.16%	-0.16%	-0.15%
Std Deviation =	2.01%	2.01%	2.00%	1.98%	1.97%	1.96%	1.96%	1.94%	1.94%	1.92%	1.91%
Variance =	4.06E-04	4.03E-04	4.01E-04	3.90E-04	3.89E-04	3.84E-04	3.82E-04	3.78E-04	3.78E-04	3.70E-04	3.66E-04
Skewness =	-1.91E-02	-3.52E-02	-2.56E-02	-2.54E-02	-3.07E-02	-5.72E-02	-9.80E-02	-8.82E-02	-5.14E-02	-5.00E-02	-0.1163304
Kurtosis =	3.05097	3.060608	3.158345	3.016353	3.01967	3.048921	3.189177	3.175616	3.232387	3.028514	3.162351
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	-0.02%	0.19%	-1.05%	-0.18%	-0.57%	-0.44%	0.76%	-0.51%	-0.27%	-1.36%	-0.86%
5% Perc =	-3.56%	-3.58%	-3.51%	-3.50%	-3.59%	-3.46%	-3.45%	-3.45%	-3.45%	-3.46%	-3.34%
10% Perc =	-2.83%	-2.82%	-2.75%	-2.77%	-2.76%	-2.75%	-2.64%	-2.64%	-2.62%	-2.63%	-2.63%
15% Perc =	-2.33%	-2.32%	-2.32%	-2.32%	-2.23%	-2.19%	-2.17%	-2.15%	-2.18%	-2.16%	-2.09%
20% Perc =	-1.94%	-1.89%	-1.93%	-1.91%	-1.85%	-1.76%	-1.82%	-1.74%	-1.81%	-1.78%	-1.72%
25% Perc =	-1.61%	-1.59%	-1.57%	-1.54%	-1.51%	-1.43%	-1.48%	-1.44%	-1.45%	-1.44%	-1.37%
30% Perc =	-1.30%	-1.25%	-1.25%	-1.27%	-1.20%	-1.16%	-1.17%	-1.17%	-1.16%	-1.16%	-1.08%
35% Perc =	-1.02%	-0.99%	-0.98%	-0.96%	-0.93%	-0.88%	-0.88%	-0.88%	-0.87%	-0.87%	-0.85%
40% Perc =	-0.76%	-0.74%	-0.73%	-0.67%	-0.67%	-0.64%	-0.64%	-0.63%	-0.61%	-0.61%	-0.60%
45% Perc =	-0.50%	-0.47%	-0.45%	-0.44%	-0.44%	-0.43%	-0.41%	-0.41%	-0.35%	-0.35%	-0.34%
50% Perc =	-0.25%	-0.22%	-0.22%	-0.19%	-0.17%	-0.17%	-0.15%	-0.14%	-0.13%	-0.12%	-0.11%
55% Perc =	0.00%	0.04%	0.03%	0.05%	0.06%	0.05%	0.08%	0.11%	0.10%	0.10%	0.08%
60% Perc =	0.26%	0.29%	0.30%	0.31%	0.32%	0.32%	0.35%	0.33%	0.33%	0.36%	0.35%
65% Perc =	0.53%	0.53%	0.55%	0.55%	0.58%	0.57%	0.59%	0.59%	0.59%	0.62%	0.59%
70% Perc =	0.81%	0.82%	0.82%	0.84%	0.84%	0.84%	0.82%	0.83%	0.85%	0.87%	0.87%
75% Perc =	1.11%	1.11%	1.12%	1.13%	1.12%	1.13%	1.12%	1.13%	1.15%	1.13%	1.13%
80% Perc =	1.44%	1.45%	1.46%	1.45%	1.45%	1.44%	1.45%	1.43%	1.44%	1.45%	1.45%
85% Perc =	1.84%	1.83%	1.82%	1.82%	1.81%	1.82%	1.82%	1.83%	1.81%	1.82%	1.82%
90% Perc =	2.33%	2.32%	2.33%	2.32%	2.28%	2.30%	2.29%	2.26%	2.26%	2.27%	2.25%
95% Perc =	3.06%	3.06%	3.06%	3.01%	2.97%	2.98%	3.03%	2.98%	2.91%	2.89%	2.93%

