RISK MANAGEMENT IN BOT PROJECT

by

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Abstract

With the growing demand of public services and the tight budget on government, BOT is one of the best alternatives to solve this problem. However, in order to create a successful BOT project, it is necessary to clearly identify, evaluate and manage the risk associated with the project.

First, the concept of risk and the risk management system is introduced. The first main objective is to create a risk management model. By applying this model, the risk associated with BOT project is identified by different phases of the project and the methods used to allocate and mitigate the risk from different parties' perspectives are also proposed.

Two case studies are discussed in the order that the first one, Hong Kong Cross Harbor Tunnel Project, is the base case to verify and reexamine our model. The second one, Taiwan High Speed Rail Project, is an on-going project but fails to meet its requirement at the initial stage.

Based on the two case studies, the answer to the creation of a successful BOT project is that an active participation of government in risk sharing is necessary.

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Table of Contents

List of Figures

List of Tables

1 Risk Management

In this chapter, before we start with the risk management in BOT project, a general overview of the basic concept of risk and the techniques we use to quantify the risk will be discussed. Finally, the framework of constructing a risk management system will be illustrated step by step given different types of risks.

1.1 Introduction

What is risk? The *Oxford English Dictionary* tells us that risk is "Hazard, chance of, or of bad consequences, loss." Not until the mid 17th century, did the word "*risk*" enter the English language[1]. The dictionary definition may satisfy notion scientists when they talk about risk, but it is too narrow when also looking at risk taking. Risk and risk taking, both forming the basis of risk management, can be viewed from a multi-disciplinary perspective. Several studies have attempted to discuss this issue. Yates and Stone (1992) looked at the elements that can be the building blocks of risk constructing. Psychologists examined the personality correlates to risk (Kogan and Wallach, 1964). Researchers in economics (Knight, 1921), sociology (Heimer, 1988), and management (Sitkin and Pablo, 1992) have examined the role of risk in each specific area. In that spirit, this thesis mainly focuses on the application of risk management in BOT project.

Risk is inherent in all construction work no matter what the size of a project or the scope of the work. Size can be one of the major cause of risk, so can changes in political

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[1] Merriam-Webster Dictionary

or economic planning. Other factors carrying risk with them include the complexity of the project, location, speed of construction and familiarity with the type of work. The evidence of many projects all over the world reveals that these risks are not being adequately dealt with. **Figure 1.1** and **Figure 1.2** shows that the extent of cost and time overruns of project financed by the World Bank reviewed between 1974 and 1988.[1] Among the 1778 projects reviewed during this period, 63% of them with cost overruns and 88% with time overruns.

Time and cost overruns can invalidate the economic case for a project, turning a potentially profitable investment into a loss-maker. Targets are sometimes missed because of unforeseen events that even an experienced project manager cannot anticipate. More often it happens because of events that are predictable in general, but not in specific terms. For example, industrial disputes, delayed decision or unexpected ground conditions may all be anticipated, but likelihood and impact are hard to predict with any precision, as no two construction projects are the same.

No matter in commercial or manufacturing industry, risk is endemic to all investment decisions. Through out the decision-making process, an important factor that always goes hand in hand with risk is *return*. In other words, each investor, faced with different risk/return profile, has his own attitude to risk. For example, the investor can opt for a risk-free investment by purchasing government short-term treasury bills securities issued at a lower fixed rate of return than other long-term securities. Investors in financial market recognize that risk play an important role in their allocation of assets across diversified portfolio. It is crucial to estimate the volatility of each asset along with its rate

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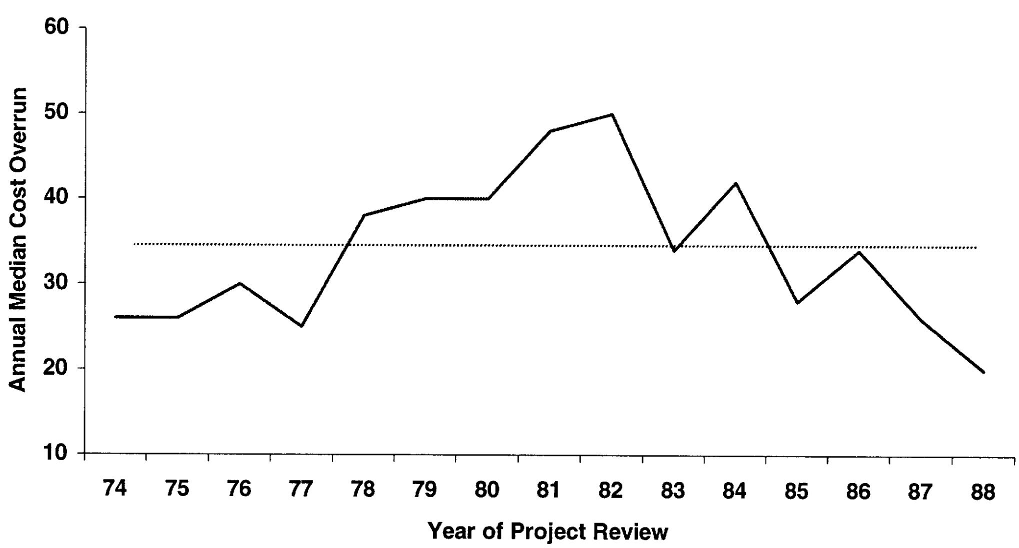
[1] World Bank, "Annual review of project performance results", 1990

of return since merely given expected return will not provide sufficient information for the investor to evaluate the decision.

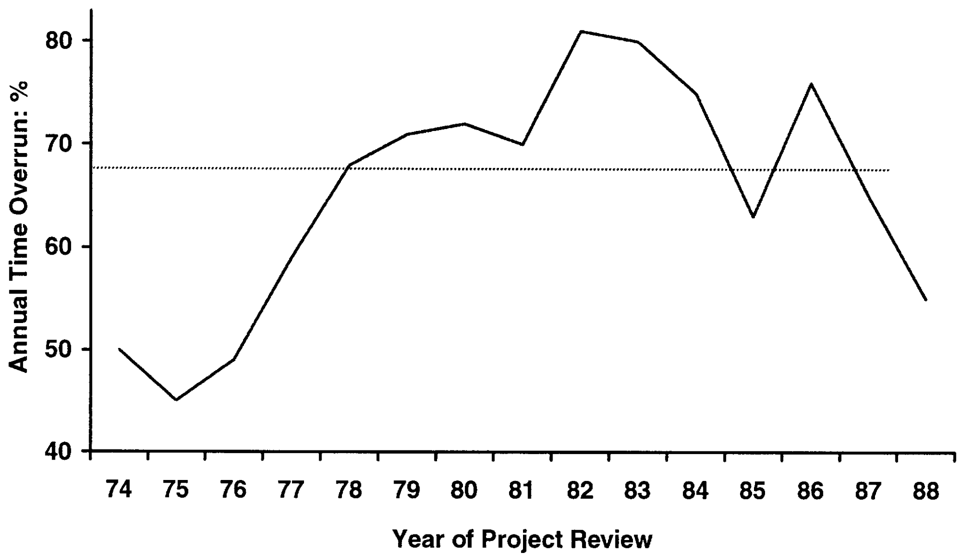
The two most important questions are whether the returns on the project justify the risks, and the extent of the loss if everything goes wrong. Clearly, the decision-maker's perception of risk is more likely to be influenced by the probability of loss and the amount of that loss than by a variance in gamble. In order to achieve a sound decision, several techniques are applied to quantify risk as an aid to decision-making process. These techniques must be based on a proper understanding of both the terms involved and the basic concepts. In the next section, these basic concepts forming the foundation of risk management and the criterions to quantify risk are discussed.

Figure 1.1 Overrun of actual cost compared with cost estimated at time of appraisal



(*Resource*: World Bank)

Figure 1.2 Overrun of project completion times



(*Resource*: World Bank)

1.2 Basic Concepts of Risk

1.2.1 Defining Risk and Uncertainty

The environment in which decision-making takes place can be divided into three types[1]:

- Certainty
- Risk
- Uncertainty

Certainty exists only when one can exactly specify what will happen during the period of time covered by the decision. In other words, certainty means where each action

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[1] Luce R. Duncan, Raiffa Howard, "Games and Decision; introduction and critical survey," 1957

is known to lead invariably to a particular outcome. This does not, of course, happen very often in construction industry.

It can be sure that certainty has a major difference between the other two types. There's much ambiguity among the concept of risk and uncertainty. Based on a general consensus, it is believed that each action in a *risky* situation leads to several known outcomes, each of which occurs with a specific probability. For example, flipping a fair coin gives an analogous illustration of risk. A person knows what the outcomes are, as well as their probabilities, though she cannot be certain about what the exact outcome is.

Uncertainty, by contrast, might be described as a situation in which there are no information or historic data relating to the situation. In other words, no one has idea about the probability of each outcome. Buying a particular stock in NYSE can be exemplified as a case for uncertainty. Someone knows that the stock price may either go up or down tomorrow, however, she cannot be certain about the probability of any of these outcomes.

A company has to operate in an environment where there are many uncertainties. The aim is to identify, analyze, evaluate and operate on risks. Accordingly, the company is converting uncertainty to risk. Furthermore, as we think more about uncertainty and risk, we would find out that risk is a more relevant term in construction project. As a result, throughout this thesis we confine ourselves to using risk to encompass uncertainty.

A risky situation is, therefore, one in which the decision maker is not sure which outcome will occur. This uncertainty may lead to an erroneous choice, and eventually, a loss. So, several criterions are used to evaluate and quantify risk in order to make a sound decision. Typically, risky choice can be classified as being part of the *normative* and *descriptive* approach[1]. The normative approach suggests some rules for choice under risk. The term normative implies that the suggested rule is the best under certain circumstances and, thus, tells people how they should make choices under risk. The descriptive approach takes a different way. Instead of telling decision makers how they should make choices, it looks at the ways people actually make decisions in situation involving risk and tries to come up with models that describe what they do.

1.2.2 Risk Criteria

In this section, some of the most important criteria of making choices under risk are discussed here by grouping all of these into three categories:

- Normative Approach
- Descriptive Approach
- Other Approach

Basically, both normative and descriptive approaches provide some reasonable criterions when making choices under risk. But as we will see later, people often do not behave according to the rules suggested by normative approach.

1.2.2.1 Normative Approach

There are two main normative rules for choice under risk:

- The Expected Value Rule
- The Expected Utility Rule

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[1] Zur Shapira, "Risk Taking: A Managerial Perspective", 1995

1.2.2.1.1 The Expected Value (EV) Theory

Statistical decision theory suggests that *expected value* (EV) is the best rule for choice under risk (Raiffa, 1968). A simple game situation will illustrate this criterion. Suppose someone is playing a game of tossing a fair coin. He is to guess what side the coin will fall on. If he guesses correctly, he will win $10, but if he is wrong, he will get nothing. The question is: *How much is he willing to pay for participating in the game?*

We can get the answer by setting up a payoff matrix as below:

Table 1.1: A simple illustration of EV rule

Outcomes	Probability	Payoff	Expected Value (EV)
Head	0.5	$10	EV= $10*0.5=$5
Tail	0.5	$0	EV=$0*0.5=$0

The answer is $5 by adding up the expected value from all possible outcomes. To rephrase the rule more precisely: Multiplying the payoff of each outcome by its specific probability of occurrence and adding the products.

$EV = \Sigma[p_i \boldsymbol{M}_i(x_i)]$

p_i: probability distribution of each outcome

$\boldsymbol{M}_i(x_i)$: function of outcome x denoted by I

Under the criterion of expected value, the decision maker's option is based on the rule:

Strategy option = $\text{MAX}_i \{\text{EV}_i\}$

The above example is very simplistic, but it shows that the most important crucial factor that must be analyzed is the probability distribution. If the factor is not realistic then the complete analysis will give the wrong information. Furthermore, people's decision-making in the risk environment is not always consistent with the theory of EV. This is because the principle objection to using EV maximization is that it ignores the attitude to risk. According to Daniel Bernoulli's study in 1738 known as the St. Petersburg Paradox, he postulated that, when approaching risky choices, people do not simply use the face value rule of outcomes (such as expected value). Rather, they use some psychological value of these outcomes, which he termed the *utility of outcomes.* We will discuss this in the later section.