Name	% CHANGE INTEREST RATE QTR 12	% CHANGE INTEREST RATE QTR 13	% CHANGE INTEREST RATE QTR 14	% CHANGE INTEREST RATE QTR 15	% CHANGE INTEREST RATE QTR 16	% CHANGE INTEREST RATE QTR 17	% CHANGE INTEREST RATE QTR 18	% CHANGE INTEREST RATE QTR 19	% CHANGE INTEREST RATE QTR 20	% CHANGE INTEREST RATE QTR 21	% CHANGE INTEREST RATE QTR 22
Description	Normal(0.2*($I$130-U$131),0.09*(U$131^0.5))	Normal(0.2*($I$130-V$131),0.09*(V$131^0.5))	Normal(0.2*($I$130-W$131),0.09*(W$131^0.5))	Normal(0.2*($I$130-X$131),0.09*(X$131^0.5))	Normal(0.2*($I$130-Y$131),0.09*(Y$131^0.5))	Normal(0.2*($I$130-Z$131),0.09*(Z$131^0.5))	Normal(0.2*($I$130-AA$131),0.09*(AA$131^0.5))	Normal(0.2*($I$130-AB$131),0.09*(AB$131^0.5))	Normal(0.2*($I$130-AC$131),0.09*(AC$131^0.5))	Normal(0.2*($I$130-AD$131),0.09*(AD$131^0.5))	Normal(0.2*($I$130-AE$131),0.09*(AE$131^0.5))
Cell	V130	W130	X130	Y130	Z130	AA130	AB130	AC130	AD130	AE130	AF130
Minimum =	-7.08%	-7.65%	-7.77%	-7.89%	-8.05%	-6.48%	-9.26%	-6.83%	-6.15%	-8.75%	-8.31%
Maximum =	6.24%	6.49%	7.11%	8.73%	6.54%	7.00%	6.52%	5.91%	6.29%	5.90%	6.01%
Mean =	-0.15%	-0.13%	-0.13%	-0.12%	-0.10%	-0.11%	-0.10%	-0.10%	-0.07%	-0.09%	-0.09%
Std Deviation =	1.94%	1.91%	1.91%	1.91%	1.90%	1.87%	1.88%	1.86%	1.83%	1.86%	1.85%
Variance =	3.76E-04	3.64E-04	3.65E-04	3.64E-04	3.62E-04	3.50E-04	3.53E-04	3.47E-04	3.37E-04	3.46E-04	3.44E-04
Skewness =	-0.1974901	-0.0823499	-0.1436976	-0.1318936	-0.1249604	-8.53E-02	-0.164107	-0.1091456	-4.95E-02	-0.1584003	-0.1977538
Kurtosis =	3.323773	3.243038	3.364604	3.581264	3.417254	3.192554	3.358854	3.172467	3.152774	3.395834	3.377878
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	-0.41%	-0.12%	-0.29%	0.08%	0.36%	-0.88%	-0.48%	-0.68%	-0.43%	-0.56%	0.72%
5% Perc =	-3.44%	-3.36%	-3.36%	-3.21%	-3.30%	-3.22%	-3.22%	-3.23%	-3.19%	-3.30%	-3.19%
10% Perc =	-2.59%	-2.57%	-2.60%	-2.54%	-2.51%	-2.60%	-2.53%	-2.53%	-2.44%	-2.41%	-2.43%
15% Perc =	-2.11%	-2.05%	-2.07%	-2.06%	-2.03%	-2.01%	-2.01%	-2.09%	-1.92%	-1.92%	-1.99%
20% Perc =	-1.70%	-1.66%	-1.72%	-1.64%	-1.63%	-1.66%	-1.63%	-1.64%	-1.57%	-1.61%	-1.63%
25% Perc =	-1.34%	-1.34%	-1.33%	-1.32%	-1.28%	-1.32%	-1.30%	-1.31%	-1.27%	-1.30%	-1.28%
30% Perc =	-1.06%	-1.06%	-1.04%	-1.04%	-1.03%	-1.02%	-1.04%	-0.96%	-0.96%	-1.01%	-0.99%