Summary of the steps involved in calculating the expected value (EV) theory

1. Consider different options available
2. Estimate the value of each option
3. Estimate the probability distribution of each option
4. Multiply the value of each option by its respective probability
5. Sum the EV of each option
6. Select the option with maximum EV

1.2.2.1.2 The Expected Utility (EU) Rule

The expected utility rule is a simple transformation of the expected value rule. It is still a summation of probabilities times their respective values, except that the values are subjective values called *utilities,* rather than the actual monetary values. The *utility function* is depicted in the form of a curve with the utility scale on the vertical axis and expected outcomes on the horizontal axis. There are several methods applied to the assessment of a person's utility function, such as the von Neumann-Morgenstern (NM), the Ramsey method, and direct measurement. The NM is considered to be the most effective and will be discussed here.

The first step in deriving a utility function by the NM method is to determine two monetary outcomes values as reference points. For convenience, we will look at the most favorable and the least favorable monetary outcomes in a decision situation. We then assign utility values to these two reference points. Since utility is an ordinal rather than a cardinal concept, these utility values are arbitrary. For convenience again, we might assign these reference utility values of 0 and 1. For example, if the payoff outcomes of a decision range from \$0 to \$500, we assign utility values of 0 to payoff \$0 and 1 to \$500. That is,

$U(\$0) = 0$ and $U(\$500) = 1$

The second step of the NM method is to assign the utility values for all the other monetary outcomes lying between these two reference points. The utility values determined by the NM method are based on the concept of certainty equivalent.

Assume that the decision-maker has to choose between two strategies:

Strategy A	a given money with certainty
Strategy B	a risky situation with probability p of winning \$500 and probability $(1-p)$ of winning \$0.

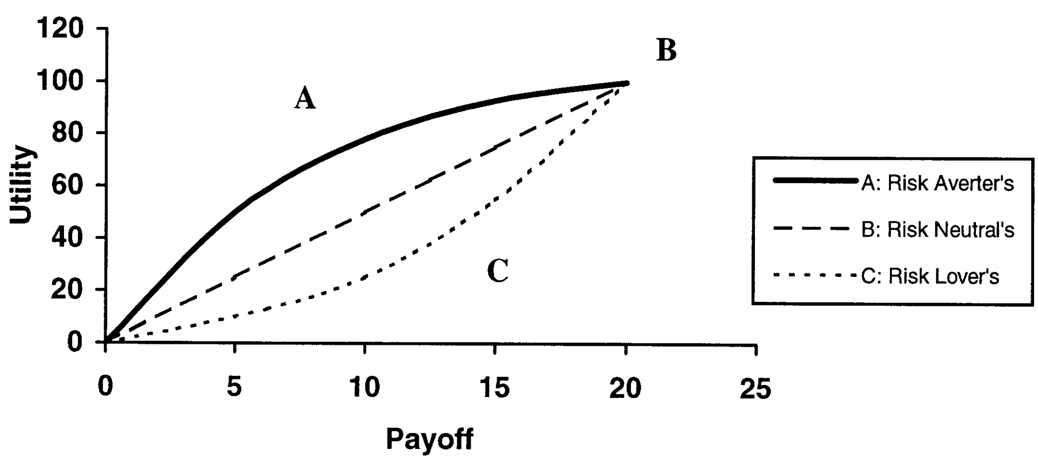
To determine a certainty equivalent of strategies A and B, we can change the parameter values of either strategies until a certainty equivalent is obtained. For convenience, assume the $p = 0.5$ and $(1-p) = 0.5$. When the certain money of strategy A reaches \$100, it makes the decision-maker indifferent between strategies A and B. Its utility equates to the expected utility of strategy B:

$$U(\$100) = p*U(\$500) + (1-p)*U(\$0) = 0.5*1 + 0.5*0 = 0.5$$

So forth and on, we can calculate the values lying between U(\$500) and U(\$100) in the same way and then plot all these utility values versus the payoff outcomes to form the utility function curve.

The utility function of a person serves as a measure of that person's risk tendencies. In general, utility curves can be grouped into three categories as shown in **Figure 1.3**, dependent on whether the decision-maker is a risk-seeking, risk-neutral, or risk-averse person. A linear function describes a risk-neutral person a concave function, a risk-averse person; and a convex function, a risk-seeking person.

Figure 1.3 Three Types of Utility Function Curves



Curve A illustrates the utility curve of an individual who always takes certain money as the priority. He is risk averse.

Curve B represents the behavior of a person who is neutral to risk. He is indifferent to between certain and uncertain money.

Curve C shows the utility function of a risk seeking individual, who is willing to take gambles rather than a certain payoff.

It should be noted that, in many cases, precise objective probabilities are not available. For instance, there is no probability for the price of any security traded on, say, NYSE on the next day. If someone wishes to use expected utility rule, the probability distribution has to be estimated. Such estimation can only be subjective.

Both EV and EU rules are decision criteria used for risky options. EV is a simple method since it is easy to use and understand. However, the disadvantage of EV is that it ignores attitude to risk. Both EV and EU rule can guarantee the same result only if the decision-maker is risk-neutral.

1.2.2.2 Descriptive Approach

In many situations the amount of data required for making a rational choice may be overwhelming. For instance, there are over 1,700 securities in New York Stock Exchange, whose prices are changing all the time. Several methods have been developed to solve this problem. The most well known of these is *prospect theory*.

1.2.2.2.1 Prospect Theory

Kahneman and Tverskichy (1979) developed a model of choice under risk that accounts for paradoxes described earlier. They illustrate the theory by conducting the following experiment. People have to choose which game they prefer in both situation 1 and 2.

Situation 1

Gamble A: sure win of $400

Gamble B: 50% chance of winning $1,000

50% chance of winning $0

Situation 2

Gamble C: sure loss of $400

Gamble D: 50% chance of losing $1,000

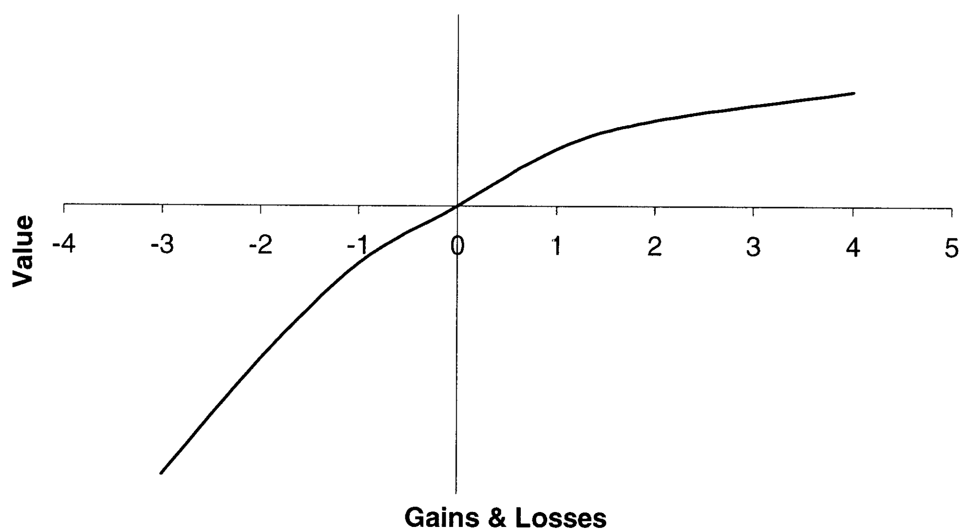
50% chance of losing $0

Most people prefer Gamble A over Gamble B, and Gamble D over Gamble C. Situation 1 depicts risk aversion and situation 2, risk seeking. Kahneman and Tversky (1979) thus proposed prospect theory to account for this pattern of risky choice.

Prospect theory has three important elements to it: a value function that plays the role of a utility function, a decision weights function that plays the role of probabilities, and an editing rule. Uncertain prospects are characterized by the value function and the decision weights and summed up in a similar way to expected utility.

The value function is shown in **Figure 1.4**. It has three characteristics. First, it defines values as deviations from a certain reference point. Second, both gains and losses diminish in value, suggesting that people are more sensitive to changes around the reference point. Third, it is steeper for losses than for gains, reflecting the assumption that people are more sensitive to losing a certain amount than to gaining the same amount. A major aspect of the value function is the reference point. Although, in general, many points can play the role of a reference, Kahneman and Tervsky proposed that the asset position also plays the role of adoption level, hence implying an almost instantaneous adjustment to a new asset position. Thus, wealth does not matter much, because if a person wins 1 million, she will immediately adapt to this new wealth and respond in a risk-averse manner to the gambles in Situation 1 and respond in a risk-seeking manner in Situation 2. Kahneman and Tervsky argued that changes in wealth are a more important determinant of risky choice than the absolute value of wealth. That is, within a very wide range of options, a millionaire and a poor person would respond in a similar way to the gambles in the situations just described.

Figure 1.4 Prospect Theory Type Value Function



An important feature of prospect theory is the editing rule. Given a choice between risky alternatives, decision-makers edit the choice problem until they arrive at a simple choice between edited alternatives that can be compared in either the domain of gains or the domain of losses.

1.2.2.3 Normative and Descriptive Approaches: A Comparison

The normative approach to risky choice emphasizes the statistical basis for decision-making. When there are large samples of repeated events, expected values provide the most sound summary statistic for choice under risk. In the expected value formula, the most likely outcome gets the highest weight, and the least likely outcome gets the lowest weight. Furthermore, utility theory proposes that the subjective value of outcomes be calculated, and, following Savage's (1954) suggestion, subjective probabilities are entered instead of objective ones.

The descriptive approach stems from the studies that people do not always follow the normative rules toward risky choice. Instead, descriptive approach uses decision weights rather than probabilities. It also suggests that decision-maker edit the choice until the alternatives can be compared in terms of gains or losses.

Around 1970, evidence has been growing of the incompatibility of the two approaches. The normative approach tells people what they should do, whereas the descriptive approach is an attempt to get an account of what people actually do. Several studies from Raiffa and Tervsky suggested that only through developing normative, descriptive, and perspective models of choice could improvements in decision-making be achieved.

1.2.2.4 Other Criteria

In this section, we are going to discuss about some risky choice criteria which can not be grouped into either normative or descriptive approaches but still play an important role for decision-making. As we may know, it is sometimes unrealistic to use one rule of thumb toward risk decision, as we can see from the contradiction between normative and descriptive approaches. In addition to the elements we pointed out previously to evaluate risky situation, here are some other rules, which are considered as important as well by decision-makers.

1.2.2.4.1 Mean-Variance (M-V) Criterion

A basic characteristic of risk is *volatility*. For example, the Dow Jones Industrials Index goes up and down in a pattern that cannot be predicted. The changes in this index create a distribution that implies risk. This volatility, in other words, risk, is measured by the *variance* of the distribution. It is the expected value of the squared deviations from the expected return. Symbolically,

$$\text{Variance} = \sigma^2 = \sum pr_i\,[r_i - E(r)]^2$$

Whereas,

pr_i: probability of each scenario i,

r_i: return on each scenario i,

$E(r)$: expected return on all scenarios.

Indeed, the concept of variance is the cornerstone in the *mean-variance approach* to the analysis of decision under uncertainty.[1] This approach suggests that, in choosing

[1] Harry Markowitz, "Portfolio Selection", *Journal of Finance*, March 1952

among risky alternatives, people should consider both the expected return and the variance of the probability distribution over the possible outcomes. The criteria suggest that, if two alternatives have the same variance, then people should choose the one with higher expected return. If, on the other hand, the two alternatives have the same expected return, people should choose the one with lower variance. It can be stated as[1]: A dominates B if

$$E(r_A) \geq E(r_B)$$

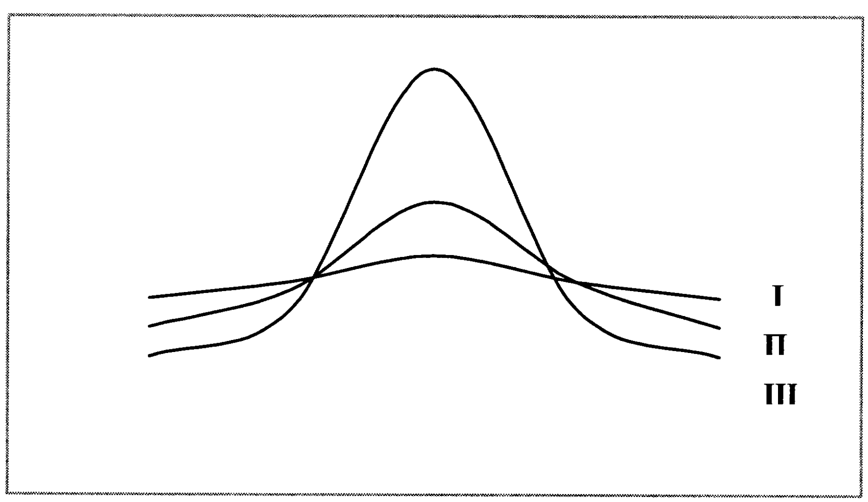
and

$$\sigma_A \leq \sigma_B$$

and at least one inequality is strict.

Given another example to clarify the criterion as shown in **Figure 1.5**. Assume that for three projects I, II, and III, all having the same expected value but $\sigma_I > \sigma_{II} > \sigma_{III}$. In this case, project III is preferred to both project I and II.

Figure 1.5 Mean-Variance Criterions



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[1] Zvi Bodie, Alex Kane, Alan J. Marcus, " Risk and Risk Aversion", *Investment*, 1999

1.2.2.4.2 Certainty Equivalence

Because we can compare utility values to the rate offered on risk-free investment while choosing between a risky one and a safe one, we may interpret a risky alternative utility value as its "*certainty equivalent*" rate of return to an investor. That is, the certainty equivalent rate of a risky alternative is the rate that risk-free investments would need to offer with certainty to be considered equally as attractive as the risky alternative. If, in other words, an individual is offered a choice to decide between a project with certain net present value, NPV, and the other with expected net present value, ENPV, that are equal, the one with uncertainty must offer higher return for compensation for risk bearing.

1.2.2.4.3 Risk Premium

A discount rate reflects the investor's time value of money and the rate of return the property must earn to justify the investment. Some projects are almost risk free, such as the case of a tenant prepared to sign a long term lease on a building at the early design stage, whereas a project which is considered risky will attract a premium to the discount rate.

The risk premium will be added to the risk free discount rate in order to compensate for the risk taking. In other words, though investor can put his money in a risk free security, the riskier investment provides an attractive premium for the investor to be willing to bear the risk. There is no formula which derives an appropriate risk premium; each investor has to decide how much risk he wants to take and what premium is appropriate for him to assume the risk.

The difficulty in choosing the appropriate risk free discount rate is rooted in the inaccuracy of the term risk free. Financial commitments always carry certain risks which can be neither eliminated nor transferred. The term risk free is intended to imply not absolutely absence of all risk, but virtually absence of default risk. In financial term, the risk free rate is taken as that which would apply if lenders viewed a borrower's credit and collateral so favorably that they were certain of repayment at the scheduled time.

The determination of the appropriate risk premium is based upon the trade off between risk and return. The concept of discounting implies that future risk is discounted more heavily than is near-term risk. A single risk-adjusted discount rate, therefore, is a poor proxy for the impact of risk on value over the project's lifetime, because risk does not increase exponentially with the passage of time. Indeed, most uncertainty happened at the early development and planning stage. Once the construction has been started and the tenants have been found, the associated risk or uncertainty diminishes. One way to solve this issue is to use different discount rates for different stages. This is also how we categorize the risks for BOT project by different phases through out the project's lifetime.

1.2.2.4.4 Risk-Adjusted Discount Rate: NPV Rule

It is tempting to consider the risk premium as the requirement for an additional rate of return. In other words, it has been suggested that one way of taking risks into account in investment appraisal is to use risk-adjusted discount rates. A real discount rate used in the calculation of net present value of a project may be viewed as composed of three parts: a time value of money, a risk premium and an adjustment for inflation.

The risk premium is added to reflect the investor's view of the degree of sensitivity of the project to risky factors. The size of the premium depends on the degree of risk associated with project and the investor's attitude toward risk. The greater the risk is, the greater the premium. The adjusted discount rate consists of these three factors:

$r_t = r_f + RP + i$

r_t: risk-adjusted discount rate

r_f: risk free rate

RP: risk premium

i: inflation rate

After the discount rate has been decided, the net present value of project can be simply calculated by discounting the cash flows by time span. This is so called the discounted cash flow (DCF) formula.[1]

$$PV = \sum \frac{C_t}{(1 + r_t)^t}$$

where r_t refers to the adjusted discount rate and C_t is the cash flow in the period t. To find out the net present value we add the initial cash flow (usually negative) $\boldsymbol{I_o}$:

$$NPV = I_o + PV = I_o + \sum \frac{C_t}{(1 + r_t)^t}$$

If, based on *professor Samii's* suggestion, we take the tax rate and depreciation into consideration, we can simply modify the formula as follow:

$$NPV = I_o + \sum (1 - t_a)\frac{C_t}{(1 + r_t)^t} + \sum \frac{t_a * D}{(1 + r_t)^t} + \frac{S_t}{(1 + r_t)^t}$$

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[1] Richard A. Brealey, Stewart C. Myers " Chapter 3: How to Calculate Present Value", *Principle of Corporate Finance*, 1996.

C_t: net revenue

t_a: tax rate

D: depreciation

S_t: salvage value of the property at the time t

Note that the salvage value is merely calculated at the end of property life time, and the C_t in each period is the net revenue (revenue minus operating cost). This formula is more appropriate for our study since most BOT projects do need to consider the factors as stated in the modified DCF formula.

The decision rule based on the discount rate is that always choose the project with positive NPV since it provides net profit, taking into account opportunity cost of capital and the risk of the project.

Although the NPV rule is very useful in modern financial world, there are still some factors that make it problematic.[1] One major problem is that the discount factor is part of a compounding function, which assumes that the risks associated with future costs and revenue grows geometrically with time. This assumption is justified on the grounds that the accuracy of our forecasting decreases with time.

The second issue is the correct projection of cash flow. Over time, external economic situation may changes variably enough to affect the projection of cash flow. This can be seen in many of our BOT cases which ended up with totally failure.

The third issue is the correct selection of discount rate. The discount rate usually reflects the opportunity cost of capital plus a risk premium to compensate for risk

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[1] Massood V. Samii, Construction Finance, 1998

bearing. The risk premium, by its nature, is very arguable in the way that what value should be added to the discount rate.

The fourth issue is that the cash flow analysis cannot capture all the benefits that a project may bring to an organization. It can only capture direct benefits in terms of revenue generation. Benefits to other divisions of an organization, such as economy of scope or improvement in a company image, are not included with this method.

Finally, it is doubtful to use only one discount rate through out the whole project life. This is based on the assumption that the risk in each phase is the same. However, as we mentioned before, this is not quite true since most uncertainties arise in the development and planning stage. Once the construction has been undertaken, partial uncertainties would eliminate and so forth reduce the total risk. For example, there are more uncertainties for an R&D lab project during the planning phase since no one knows the chance for new product development. However, once you have a breakthrough in the development and the new product begins to sell on the market, the relative risks, such as operation cost, revenue (from negative to positive) are reduced. Assume we use the same discount rate for both the planning and operation phase, we might probably decline this profitable proposal.

In brief, we describe the basic rules and concepts to make decision in a risky situation. But when it comes to the more complex project, we need to *manage* the risk in a more systematic way. Typically, a peculiar risk management system is developed to analyze the risk as well as to quantify it and deal with it. We will discuss this in the next section.

1.3 The Risk Management System

Attention to risk is essential to ensure good performance, whether you are managing a company, a project or providing service for your client. The main issue related to risk management is how we quantify the risk and how to deal with it. There are many techniques developed to give answer to this issue.

1.3.1 Risk Management Overview

Risk management is not new, nor does it employ black box magical techniques. It is a system aiming to *identify* and *quantify* all the risks to which a project is exposed to so that a sound decision can be made to manage the risks.

Risk management cannot remove **all** risks from project; it is not synonymous with insurance. Its principle aim is to ensure that risks are managed efficiently. The client and his project manager must recognize that certain risks will remain to be carried by the client. This residual risk must be allowed for in the client's estimate of time and cost. Risk management system must be practical, reasonable and cost effective. Risk management need not be complicated nor require the collection of vast amounts of data. It is a matter of judgment, common sense, analysis, experience and a willing or gut to assure the risk.

Effective management of risky projects demands rapid and realistic prediction about the future expectation and the alternative courses of action of positive decision-making. It requires flexible attitudes and procedures. We can see from many public projects that ended up with totally failure simply because of the lack of proper risk management system. So far, risk management is most frequently used in private sector projects.[1] The public sector should follow their example. It is urgent for politicians and government to notice this issue, and to examine current procedures used in the planning and implementation of projects, because some of these are causing unnecessary delay, avoidable cost overrun, and poor performance.

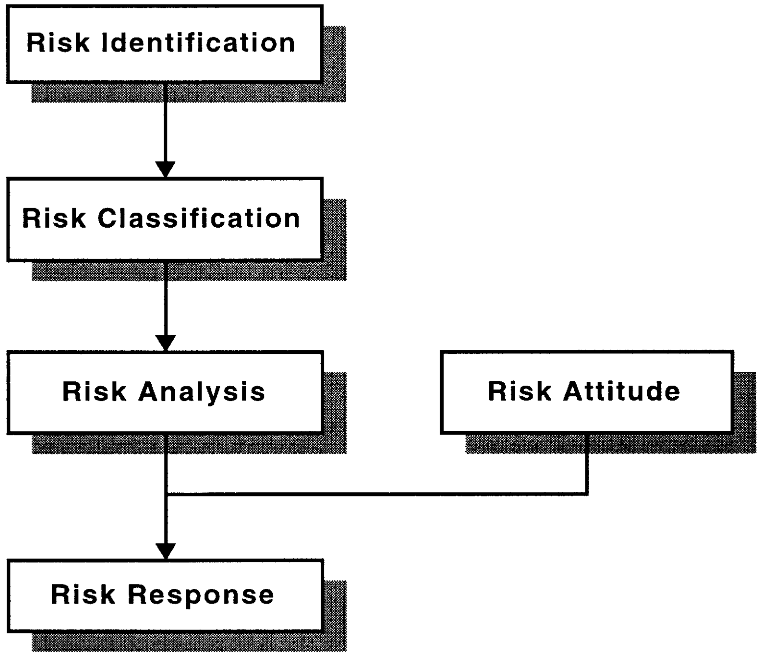
1.3.2 Risk Management Framework

The process of risk management is broken down into the risk management systems in **Figure 1.6** which shows the sequence for dealing with risk. Naturally the risk management system must be applied to each option under consideration. Generally, the stages are:

Risk identification	Identify the source and types of risks
Risk classification	Consider the type of risk and its effect on the person or organization
Risk analysis	Evaluate the consequences associated with the type of risk, or combination of risks, by using analytical techniques. Assess the impact of risk by using various risk measurement techniques
Risk attitude	Any decision about risk will be affected by the attitude of the person or organization making the decision
Risk response	Consider how the risk should be managed by either transferring it to another party or retaining it