35% Perc =	-0.80%	-0.82%	-0.80%	-0.79%	-0.77%	-0.76%	-0.74%	-0.73%	-0.73%	-0.73%	-0.72%
40% Perc =	-0.56%	-0.59%	-0.55%	-0.58%	-0.51%	-0.54%	-0.50%	-0.53%	-0.49%	-0.52%	-0.47%
45% Perc =	-0.35%	-0.29%	-0.31%	-0.34%	-0.29%	-0.30%	-0.29%	-0.28%	-0.30%	-0.26%	-0.26%
50% Perc =	-0.09%	-0.10%	-0.09%	-0.09%	-0.06%	-0.09%	-0.06%	-0.07%	-0.08%	-0.05%	-0.04%
55% Perc =	0.13%	0.09%	0.15%	0.13%	0.18%	0.16%	0.18%	0.15%	0.14%	0.18%	0.17%
60% Perc =	0.38%	0.36%	0.39%	0.36%	0.37%	0.37%	0.39%	0.41%	0.36%	0.40%	0.42%
65% Perc =	0.60%	0.63%	0.60%	0.62%	0.61%	0.61%	0.66%	0.64%	0.61%	0.64%	0.66%
70% Perc =	0.86%	0.87%	0.86%	0.87%	0.86%	0.88%	0.86%	0.85%	0.88%	0.90%	0.88%
75% Perc =	1.13%	1.13%	1.13%	1.16%	1.14%	1.15%	1.16%	1.15%	1.15%	1.15%	1.15%
80% Perc =	1.44%	1.45%	1.43%	1.45%	1.44%	1.45%	1.45%	1.44%	1.44%	1.44%	1.45%
85% Perc =	1.81%	1.81%	1.79%	1.79%	1.80%	1.79%	1.78%	1.80%	1.78%	1.79%	1.78%
90% Perc =	2.27%	2.25%	2.26%	2.25%	2.24%	2.27%	2.26%	2.20%	2.23%	2.21%	2.22%
95% Perc =	2.89%	2.92%	2.96%	2.94%	2.94%	2.91%	2.90%	2.87%	2.88%	2.93%	2.80%

Name	% CHANGE INTEREST RATE QTR 23	% CHANGE INTEREST RATE QTR 24	% CHANGE INTEREST RATE QTR 25	% CHANGE INTEREST RATE QTR 26	% CHANGE INTEREST RATE QTR 27	% CHANGE INTEREST RATE QTR 28	% CHANGE INTEREST RATE QTR 29	% CHANGE INTEREST RATE QTR 30	% CHANGE INTEREST RATE QTR 31	% CHANGE INTEREST RATE QTR 32	% CHANGE INTEREST RATE QTR 33
Description	Normal(0.2*($I$130-AF$131),0.09*(AF$131^0.5))	Normal(0.2*($I$130-AG$131),0.09*(AG$131^0.5))	Normal(0.2*($I$130-AH$131),0.09*(AH$131^0.5))	Normal(0.2*($I$130-AI$131),0.09*(AI$131^0.5))	Normal(0.2*($I$130-AJ$131),0.09*(AJ$131^0.5))	Normal(0.2*($I$130-AK$131),0.09*(AK$131^0.5))	Normal(0.2*($I$130-AL$131),0.09*(AL$131^0.5))	Normal(0.2*($I$130-AM$131),0.09*(AM$131^0.5))	Normal(0.2*($I$130-AN$131),0.09*(AN$131^0.5))	Normal(0.2*($I$130-AO$131),0.09*(AO$131^0.5))	Normal(0.2*($I$130-AP$131),0.09*(AP$131^0.5))
Cell	AG130	AH130	AI130	AJ130	AK130	AL130	AM130	AN130	AO130	AP130	AQ130
Minimum =	-7.67%	-8.97%	-7.05%	-7.27%	-7.13%	-7.62%	-6.30%	-7.51%	-7.38%	-8.37%	-7.55%
Maximum =	5.98%	7.68%	6.32%	6.34%	7.21%	6.36%	6.36%	6.27%	6.82%	5.71%	8.44%
Mean =	-0.08%	-0.08%	-0.06%	-0.07%	-0.08%	-0.07%	-0.06%	-0.05%	-0.07%	-0.04%	-0.05%
Std Deviation =	1.85%	1.85%	1.84%	1.86%	1.87%	1.86%	1.82%	1.82%	1.84%	1.80%	1.83%
Variance =	3.42E-04	3.43E-04	3.39E-04	3.48E-04	3.51E-04	3.44E-04	3.32E-04	3.33E-04	3.40E-04	3.24E-04	3.34E-04
Skewness =	-0.1810555	-0.2240852	-0.1126298	-0.2151794	-0.2074419	-0.2028403	-0.1091684	-0.1389614	-0.1922511	-0.1547692	-0.1461832
Kurtosis =	3.357358	3.80318	3.259643	3.378795	3.312687	3.439368	3.245372	3.264143	3.409148	3.321705	3.51582
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	-0.35%	-0.17%	0.85%	0.51%	0.32%	-0.41%	-0.18%	0.37%	0.00%	0.45%	0.65%
5% Perc =	-3.11%	-3.07%	-3.15%	-3.25%	-3.30%	-3.19%	-3.07%	-3.18%	-3.26%	-3.13%	-3.10%
10% Perc =	-2.44%	-2.44%	-2.48%	-2.49%	-2.52%	-2.41%	-2.40%	-2.33%	-2.42%	-2.38%	-2.36%
15% Perc =	-1.97%	-1.92%	-1.90%	-1.95%	-1.97%	-1.96%	-1.91%	-1.92%	-1.90%	-1.82%	-1.90%
20% Perc =	-1.59%	-1.52%	-1.58%	-1.60%	-1.61%	-1.55%	-1.59%	-1.54%	-1.53%	-1.48%	-1.48%
25% Perc =	-1.32%	-1.25%	-1.28%	-1.24%	-1.26%	-1.24%	-1.24%	-1.22%	-1.23%	-1.18%	-1.20%
30% Perc =	-0.98%	-0.99%	-0.99%	-0.95%	-0.99%	-0.98%	-0.93%	-0.95%	-0.95%	-0.93%	-0.95%
35% Perc =	-0.73%	-0.75%	-0.73%	-0.67%	-0.70%	-0.69%	-0.67%	-0.71%	-0.69%	-0.68%	-0.73%
40% Perc =	-0.48%	-0.49%	-0.44%	-0.45%	-0.44%	-0.46%	-0.46%	-0.46%	-0.49%	-0.43%	-0.46%
45% Perc =	-0.29%	-0.27%	-0.21%	-0.22%	-0.21%	-0.26%	-0.23%	-0.23%	-0.26%	-0.21%	-0.20%
50% Perc =	-0.07%	-0.04%	-0.02%	0.00%	0.02%	-0.01%	-0.02%	0.01%	-0.02%	-0.02%	0.01%
55% Perc =	0.21%	0.18%	0.20%	0.23%	0.23%	0.21%	0.20%	0.23%	0.22%	0.20%	0.22%
60% Perc =	0.43%	0.43%	0.40%	0.45%	0.43%	0.47%	0.42%	0.43%	0.45%	0.43%	0.45%
65% Perc =	0.64%	0.64%	0.65%	0.65%	0.66%	0.68%	0.64%	0.66%	0.66%	0.64%	0.67%
70% Perc =	0.87%	0.88%	0.86%	0.89%	0.92%	0.89%	0.89%	0.90%	0.91%	0.91%	0.90%
75% Perc =	1.15%	1.16%	1.16%	1.16%	1.17%	1.16%	1.16%	1.15%	1.15%	1.15%	1.17%
80% Perc =	1.45%	1.44%	1.45%	1.43%	1.45%	1.45%	1.44%	1.44%	1.44%	1.44%	1.44%
85% Perc =	1.78%	1.78%	1.79%	1.78%	1.78%	1.78%	1.78%	1.79%	1.77%	1.78%	1.77%
90% Perc =	2.24%	2.20%	2.24%	2.24%	2.22%	2.18%	2.21%	2.22%	2.19%	2.20%	2.21%
95% Perc =	2.85%	2.80%	2.90%	2.85%	2.95%	2.93%	2.86%	2.78%	2.82%	2.82%	2.90%