[1] P.A. Thompson, J.G. Perry, "Engineering Construction Risk," 1992

Figure 1. 6 The Risk Management Framework

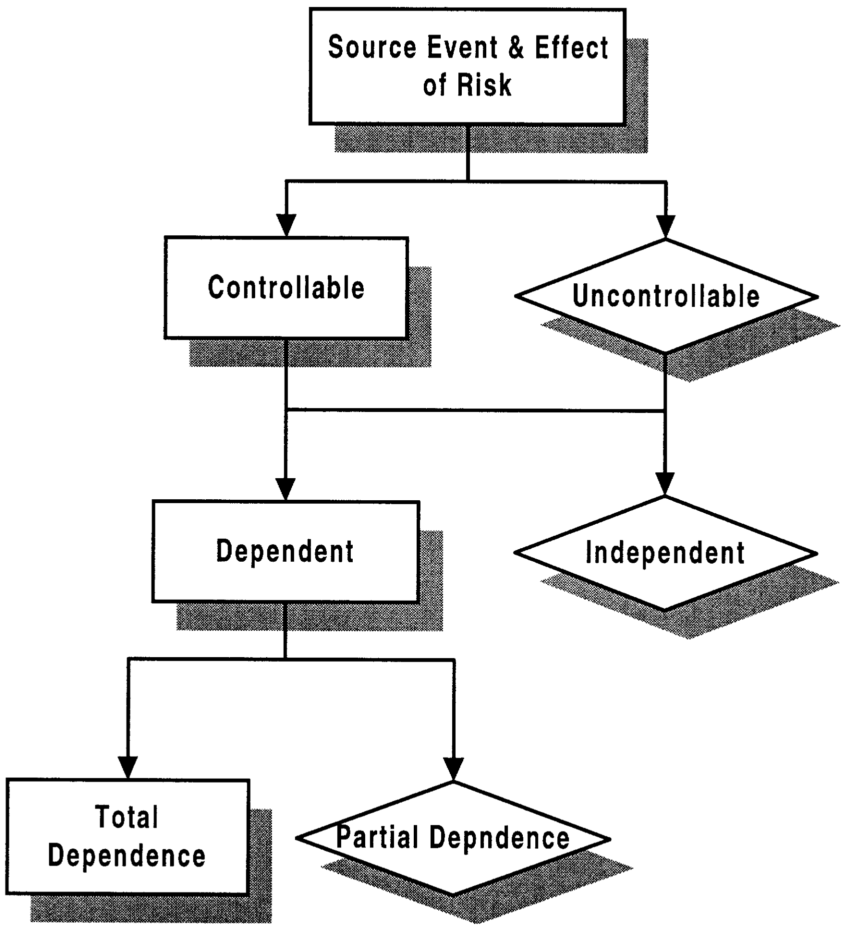


1.3.2.1 Risk Identification

Figure 1.7 shows the factors to be considered in the risk identification phase; the various aspects are discussed in sequence. It is worth stating that an identified risk is not a risk, it is a managerial problem. Inevitably, bad definition of a risk will breed further risk.

When attempting to identify risk, it is rather like trying to map the world. Maps of the world tend to be centered on the location of the mapmaker. Much of the world is not visible from where you stand. Some territory which is familiar and obvious to you may not be so obvious to everyone. Similarly, looking at a large project from the top, with multiple layers of planning, complex vertical and horizontal interactions, and sequencing problems, resembles looking into the world map through a fog. Management's ability to influence the outcome is limited to what they can see. A clear view of the event is the first requirement, focusing on the sources of risk and the effect of the event.

Figure 1. 7 Risk Identification



1.3.2.1.1 Sources of Risk

The sources of risk and the effects of risk, which must be clearly distinguished, are listed below. The sequence is:

The main objective is to compile a list of the main risk resources, a description of their likely consequences, and an approximation of their potential damage on cost and time. Some risks are controllable, such as a lack of co-ordination between the mechanical engineering services specialist contractors and the suspend ceiling specialists contractors. Other risks, such as the risk caused by exceptionally inclement weather, cannot be controlled, but a contingency provision can be made by considering the worst scenario. It is not always obvious to think in terms of the source, the event, and the effect. For instance, the event of a boiler exploding might have been caused by defective design, or defective workmanship resulting in the project being delayed and costing more. In the case of late completion of a project the contractor might be liable to pay liquidated damages and the client suffers the consequential loss.

Controllable and Uncontrollable Risks

Controllable risks are those risks which a decision-maker undertakes voluntarily and whose outcomes is within our direct control. In contrast, uncontrollable risks are which we cannot influence.

The distinction between controllable and uncontrollable risks is very important to construction industry. For instance, a decision-maker would probably assure the risks associated with the new technology introduced in building. Such risks may be performance risks, where the true capability of technician is uncertain, or financial risks, resulting from uncertain installation cost or maintenance expense. However, these risks can be tolerated if additional benefits or reasonable premium, such as accumulation of experience, prestige, or favorable financial support are likely to occur. By exploiting available expertise and through careful planning, we may be able to control the eventual outcome.

By contrast, uncontrollable risks, such as weather condition, or relative statutory change, usually result from the sources which the decision-maker is unable to avoid through existing technology or by any available method.

Dependent and Independent Risks

Two sources of risk in an investment project are dependent if a knowledge of the magnitude of one, influences the estimates for the other. There may be dependency between the set of controllable risks and the set of uncontrollable risks. For example, the expected life of a building component is mainly dependent on its design, the standard of workmanship, and the quality of materials.

When considering the dependency between risks, there are three types of dependence:

- No dependence because the variables are mutually exclusive
- Total dependence
- Partial dependence

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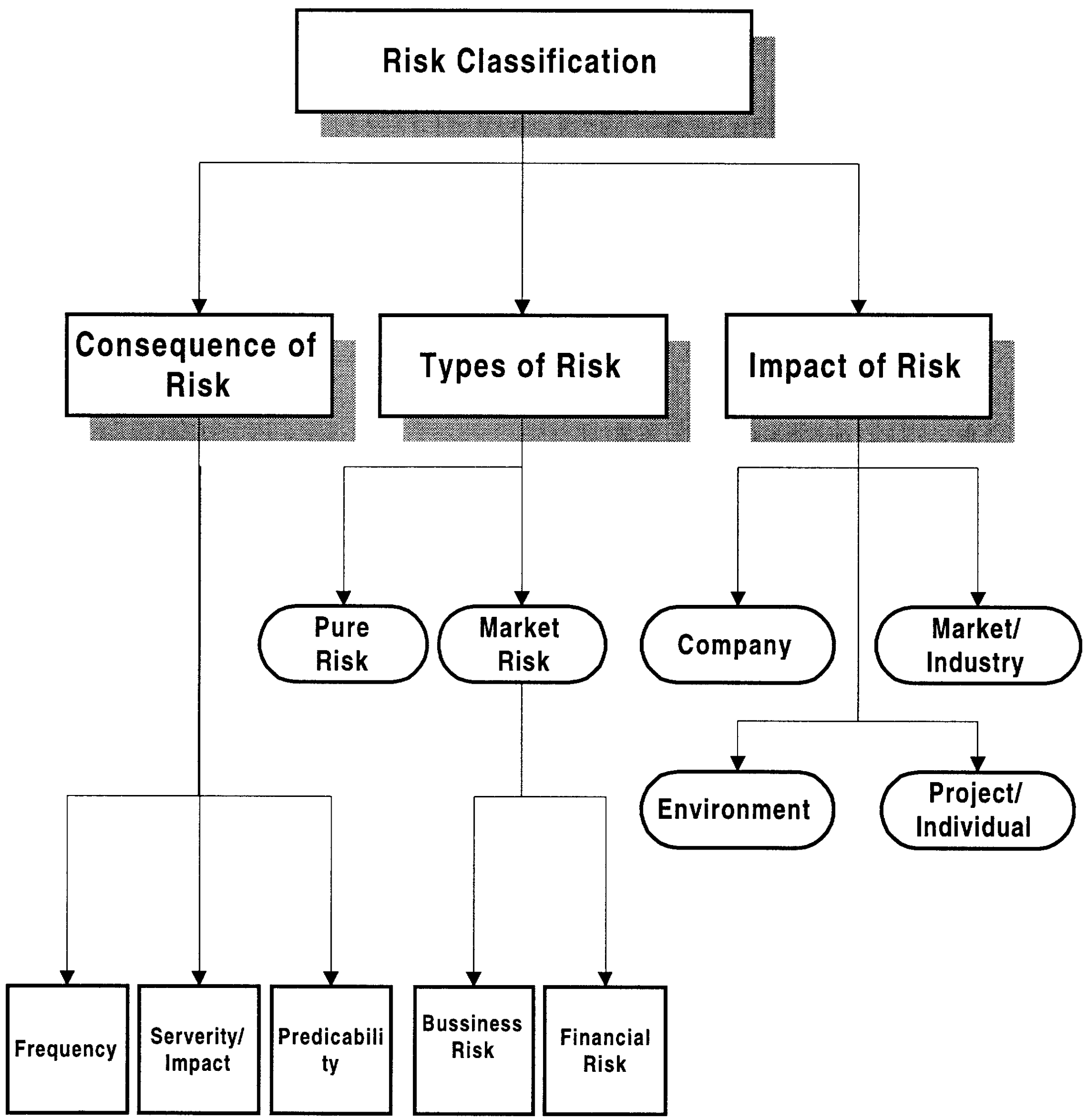
[1] Roger Flanagan, George Norman, "Risk Management and Construction", 1993

1.3.2.2 Risk Classification

There are three ways of classifying risk: by *identifying the consequence*, *type* and *impact of risk*, as shown in **Figure 1.8**

Figure 1. 8 Risk Classifications



1.3.2.2.1 Types of Risk

Basically, we group risk into two types:

- Market risk, which is common to many assets, is also called systematic risk or non-diversifiable risk
- Specific risk, which is specific to individual asset, is also called unsystematic risk, pure risk or diversifiable risk

Nearly all the work classifying the types of risk is related to ***portfolio theory***, which considers investment in stocks and equities. Such risks are divided into **market risk**, which is related to the way general market behaves, and **specific risk**, which is specific to a particular company. Almost all shares respond, to some extent, to movements in the market and this response can be measured by the beta coefficient. For example, a share with beta coefficient of 1.5 will, on average, move 1.5 % for each 1% move in the market. This is sometimes called the ***CAPM*** model. A diversified portfolio of such shares would be 1.5 times as variable as the market index. The beta coefficient is thus a measure of the variability of the portfolio. Specific risk is measured by the beta coefficient for a particular company's share price against the market or sector share movement.

According to the portfolio theory, total risk can be reduced by well-diversified portfolio. But not ***all*** risks can be reduced by diversification. The only risk that can be removed through diversification is the **specific risk**, which is also called ***unsystematic risk*** or ***pure risk***. This is the risk that is specific to each company. By selecting many well negatively correlated securities in portfolio, all the unsystematic risk specific to each company can be cancelled by each other risk affect. However, all the securities in portfolio are still exposed to the market risk, which is unavoidable in any aspect, such as interest rates, inflation rate, or exchange rate.

One of the principles of the theory is that investors should not expect to be rewarded for taking on risks which can be avoided. Instead, they should expect to be rewarded only for unavoidable or market risk. Thus, portfolio theory is in agreement with the adage of 'not keeping all your eggs in one basket', since efficient capital markets will not offer rewards for specific risk.

This argument is valid in the construction industry. Contractors, who diversify into the various sub-segments of the market such as civil engineering, oil and gas engineering or public and private, are more resilient to economic shocks. The same is true for the developer: speculative housing and offices should be complemented with retirement homes, car parking facilities and so on in different localities.

Moreover, a company systematic risk can be split into two components: business and financial risk. Business risk is the result of a company trading with its assets, financial risk arises directly out of the gearing process. Whilst the former is borne by the equity and debt holders, the latter brings risk only to the equity holders. The tradition that debt capital has priority over equity capital in both the distribution of the company's annual net cash flow and in any final liquidation distribution, ensures that the risk of a reduced or zero dividend is borne only by shareholders. The severity of the financial market is directly related to the level of gearing.