Name	% CHANGE INTEREST RATE QTR 34	% CHANGE INTEREST RATE QTR 35	% CHANGE INTEREST RATE QTR 36	% CHANGE INTEREST RATE QTR 37	% CHANGE INTEREST RATE QTR 38	% CHANGE INTEREST RATE QTR 39	% CHANGE INTEREST RATE QTR 40	% CHANGE INTEREST RATE QTR 41	% CHANGE INTEREST RATE QTR 42	% CHANGE INTEREST RATE QTR 43	% CHANGE INTEREST RATE QTR 44
Description	Normal(0.2*($I$130-AQ$131),0.09*(AQ$131^0.5))	Normal(0.2*($I$130-AR$131),0.09*(AR$131^0.5))	Normal(0.2*($I$130-AS$131),0.09*(AS$131^0.5))	Normal(0.2*($I$130-AT$131),0.09*(AT$131^0.5))	Normal(0.2*($I$130-AU$131),0.09*(AU$131^0.5))	Normal(0.2*($I$130-AV$131),0.09*(AV$131^0.5))	Normal(0.2*($I$130-AW$131),0.09*(AW$131^0.5))	Normal(0.2*($I$130-AX$131),0.09*(AX$131^0.5))	Normal(0.2*($I$130-AY$131),0.09*(AY$131^0.5))	Normal(0.2*($I$130-AZ$131),0.09*(AZ$131^0.5))	Normal(0.2*($I$130-BA$131),0.09*(BA$131^0.5))
Cell	AR130	AS130	AT130	AU130	AV130	AW130	AX130	AY130	AZ130	BA130	BB130
Minimum =	-7.07%	-7.42%	-7.50%	-9.14%	-7.36%	-8.48%	-7.71%	-7.09%	-6.85%	-7.49%	-8.08%
Maximum =	7.19%	6.00%	6.09%	5.65%	6.60%	5.97%	7.10%	6.31%	6.73%	6.12%	6.82%
Mean =	-0.05%	-0.04%	-0.04%	-0.04%	-0.04%	-0.05%	-0.04%	-0.04%	-0.03%	-0.03%	-0.03%
Std Deviation =	1.82%	1.82%	1.81%	1.82%	1.80%	1.83%	1.82%	1.81%	1.81%	1.82%	1.80%
Variance =	3.32E-04	3.33E-04	3.26E-04	3.31E-04	3.26E-04	3.36E-04	3.30E-04	3.28E-04	3.26E-04	3.30E-04	3.24E-04
Skewness =	-0.1794759	-0.1927259	-0.1309024	-0.259669	-0.1331314	-0.2517673	-0.2225521	-0.1922001	-0.1469889	-0.2061554	-0.1663453
Kurtosis =	3.325333	3.404175	3.279413	3.665856	3.390775	3.552901	3.492443	3.396347	3.259632	3.385237	3.341942
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	0.84%	-0.71%	0.74%	-0.36%	0.43%	-0.40%	-0.88%	-0.62%	-0.35%	0.48%	-0.97%
5% Perc =	-3.17%	-3.11%	-3.13%	-3.11%	-3.00%	-3.13%	-3.09%	-3.08%	-3.08%	-3.07%	-3.11%
10% Perc =	-2.32%	-2.34%	-2.36%	-2.42%	-2.43%	-2.33%	-2.40%	-2.39%	-2.41%	-2.35%	-2.43%
15% Perc =	-1.89%	-1.87%	-1.91%	-1.87%	-1.87%	-1.96%	-1.86%	-1.86%	-1.88%	-1.86%	-1.91%
20% Perc =	-1.57%	-1.48%	-1.54%	-1.43%	-1.50%	-1.51%	-1.49%	-1.52%	-1.52%	-1.53%	-1.48%
25% Perc =	-1.24%	-1.22%	-1.22%	-1.15%	-1.17%	-1.18%	-1.22%	-1.17%	-1.15%	-1.17%	-1.18%
30% Perc =	-0.95%	-0.93%	-0.95%	-0.88%	-0.91%	-0.91%	-0.89%	-0.91%	-0.86%	-0.88%	-0.91%
35% Perc =	-0.66%	-0.69%	-0.68%	-0.66%	-0.67%	-0.64%	-0.63%	-0.63%	-0.65%	-0.63%	-0.62%
40% Perc =	-0.43%	-0.43%	-0.43%	-0.43%	-0.45%	-0.42%	-0.43%	-0.42%	-0.39%	-0.43%	-0.40%
45% Perc =	-0.19%	-0.21%	-0.22%	-0.22%	-0.22%	-0.20%	-0.23%	-0.18%	-0.21%	-0.15%	-0.18%
50% Perc =	0.01%	0.02%	0.00%	0.00%	0.00%	0.03%	0.01%	0.02%	0.00%	0.06%	0.02%
55% Perc =	0.21%	0.23%	0.26%	0.24%	0.24%	0.24%	0.24%	0.26%	0.25%	0.23%	0.23%
60% Perc =	0.44%	0.44%	0.47%	0.45%	0.45%	0.45%	0.43%	0.44%	0.48%	0.47%	0.44%
65% Perc =	0.70%	0.67%	0.67%	0.66%	0.67%	0.68%	0.67%	0.66%	0.68%	0.69%	0.68%
70% Perc =	0.90%	0.91%	0.90%	0.90%	0.91%	0.91%	0.92%	0.90%	0.91%	0.90%	0.91%
75% Perc =	1.15%	1.15%	1.17%	1.16%	1.16%	1.17%	1.16%	1.15%	1.18%	1.17%	1.16%
80% Perc =	1.44%	1.44%	1.45%	1.45%	1.46%	1.44%	1.44%	1.45%	1.45%	1.45%	1.45%
85% Perc =	1.76%	1.79%	1.78%	1.80%	1.77%	1.77%	1.78%	1.77%	1.77%	1.77%	1.78%
90% Perc =	2.18%	2.21%	2.20%	2.21%	2.19%	2.16%	2.16%	2.19%	2.24%	2.19%	2.18%
95% Perc =	2.83%	2.83%	2.79%	2.87%	2.83%	2.81%	2.83%	2.88%	2.86%	2.78%	2.83%

Name	% CHANGE INTEREST RATE QTR 45	% CHANGE INTEREST RATE QTR 46	% CHANGE INTEREST RATE QTR 47	% CHANGE INTEREST RATE QTR 48	% CHANGE INTEREST RATE QTR 49	% CHANGE INTEREST RATE QTR 50	% CHANGE INTEREST RATE QTR 51	% CHANGE INTEREST RATE QTR 52	% CHANGE INTEREST RATE QTR 53	% CHANGE INTEREST RATE QTR 54	% CHANGE INTEREST RATE QTR 55
Description	Normal(0.2*($I$130-BB$131),0.09*(BB$131^0.5))	Normal(0.2*($I$130-BC$131),0.09*(BC$131^0.5))	Normal(0.2*($I$130-BD$131),0.09*(BD$131^0.5))	Normal(0.2*($I$130-BE$131),0.09*(BE$131^0.5))	Normal(0.2*($I$130-BF$131),0.09*(BF$131^0.5))	Normal(0.2*($I$130-BG$131),0.09*(BG$131^0.5))	Normal(0.2*($I$130-BH$131),0.09*(BH$131^0.5))	Normal(0.2*($I$130-BI$131),0.09*(BI$131^0.5))	Normal(0.2*($I$130-BJ$131),0.09*(BJ$131^0.5))	Normal(0.2*($I$130-BK$131),0.09*(BK$131^0.5))	Normal(0.2*($I$130-BL$131),0.09*(BL$131^0.5))
Cell	BC130	BD130	BE130	BF130	BG130	BH130	BI130	BJ130	BK130	BL130	BM130
Minimum =	-7.68%	-7.93%	-7.81%	-7.09%	-6.83%	-6.74%	-6.70%	-6.97%	-7.77%	-7.32%	-6.57%
Maximum =	6.08%	5.74%	5.61%	6.13%	6.84%	7.26%	7.47%	5.58%	7.03%	6.83%	5.15%
Mean =	-0.03%	-0.02%	-0.03%	-0.02%	-0.02%	-0.02%	-0.02%	-0.02%	-0.02%	-0.03%	-0.01%