1.3.2.2.2 Impact of Risk

Figure 1.9 gives a simplified view of the risk hierarchy. At its broadest level, risk will have an impact upon environment. The project itself is at the lowest level of the hierarchy.

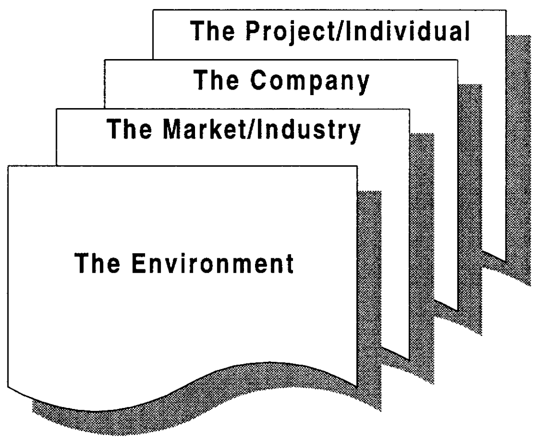


Figure1.9 The Risk Hierarchy

Risk and the general environment

The general environment is that which affects all organizations in a given society. General environmental risk can be divided into two parts: the physical and the political, social, and economic.

The physical environment includes the weather and other natural phenomena such as landslips and earthquakes. It can have a significant impact on the construction process. While the physical environment cannot be controlled, the risks that arise from it can be identified and steps taken to mitigate the damage.

The political, social and economic environment is partially controllable. The government can control events in its own country but not in the world. For example, the property crash resulted from a property boom followed by falling demand, a rent freeze, taxation, and a harsh monetary policy. The cause of the environmental risk was controllable, but only by government, and the effect of on the property and construction industry was devastating.

Nobody can ignore environmental risks. Although pressure can be brought to bear upon the government to influence or change decisions, in general, most events are uncontrollable by the individual or the company. In these circumstances, attention must be given to evaluating the risk exposure.

The market/industry risk

Market risk relates to any event that might affect the complete industry, such as a national strike of all building workers. Throughout the developed world, the construction industry is characterized by its client-oriented service. Typically, the industry contains a small number of relatively large firms and a very large number of small firms. The likelihood is that large firms will analyze their exposure in a more systematic way than small firms.

All companies will want to ensure they maintain their market share of available projects, be they members of the design or the construction team. This means that they must constantly evaluate competition and price level. Since they are all interdependent the reactions of any one firm to market risk may have to take account of the likely actions of other firms in the industry.

The Company Risk

Any company operates within market. The company will have a number of current projects at any one time, each project generally being a profit center. Company risk and project risk are intrinsically linked because the company must provide resources and assistance to its own project.

To avoid over exposure to many risky projects, some company will form a separate company for a particular project. For example, the Channel Tunnel is being undertaken by Transmarche Link which is a special consortium.

Project/Individual Risk

Project risk and company risk are strongly correlated as we mentioned before. But when analyzing whether a project is feasible or not, the risk involved in the specific project is not exactly the same to which the company exposed. So, choosing a particular discount rate, which is different from those used by the company, for the project is reasonable.

1.3.2.2.3 Consequence of Risk

When considering the consequences of a risk occurring, the relevant factors relating to effects of the risk are taken into account. Most professionals will tend to rely upon expert judgment and knowledge, tempered with some information, if it is available, about past events.

There are many sources of risks where no reliable data are available. Rather than ignore these sources, the course of action should be considered within the overall risk management system.

1.3.2.3 Risk Analysis

The most important task of risk management is to analyze risk to provide an integral solution to decision-maker. A simple method for considering project risks would be to analyze any risk independent of others, with no attempt to estimate the probability of occurrence of that risk. The estimated effects of each risk could then be accumulated to provide total project outcome values.

Another approach, though more complex, greater realism and confidence can be achieved by applying probabilities to risks and considering the inter-dependencies between the risks. The two most useful techniques for doing so are sensitivity analysis and probability analysis, as we will discuss later.

The essence of risk analysis is that it attempts to capture all feasible options and to analyze various outcomes. By giving specific weighted number to each option, decision-maker is able to quantify risk and respond to it.

The choice of risk analysis technique to be used should be based on following factors,

- The type and size of project
- The information available
- The cost of the analysis and the time available to carry it out
- The experience of the analyst

The application of any risk analysis technique requires that the uncertain data can be given a range of different values. For example, if the duration and costs for specific activities are uncertain, use a range of values within which the decision maker believes they are likely to lie.

Most quantitative risk analysis techniques require the speed and accuracy of computer. With the assistance of computer, many programs are designed for specific cases and organizations.

1.3.2.3.1 Sensitivity Analysis

Sensitivity analysis is a technique used to consider the effect on the whole project subject to changes in the value of each risk which is considered to be potentially serious to the project. In other words, sensitivity analysis is used to identify the impact on the total of a change in a single risky variable.

The analysis involves repetitive calculation of the effects on the project outcome of a range value of the variables. Project outcome is usually considered in terms of speed of construction, final costs or an economic criterion such as NPV or IRR (Internal rate of return). For example, there are probabilities that the cost on the high-speed railway station would increase by 5%, 10% and 15%. We are able to recalculate the NPV with the change in the cost of station then plot the percentage changes in the station costs against the percentage changes in NPV.

The result of a sensitivity analysis can be shown graphically on a **spider diagram** as illustrated in **Figure 1.10**[1]**.** This example is based upon analyzing the possible costs to the contractor of a contract to construct the reservoir. The spider diagram shows the results of calculating the sensitivity on site. For instance, it indicates that a decrease in output when grouting can have a significant effect on the overall cost to the contractor. The sensitivity analysis provides clues to further investigation. It shows the value of

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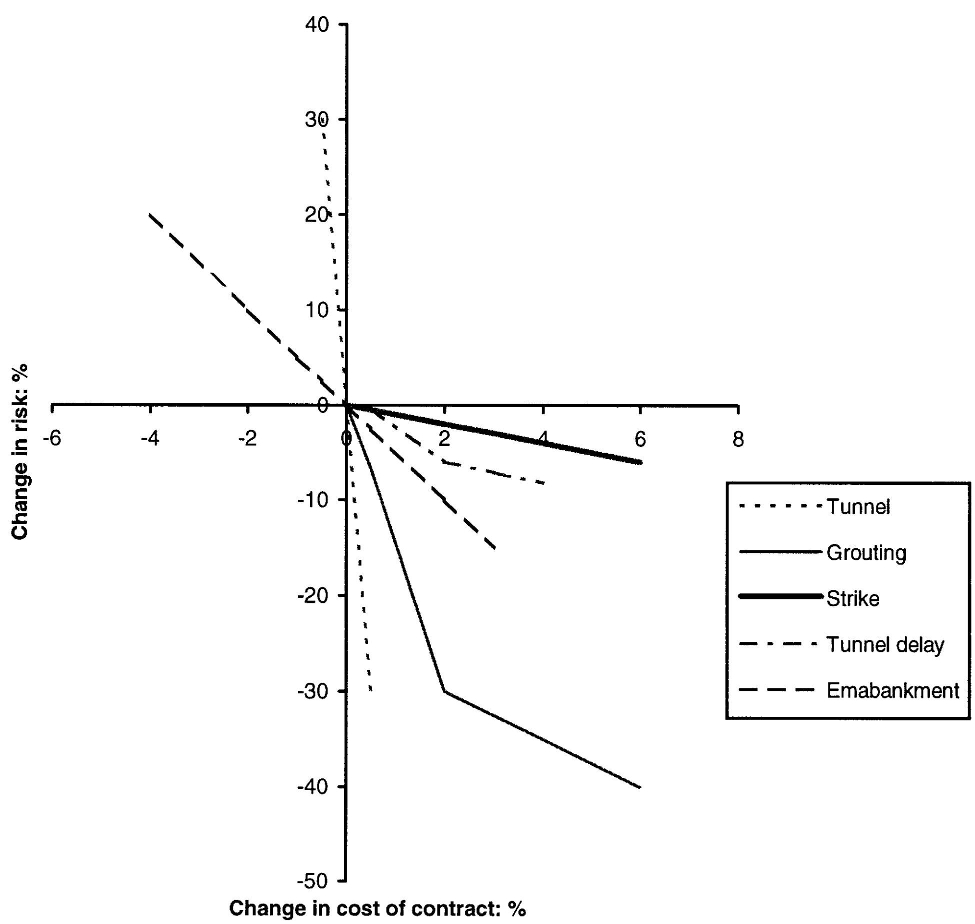
[1] Peter Thompson, John Perry, "Engineering Construction Risk", 1992

information regarding variables for a project, which of the parameters should be considered, and which it might be considered ignored. Evidence has shown that the consideration of the eight largest risks will typically cover up to 90% of the total. (Porter, 1981). Consequently, the identification of these risks by sensitivity analysis can yield savings on information and costs. However, there is also a limitation to sensitivity analysis. Each risk is considered independently with no attempt to quantify their probabilities of occurrence. Besides, in reality a variable would not change without other project factors changing, which is the case not reflected in sensitivity analysis.

Figure 1.10 Spider Diagram: Dearden Clough Reservoir, Sensitivity analysis covering uncertainties in estimated construction cost.



1.3.2.3.2 Probability Analysis

As discussed in previous section, there are some limitations to sensitivity analysis. However, probability analysis overcomes many of the limitations by specifying a probability distribution for each risk, and then considering the effects on the risks in combination. The result of the analysis is a range of values in which the final outcome could lie. An essential step in this type of risk analysis is estimating the range of probabilities within which the possible outcomes of a given process may occur.

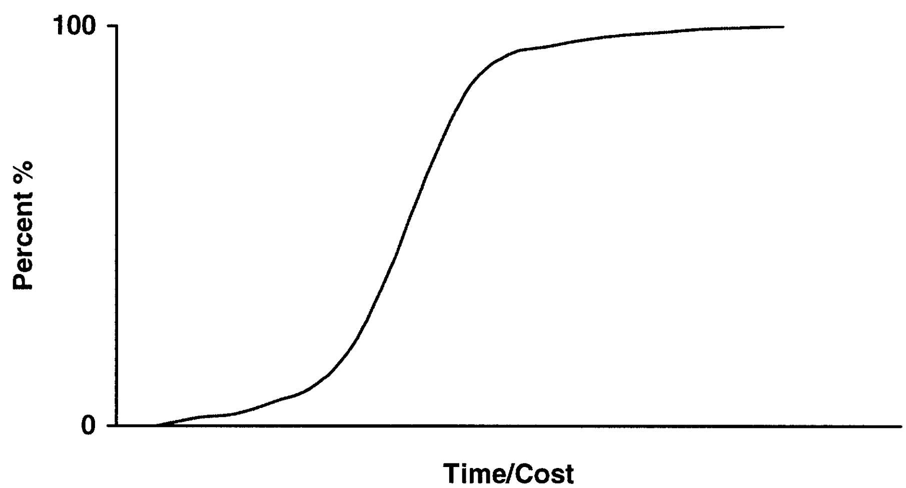
Random sampling is used where calculation of data inserted into an equation would be difficult or impossible. It is used in a probabilities analysis in the following way.

- The range of values for the risks being considered is estimated and a suitable probability distribution of each risk is chosen.
- A value for each risk within its specific range is selected; this value should be chosen randomly.
- The outcome of the project is calculated combining the values selected for each risk.

One commonly used technique to construct the probability distribution is by applying Monte Carlo simulation. It is called Monte Carlo because it makes use of random numbers to select outcomes. It requires sets of random numbers to be generated for use in testing various options. Random numbers could be selected in a variety of ways such as throwing a dice. In reality, using computer program is the most effective way.

In Monte Carlo simulation a large number of hypothetical projects are generated to reflect the characteristics of the actual project. Each simulation is accomplished by replacing a risky variable with the random number drawn from the probability distribution used to describe that variable. It is usual to make at least 100 iterations which then build up into a frequency distribution for the whole project. Cumulative frequency curves, as shown in **Figure 1.11,** are also usually presented as part of the results. From these it is simple to read off the likelihood that a certain activity will not exceed a given time or cost.

Figure 1.11 Cumulative Frequency Curve



1.3.2.3.3 Decision Tree

In most major projects there are choices in how to achieve the objectives, so that at the start of the project the decision maker is faced with a variety of alternatives. These alternatives can be shown graphically in a decision tree showing the decision making process and the options available.

A measure of the value for each possible outcome is required in order to give meaning to the decision tree. The most commonly used is the *expected value* (EV), which is the sum of the payoffs weighted by their probabilities. The decision-maker has to place a probability on each outcome. The probabilities are likely to be rough assessment so it is advisable to draw a number of decision trees using slightly different probability values.

1.3.2.4 Risk Response

The response to, or the allocation of, risk can be grouped into four basic forms:

- Risk retention
- Risk reduction
- Risk transfer
- Risk avoidance

Proper allocation of risk must be considered the ability to absorb risk and the premium offered to bear the risk. For example, a contractor will pay for the insurance to transfer the risk to surety. On lump sum contracts, clients are passing more risk to contractors and trade contractors. As we mention before, risks and rewards should go hand in hand in order to encourage specific party to bear the specific risk.

1.3.2.4.1 Risk Retention

Risks that produce small, repetitive losses are those most suited to retention. Not all risk can be transferred, but even if they were capable of being transferred it may not prove to be economical to do so. The risk will then have to be retained. Besides, it is preferable to retain a portion of the risk in certain circumstances. For example, a reduction in an insurance premium with a corresponding retention in the form of limited excess provision in the event of a claim, may be preferred to full coverage; the gamble is between paying the premium and the probability of the event occurring and the consequential loss that would result. In summary the relevant factors are:

- The cost of the insurance premium;
- The maximum probable loss;
- The likely cost of the loss;
- The likely cost of paying for the loss, if uninsured.

1.3.2.4.2 Risk Reduction

One of the ways of reducing the risk exposure is to share risks with other parties. For instance, the general contractor will attempt to reduce his risk exposure to pay liquidated damages for late completion by imposing liquidated damages clauses in sub-contract agreement.

Similarly with the contractual arrangement, the use of management fee types of contract will remove the adverse attitude of contractors and should reduce the likelihood of claims from contractors and should reduce the likelihood of claims from the contractor for direct loss and expense.

1.3.2.4.3 Risk Transfer

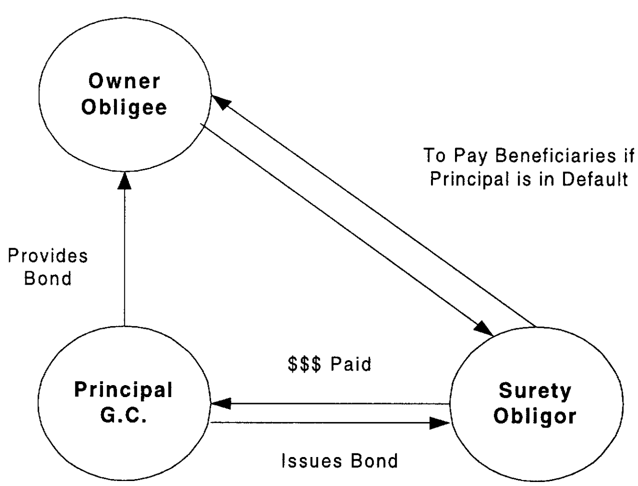
Transfer risk does not reduce the criticality of the source of risk; it just removes it to another party. In some cases, transfer can significantly increase risk because the party, to whom it is being transferred, may not be aware of the risk they are being asked to absorb.

The most common form of risk transfer is by means of insurance which changes an uncertain exposure to a certain cost. On construction projects, fault-free building cannot be guaranteed and defects may be discovered long after practical completion. Latent defects which cannot reasonably be discovered at the stage of a building's completion period are a fact of life.

One advantage of current arrangement of risk transfer by means of insurance is it reduces the likelihood of litigation between different parties. As a matter of fact, surety acts as an intermediate deputy who bears the risk with reasonable awarding. Based on Professor John Miller's statement, the relationship between each party and surety can be shown in **Figure 1.12**.[1]

Payment bond and performance bond are provided by surety to ensure the project will be completed in the event of default by the contractor. Bond is the form of insurance paid by the principal.

Figure 1.12 Performance Bond for Risk Transfer



(*Resource*: John B. Miller. Law in the construction industry)

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[1] Professor John B. Miller, "Law and the Construction Industry", 1998

1.3.2.4.4 Risk Avoidance

Risk avoidance is synonymous with refusal to accept risks. It is usually associated with pre-contract negotiation but it may well be extended to decisions made in the course of execution of the project. The use of exemption clauses is an example to avoid specific risk or the consequence resulted from the risk.

1.3.2.5 Risk Attitude

As we mentioned before, risk always goes hand in hand with reward. The premium that gives the basic judgment of whether one should bear the risk is quite different among individuals. In other words, the attitude toward risk choice is based on each individual's risk preference. Simply speaking, there are three types of people:

- Risk loving
- Risk averse
- Risk neutral.

Most of the risk theories are based on the rational of risk aversion. It is more unpleasant to lose a given sum than to gain the same amount since one would change his standard of living to which his is accustomed.

2 Risks in Build-Operate-Transfer Project

2.1 An Overview: BOT Concept

2.1.1 Introduction to BOT

Although the term **Build, Operate, Transfer**, sometimes referred to as BOOT (Build, Own, Operate, Transfer), is relatively new, the practice of this concept has been around for several centuries. The main objective of this concept is to allow private sectors or individuals to develop and operate public infrastructure projects.

The host government would establish main objectives of a specific project and assume the role of defender of the public interest, while the consortium or private sector would take the role of contractor to design, build, finance and operate the project. The concessionaire would assume the responsibility for the completion of the project, any risk involved in different stages and the operation performance. The consortium would be granted a concession period, after which the contract might be renewed at the option of the government, or title would be transferred from the concessionaire to the government.

The BOT theme has several variations:

BOO: Build, Own, Operate (without any obligation to transfer ownership)

BTO: Build, Transfer, Operate

BRT: Build, Rent, Transfer

BOOST: Build, Own, Operate, Subsidize, Transfer

DBFO: Design, Build, Finance, Operate (similar to BTO, the government will retain title to the land and lease it to the private concern over the life of the concessionary agreement)

Traditionally, most infrastructure service, such as railroad, power supplies and water sanitation, is delivered as a public good by government. The government takes the responsibility of designing, building, financing, operating and maintaining the physical project. However, physical infrastructure is increasingly more expensive, and even in the developed world many governments can no longer afford to utilize the necessary resources to allow them to provide sufficient infrastructure service to sustain its economy to flourish or prosper continually. In addition, many public services are considered low-efficiency or poorly management due to the lack of incentives of competitiveness, which is the key factor to survive in the private market. So the idea of BOT was proposed as not only a substitute to relieve the tight budget on government but also a vehicle to improve the quality of service. In a BOT project, the consortium usually provides equity financing in the amount of 10 to 30% of the total cost and seeks debt financing for the balance of the investment. The host government may provide assistant to the consortium in the form of initial land acquisition and favorable tax relief in equipment, material, or income.

2.1.2 History Background: How the concept evolved

The historical development of private sector involvement in the provision of infrastructure as the term is understood today has its root in Europe, in the beginning of a demand for mass travel and long distance transport in the second half of the seventeenth century. The Industrial Revolution stimulated the booming in western society. At that time, the needs for infrastructure facilities, such as railroads, power plants, canals and turnpikes increased explosively. Undoubtedly, large cash was required to support these projects. Governments of the time had only rudimentary tax system arrangements primarily to service heads of state and any wars they might embark on. Infrastructure was therefore left to individuals to finance and build. However, as the revenues generated from the improvement in industrial production, governments were able to fund their own infrastructure, but where large or specialist undertakings were suggested the concession or franchise arrangement was adopted.

In the mid-1800's, French was the leading activists of this concept. According to Monod[1] the need for water distribution initiated the first concession being granted in 1782 to the Perier brothers in Paris. The most notable spread in the use of concession occurred after 1830 in France. However, the use of concession was not only confined to France but soon widely found in Spain, Italy, Germany and Belgium. The use of concession contracts declined in industrialized countries as the initial infrastructure was completed.

One of the best-known BOT projects in modern world is the Suez Canal which opened on 17 November 1869 with a 99-year concession. The total length of the canal is 195 km connecting the Mediterranean and Red Sea. Ferdinand de Lesseps was given the responsibility for forming the company to build and operate the canal. It was to be financed by European capital with Egyptian financial support. The land was donated by the Egyptian government which relaxed many of the taxes generally levied on important materials and equipment. The consortium was to pay all the costs of design and construction. The government would receive 15% of the annual profits from the canal's operation, 10% would be paid out to the initial shareholders, and the 75% would accrue to the company. Also, in 1958, the concession agreement was modified to include a provision stating that 80% of all workers must be Egyptian. Construction began in 1859 and was scheduled for completion in 1864 at a total cost of £8 million, a sum that grossly underestimated the real cost of the project. In 1863 British engineer Sir John Hawkshaw projected the eventual total cost would be £10 million when the project was to be completed in 1868- four years later than expected. However, in 1875, the interest on the debt of the Egyptian government in the course of financing a portion of the project was so high that even exceeded the gross income of the entire country. Finally, the company found a solution to transfer the title to British government.

Industrialized countries generally funded new infrastructure between the late 1800s and the 1970s from their respective fiscal resources or sovereign borrowings. These governments also played a role in identifying needs, implement strategic policy and procuring the either by direct ownership or a closely controlled franchise. This traditional approach was followed by less developed countries today by means of issuing government bonds or direct loans from organization such as World Bank, Asian Development Bank and the International Monetary Fund.

However, a truly fever of privatization emerged in the late 1970s. It challenged the traditional approach of establishing infrastructure, which place pressures on the governments, in both developed and developing countries, to change the current policies and set up new rules for the game. There were two influences for this change. First, the existing and limited additional infrastructure is unable to keep pace with economic

[1] Monod J., "The private sector and the management of public drinking water supply", World Bank, 1982.

growth. Cited from the *Economist* on 6 March 1993 to give an example of this situation stating that[1]:

Between 1970 and 1991 Britain built an extra 9% of main roads and motorways. During the same period, passenger cars drove 116% more miles; vans and goods vehicles, 75% more. Crowded Britain is not unique. Between 1970 and 1990 America's vehicle miles almost doubled, while the amount of its urban roads rose by just 4%.

There is no exception in the developing countries, sometimes so-called "Newly Industrialized Countries", which are countries now establishing their infrastructure and with the GDP moving constantly. Many Southeast Asia countries and Latin American countries apply. All these countries have a common symptom of suffering from limited infrastructure to sustain its high-rocketing economic expansion. According to the World Bank statistics data (1998), Philippine has only 19.8% of the surface covered by road, compared with 100% in UK. In Bangkok, the current traffic congestion shaves 1% from gross national product and costs an average 40 days in commuting time. All these countries are facing this problem of economic growth outstripping infrastructure development.

Second, the importance placed on health and welfare demands. The longevity of population had resulted in the dramatic increases of health and medical costs. Most governments were heavily in debt to these social expenses. It became clear that these governments had fiscal shortcomings in funding public infrastructure. One of the best ways to relieve this constraint is by adopting the idea of privatization which grants private sectors the title to design, build, operate and maintain specific infrastructure by its

[1] C Walker, A.J. Smith, " Privatized Infrastructure: the Build Operate Transfer Approach", 1995

own financing within a predetermined concession period. This requires massive investments and regulatory changes to control these significant projects.