Std Deviation =	1.79%	1.78%	1.80%	1.78%	1.78%	1.80%	1.78%	1.78%	1.80%	1.81%	1.76%
Variance =	3.21E-04	3.18E-04	3.23E-04	3.17E-04	3.16E-04	3.23E-04	3.15E-04	3.15E-04	3.24E-04	3.29E-04	3.08E-04
Skewness =	-0.1785313	-0.1439221	-0.1902353	-0.1700869	-0.1696079	-0.1776612	-0.1243213	-0.1557169	-0.1814727	-0.248134	-0.1312916
Kurtosis =	3.394027	3.269809	3.288917	3.308118	3.343918	3.468784	3.2857	3.29211	3.54016	3.657072	3.127643
Errors Calculated =	0	0	0	0	0	0	0	0	0	0	0
Mode =	-0.17%	1.90%	-0.51%	0.79%	-0.10%	0.68%	0.36%	0.19%	0.47%	-0.37%	-0.64%
5% Perc =	-3.00%	-3.07%	-3.15%	-3.04%	-2.98%	-3.11%	-2.98%	-2.91%	-3.06%	-3.08%	-2.98%
10% Perc =	-2.27%	-2.29%	-2.29%	-2.25%	-2.34%	-2.27%	-2.35%	-2.29%	-2.28%	-2.38%	-2.27%
15% Perc =	-1.90%	-1.84%	-1.87%	-1.90%	-1.86%	-1.81%	-1.84%	-1.82%	-1.83%	-1.82%	-1.82%
20% Perc =	-1.52%	-1.52%	-1.49%	-1.49%	-1.49%	-1.44%	-1.50%	-1.50%	-1.48%	-1.44%	-1.42%
25% Perc =	-1.21%	-1.21%	-1.17%	-1.16%	-1.18%	-1.12%	-1.16%	-1.19%	-1.16%	-1.12%	-1.14%
30% Perc =	-0.94%	-0.90%	-0.88%	-0.85%	-0.89%	-0.87%	-0.90%	-0.89%	-0.86%	-0.85%	-0.87%
35% Perc =	-0.66%	-0.64%	-0.60%	-0.62%	-0.60%	-0.63%	-0.64%	-0.64%	-0.62%	-0.61%	-0.63%
40% Perc =	-0.42%	-0.40%	-0.41%	-0.38%	-0.36%	-0.38%	-0.43%	-0.41%	-0.37%	-0.38%	-0.40%
45% Perc =	-0.18%	-0.19%	-0.16%	-0.19%	-0.15%	-0.18%	-0.16%	-0.20%	-0.19%	-0.20%	-0.19%
50% Perc =	0.02%	0.04%	0.04%	0.04%	0.03%	0.04%	0.02%	0.05%	0.04%	0.01%	0.02%
55% Perc =	0.22%	0.21%	0.24%	0.25%	0.23%	0.25%	0.22%	0.24%	0.28%	0.24%	0.24%
60% Perc =	0.47%	0.45%	0.45%	0.46%	0.48%	0.45%	0.42%	0.44%	0.48%	0.46%	0.45%
65% Perc =	0.68%	0.68%	0.66%	0.68%	0.66%	0.67%	0.67%	0.68%	0.67%	0.68%	0.69%
70% Perc =	0.90%	0.91%	0.91%	0.90%	0.92%	0.91%	0.92%	0.92%	0.90%	0.92%	0.90%
75% Perc =	1.16%	1.16%	1.17%	1.17%	1.16%	1.17%	1.17%	1.17%	1.16%	1.16%	1.15%
80% Perc =	1.44%	1.44%	1.45%	1.45%	1.44%	1.44%	1.45%	1.44%	1.43%	1.44%	1.44%
85% Perc =	1.78%	1.78%	1.77%	1.78%	1.77%	1.75%	1.79%	1.78%	1.76%	1.77%	1.77%
90% Perc =	2.23%	2.21%	2.16%	2.18%	2.20%	2.19%	2.17%	2.16%	2.20%	2.17%	2.22%
95% Perc =	2.83%	2.86%	2.91%	2.84%	2.77%	2.83%	2.83%	2.78%	2.88%	2.78%	2.82%

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