In the United States, the construction of privately built and operated toll roads was commonplace during Revolutionary days. But real privatization fever hit the United States in the 1980s and 1990s when newspapers began to announce the privatization of prison and school systems.[1] In addition, while the construction industry was in a great recession during the 1970s, many companies saw a revival opportunity of obtaining contract through BOT approach. This also relieved pressure on the host government tight budget. Since the risks associated with the projects were high, many agreements with host government allowed developer return on investment to exceed 25 percent. The U.S. federal government today acknowledges BOT and encourages the implementation of BOT-related transportation projects since it sees BOT as a primary way to make U.S. companies more competitive globally. The Untied States indeed has taken several steps to implement and support the privatization movement.

2.1.3 Current Market

Based on history, the economic growth of a country is related to its availability of public infrastructure. There is no doubt that the developing country is where eagerly needs more infrastructure to keep pace with its fast-growing economic. For example, according to World Bank statistics, the developing countries invest $250 billion dollars each year in new infrastructure (World bank Working Paper, 1990). The Asian market is where most of the big money will be spend on infrastructure development in the next two decades. For example, china plans to spend $92 billion per annum between 1995 to the end of the century, South Korea $400 billion on infrastructure, and Taiwan about $245 billion. Another study indicates that East and South Asia will require at least $1.2 to 1.5 trillion in infrastructure investment between 1990 and 2000.

The wave of private sector participation in infrastructure now sweeping the globe started in Chile, New Zealand, and the United Kingdom in the early 1980s. From 1984 to 1994, there are more than 900 privatized infrastructure projects got under way and more than 2,200 are under preparation in 86 countries. Since 1984, the value of privatizations has totaled US$357 billion and that of new investment projects more than US$308 billion. Thus private investment in infrastructure amounted to US$60 billion a year on average. Privatization activity has been dominated by sales of power companies and telecommunications companies licenses as shown in **Figure 2.1**[2]. The sales of transportation and sanitation companies are also important. If we take a closer look at the specific sector, telecommunications investments tend to be funded mostly with retained earnings, reflecting strong market growth and consumers' willingness to pay for service. The liberalization of telecommunications that started in a few countries in the 1980s turned into a worldwide trend in the 1990s. Now more than 90 developing countries open their telecommunications sector to private participation between 1990 and 1998. These countries transferred to the private sectors the operation and construction risk of more than 500 projects. The transactions involved investment commitments of US$214 billion. Two-thirds of that amount has been invested in expanding and modernizing networks; the other third has gone to government as license fee. According to the World Bank PPI Project Database, the data reflect that most of the privatization contracts among

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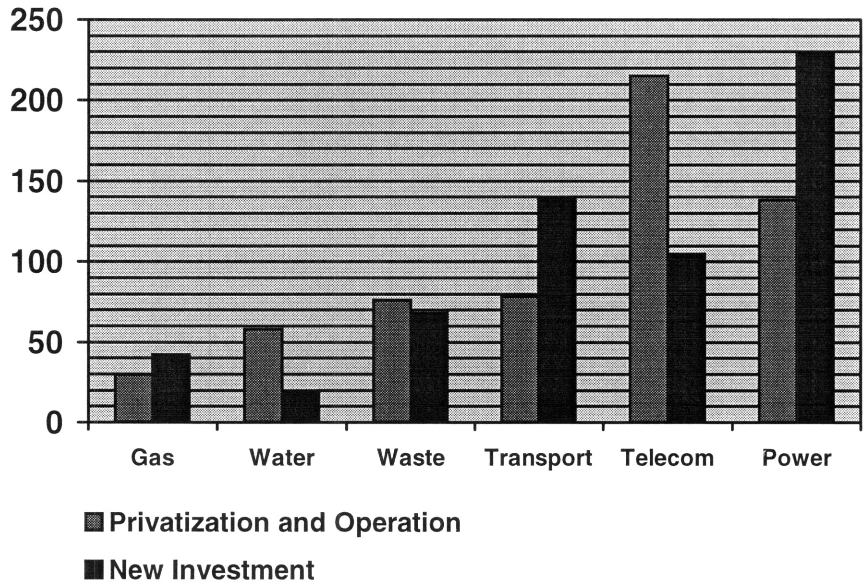
[1] Sidney M. Levy, "Build, Operate, Transfer: Paving the Way for Tomorrow's Infrastructure", 1996
[2] World Bank PPI Project Database.

developing countries are Greenfield projects, which include BOT and BOO contracts. As to the total investment, Latin America and East Asia lead the way with 52 percent and 20 percent, respectively. **Table 2.1** shows the total investment by region.

Figure 2.1 Private Infrastructure Projects by Sectors, 1984-1995



(*Source*: World Bank, PPI Project Database)

Table 2.1 Telecommunication Projects with Private Participation in Developing Countries by Region, 1990-1998

Region	Countries	Projects	Total Investment (1998 US$ millions)
East Asia and the Pacific	14	64	42,269
Europe and Central Asia	24	254	32,382
Latin America and the Caribbean	22	99	110,919
Middle East and North Africa	6	13	2,979
South Asia	4	41	19,073
Sub-Saharan Africa	24	50	6,420
Total	94	521	214,043

(*Source*: World Bank, PPI Project Database)

The fast growing countries of Asia are emphasizing new investment, which account for more than 70% of the new privatized infrastructure in this region, as witness the top ten new private infrastructure projects in **Table 2.2**. Two countries in the region are the clear front runners- the Philippines, mostly in power, and China, mostly in power and transport. Even the United States with its mature infrastructure is not immune to the spreading of this new delivery mechanism toward a private/public alliance. With the us department of transportation's announcement that it will need to spend $51.5 billion annually just to maintain the condition and performance of the federal highway system, and $16.7 billion each year to improve the system, it is no wonder that the Intermodal Surface Transportation Efficiency Act allows state government to issue contract with private consortium to design, build, finance, operate and maintain the projects within its own objectives and specific concession duration.

Table 2.2 Top ten Private Infrastructure Projects, 1984-1995

Location	Projects	Contract	Cost (US$ billions)
France/United Kingdom	Channel Tunnel	BOT, 55 years	19.0
Taiwan	Taipei Mass Rapid Transit System	BOT	17.0
Japan	Kansai International Airport	BOT	15
Europe	Concert Pan-European Telecom Service	BOO	5.3
Argentina	Buenos Aires Water and Sewer Service	ROT, 30 years	4.0
Thailand	TelecomAsia Communication Network	BTO, 25 year	4.0
China	Daya Bay Nuclear Power Plant, Phase 1	BOO	3.7
Malaysia	North-South toll Expressway	BOT, 30 years	3.4
Mexico	Petacalco coal-fired Power Plant	BOT	3.0
Thailand	Bangkok Elevated Road and Train System	BOT, 30 years	2.98

(*Source*: World Bank Private Sector Note #45)

2.2 Contractual Organization

The BOT contractual structure may vary from different projects to reflect the distinction and unique of specific project. Typically, a contractual arrangement is shown in **Figure 2.2.**

From the government perspective, it is essential to determine the needs of governments since all these infrastructure services such as electricity, water sanitation, telecommunication, and transportation are significant prerequisites of society. It includes the following three points:

- Governments must address and set long-term policy objectives for their people.
- Governments should continually balance their budgets to ensure that taxation levels do not rise to smother the very growth the infrastructure provides. Not to do so endangers the stability of society and the government.
- Government generally encourages efficiency and growth.

Bases on the above three points of a successful government, the objectives of this new partnership from the government perspective are as follow:

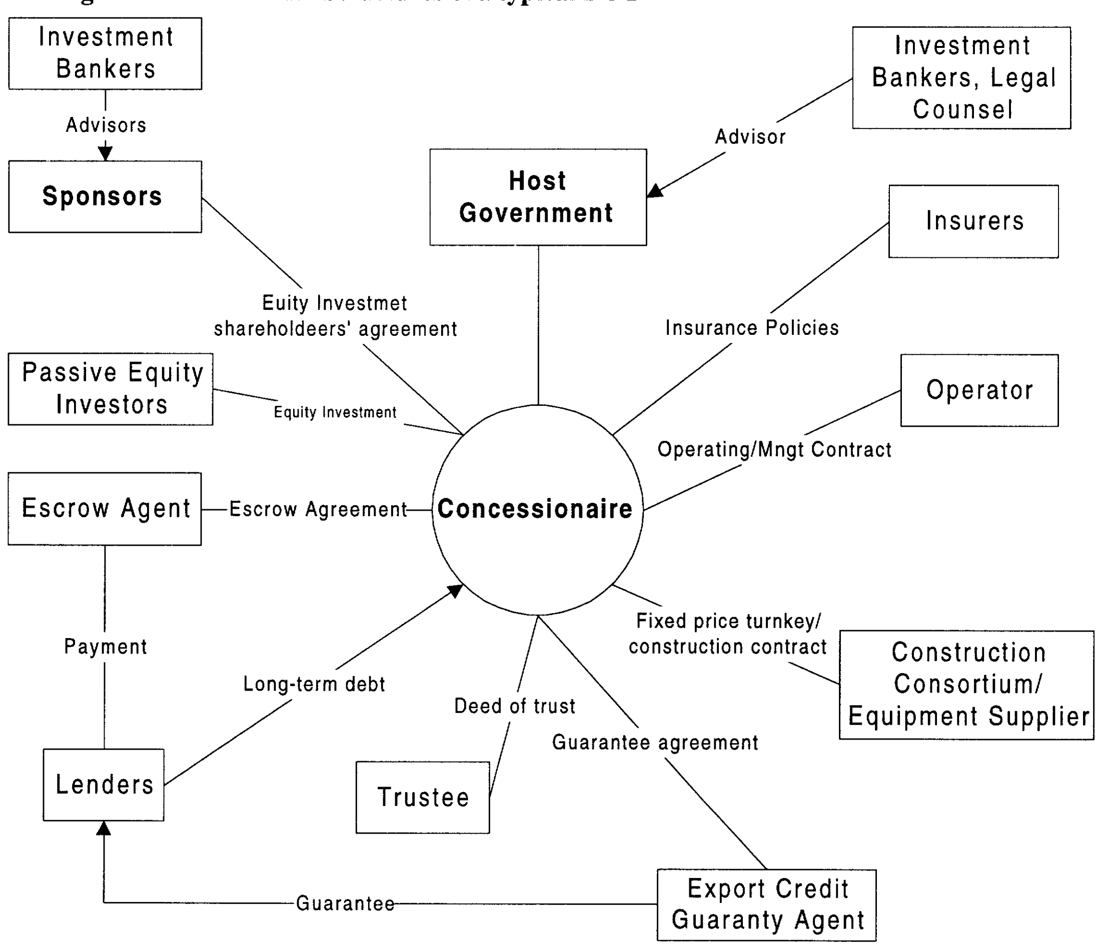
- Relief of financial burden
- Better service to the public
- Reduction in inefficient bureaucracy
- Encouragement of growth
- More flexibility to balance the budget to use in other areas such as education, arts and social welfare.

However, the success of this new partnership has to go hand in hand with the concern of whether the "project" is profitable and operated successfully or not. The marriage of public/private can be deemed successful only if both sides can reach a win-win solution.

From a concessionaire perspective, its objectives to fulfill this contractual structure are as follow:

- Assume the construction phase is performed successfully and on time.
- Monitor the operation phase of the project to ensure the shareholders' benefits.
- Ensure the payoffs of loan are paid as schedule.

Figure 2.2 Contractual Structures of a typical BOT



(*Source*: Walker. Privatized Infrastructure)

2.3 Project Financing

2.3.1 Defining Project Financing

When it comes to define the meaning of project finance, we may find the answer obscure since the methodologies and tools used in project finance vary from project to project, and country to country. The variability arises from the different viewpoints or criteria toward the unique mix of debt and equity between lenders and investors. Usually lenders tend to focus on the downside risks while investors tend to look at the upside opportunity. A more precise definition as follow[1]:

> *A financing of a particular economic unit in which a lender is satisfied to look initially to the cash flows and earnings of that economic unit as the source of funds from which a loan will be repaid and to the assets of the economic unit as collateral for the loan.*

Project financing should be distinguished from conventional direct financing or so-called *corporate financing*. As to the conventional direct financing, lenders to the firm look to the firm's entire asset portfolio to generate the cash flow to payoff their loans. They also have full recourse to all assets and revenue of the economic entity. The assets and their financing are integrated into the firm's asset and liability portfolios. Often, such loans are not secured by any collateral. The critical distinguishing feature of a project financing is that the project is a distinct legal entity; project assets, project-related contracts, and project cash flow are segregated to a substantial degree from the sponsoring entity. The financing structure is designated to allocate financial returns and risks more efficiently than the traditional financing structure. In a project financing, the

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[1] Peter K. Nevitt, "Project Financing", Euromoney.

sponsors provide limited recourse to cash flow from their other assets that are not part of the project. Also, they typically pledge the project assets to secure the project loans.

On the other hand, one characteristic often used by government in its evaluation of competing bids is the project ***Debt to Equity*** ratio (**D/E** ratio), and it has often been said that governments will consider the project more viable if project sponsors are more willing to back the scheme with their own money, in other words, higher D/E ratio. Dias and Ioannou[1] present a mathematical model attempting to predict the optimal E/D ratio for the project based on the Capital Asset Pricing Model. They conclude that there is an optimal E/D ratio that maximizes the return of equity shareholders, and this ratio is usually between 40% and 60%.

However, both lenders and investors tend to overlap when analyzing the commercial viability of the revenue stream assessment. Although the financial engineering techniques varies from country to country- the BOT vehicles of Western Europe for example, are very different from the other areas in the world, they all share the same conception characteristics:

- Host government is unwilling or unable to fund the new infrastructure
- A strong need in infrastructure
- Funding bodies are convinced of the potential of commercial success

Typically, the developer or the sponsors have to package the financial formula. They know that their standalone project has a large hole of early development and construction debt, in other words, high initial cost. Early injection of equity reduces this debt without incurring interest payments but comes with the trade-off that investors will

[1] Dias A. and Ioannou P.G. "Debt capacity and optimal capital structure for privately financed infrastructure projects", 1995.

push for high tolls to maximize their dividends. The lenders may see this pressure as adding risk to the future cash flow predictions. A balance, therefore, has to be attained through the finance engineering vehicles based on all the risks involved. In the following sections, these finance vehicles used today will be discussed from different parties' perspectives and how the related risks are mitigated.

In summary, the ultimate goal in project financing is to arrange a borrowing for a project that will benefit the sponsor and at the same time be completely non-recourse to the sponsor, in no way affecting its credit standing or balance sheet, while at the same time providing sufficient credit support through guaranteed or undertakings if a sponsors or third party, so that lenders will be satisfied with the credit risk. Structuring a project-finance package entails deciding how much of the project resources should come in the form of equity and the rest will be debt.

2.3.2 Sources of Finance

Usually the sources of a project finance comes from two areas:

- Equity
- Debt. There are two kinds of debts: subordinate debt and senior debt. Subordinate debt is sometimes called mezzanine financing or quasi-equity; and senior debt will usually be secured or asset based.

Equity is provided by shareholders; shareholders include project sponsors, who are the driving force behind a project, as well as passive investors, who hold equity positions without being involved in project promotion. Shareholders' return depends merely on the project's profit. In addition, equity holders take more risk than debt creditors since they are the last to get paid. Therefore, they are likely to expect higher return to compensate their risk; Debt refers to fund lent by financier. Lenders receive payments according to a predetermined rate. Their payment does not depend on the profit of the company.

Equity

The equity investment in a project financing represents the risk capital. It forms the basis for lenders or investors advancing more senior forms of capital to the project. Usually it makes up 20 to 40 per cent of the total financing. Although the equity investors are the last to get paid, the potential profits are substantial. Lenders consider equity as a margin of safety. There are two important reasons for creditors to require equity investment in financing package:

- Lenders expect the projected cash flow may be able to payoff the operation cost, debt service and a comfortable margin of safety to cover any contingency that might arises. The more debt the lender put into the cash flow projection, the more risk the lender assume.
- Lenders look at equity as a collateral for their loans. They want investors to have enough stakes to see through the project to a successful completion rather than walk away easily.

The appropriate D/E ratio depends on how the investors negotiate with the senior lenders. Many factors should be taken into consideration, such as commercial interest rate, system risk, and the prediction of future economy which might have an immense impact on the projection of cash flow. One point worthy to mention here is that usually the meaning of off-balance sheet financing is easily mistaken as the conception that project financing requires little or no equity investment by the sponsors. In practice, as mentioned before, the lenders are reluctant to fully finance a project by its own since they are not the equity risk taker. However, unless guarantees are available from very creditworthy guarantors, lenders will always require a substantial equity investment to ensure the sponsors' continued interest and devotion to the completion and success of the project.

Equity investment can take in two forms: preferred stock and common stock. The preferred stock pays dividends and is senior to common stock. Preferred stock has fixed return, while return on common stock depends the financial performance of the company.

Mobilizing equity can be straightforward. The sponsor can reallocate the resources from the corporate to invest in the project company. The financing techniques used nowadays are far more complicated and sophisticated than those used 20 years ago and many resources are explored to fulfill today's need. The possible sources of equity investment in BOT are:

- Sponsors own capital and subordinated loans, which are sometimes used to complement the equity.
- Investment fund, a few of which have been recently formed to provide equity in private infrastructure projects.
- Multilateral institutions, such as the International Finance Corporation (IFC) and regional development bank, such as Asian Development Bank (ADB), which has established equity division to directly invest in BOT projects.
- International equity market, where projects sponsors can issue equity shares to the public or place shares privately with institutional investors.

- Local capital markets, where sponsors can issue equity shares to the public or to local institutional investors such as pension funds and insurance companies that may be interested in the project company.

Subordinated debt

Subordinated loans are senior to equity capital but junior to senior debt and secured debt. Subordinated debt usually has the advantage of being fixed rate, long-term, unsecured and maybe considered as equity by senior lenders for purpose of calculating D/E ratio. Sponsors can sometimes use subordinated debt as an initial injection of capital in order to secure senior loans. It also has the advantage of being advances required by investors to cover construction cost over-run or debt service. Subordinated loans usually come from finance companies, risk capital companies and risk portfolio managers of insurance companies.

Subordinated debt is also called quasi-equity since it has similar characteristics of equity investment. However, subordinated debt by a sponsor has the following advantages over capital contributors:

- From the tax viewpoint, the interest on debt is deductible for income tax purpose
- The payoff of loan is predetermined hence the schedule and rate of payment is certain beforehand, whereas the dividends policy may change each year.
- It still preserves the right to convert to stock if an initial agreement is made.
- A greater market for debt service than equity finance.

Senior Debt

The senior debt usually constitutes the largest part of the financing and is usually accounts for more than 50 per cent of the total. It has the first priority to be paid off in the case that sponsors get into financial difficulty. Senior debt usually comes from commercial bank lenders. After the debt crisis in 1980s, commercial banks consider large project as risky investment, particularly if the loans are non-recourse. Each bank, therefore, has its limitation toward debt financing in large projects. It is unlikely that a single commercial bank is able to meet all the requirements for a single project. So now commercial banks provide finance through syndications of lenders. In addition to the commercial banks, other senior debt resources are as follow:

- Specialized fund sponsored by governments
- The IFC and most regional development bank
- Suppliers' credit
- International capital market, which increasingly tapped through issuing various kink of bonds
- Local capital markets in developing countries

Senior debt falls into two categories: secured and unsecured debt. An unsecured loan is debt backed by the general credit of the borrower, and is not secured by a perfected security interest in any asset. Unsecured loans are only available to the most creditworthy companies with long histories of financially successful operation and good relationship with their lenders. Banks and other commercial finance companies are the source for senior debt. Banks are usually balance sheet lenders and the least expensive source for project financing. Secured loans are available to most projects where the assets securing the debt have value as collateral, which means that such assets can readily be converted to cash. Banks are good resources for secured loans. A secured loan is superior to unsecured loan in the event of financial difficulties. The secured creditor in control of key assets of a project is in a position to demand that its debt service, payments of interest and principle continue, even though the unsecured creditors are paid nothing. **Table 2.3** gives a summary of possible financing resources:

Table 2.3 Resources for Finance

Equity (20 to 40 per cent of total financing)	**Debt** (60 to 80 per cent of total financing)
• Sponsors' own capital • Multilateral Institution • International equity markets • Local capital markets • Investment fund • Governments' official lending agencies	• Institution investors (pension funds, insurance companies, and mutual fund) • International commercial banks • IFC • Bond markets • Suppliers' credit • Specialized infrastructure funds • Government-guaranteed official loans

2.4 Risk Analysis

2.4.1 Introduction

Risks are unavoidable in any project. The main scheme of the arrangement of BOT contract is to identify each risk and allocate each risk to different parties based on the agreement of the contract. As mentioned in Chapter 1, the first step of risk management system is to identify and classify the risk and then the decision-maker has to respond to each risk based on his own risk preference. In this section, risk inherent in BOT projects will be identified and the measures used to deal with it will be discussed.

2.4.2 Types of Risks in BOT

A list of the main risk resources should be compiled for the decision-maker to assess the possible outcomes of uncertainty inherent in projects. Based on Woodward *et al* suggestion, we can simply classify the BOT risks by different phases of the project.

There are three main time frames of the project: development, construction and operation phase. In each phase, each risk associated with it are different from the other, therefore different measures should be taken. **Table 2.4** summarizes the risks associated with BOT by different phases of the project.

Table 2. 4 Types of risks by phases

Development Phase

- Technology Risk
- Credit Risk
- Bid Risk

Construction Phase

- Completion Risk
- Cost Overrun Risk
- Performance Risk

Operation Phase

- Operation Cost Overrun
- Performance Risk
- Liability Risk
- Equity Resale Risk
- Off-take risk

On-going Risks

- Interest Rate Risk
- Exchange Rate Risk

2.4.3 Development Phase

At this stage, the main risk is rejection by the host government. The risk is high but involves relatively small losses. These risks are borne primarily by the sponsors.

Technology Risk

A technology may not be economically viable or the regulation regarding its use may change. This risk is much more concerned in the project where new technology is not approved feasible or economic viable during the phase of development. Usually, project sponsors have to assume this risk through their equity participation.

Credit Risk

Credit risk refers to the creditworthiness of the sponsors or the project itself. The lenders may make their decisions based on how they rate the credit of the concerned parties and project through various reliable agencies. Usually there are three ways to allocate this risk. First, the credit of sponsor can be enhanced through the issuing of letters of credit from commercial banks. Second, under the guarantee of credit rating agency, the lenders need not rely solely on the sponsors' creditworthiness. In other cases, the credit report agency, such as Standard & Poors, rates the credit of specific project based on the credit strength and the capability of the concessionaire. Third, government acts as a guarantor to assure the lenders of the selected consortium's credit reliability. This is considered useful while there is insufficient credit history of the sponsor.

Bid Risk

Bid risk refers to the rejection by the government of the bidding to the project. Reasons for rejection include commercial weakness and failure to obtain licenses, permissions and clearance. The risk is high but involves relatively small losses, such as the expenditure for feasibility study or the cost for preparation of the bidding package. The sponsor usually assumes this risk.

2.4.4 Construction Phase

Any interruption in construction phase might result in the delay of the projected cash flow projection and thus delay the scheduled payment of loans. Main risk is failure to complete the project with accepting performance and within an acceptable time frame and budget. This risks mainly fall on the sponsors. They in turn hedge the risks by purchasing insurance or surety bond and require guarantees from the contractors and subcontractors in the form of a predetermined agreement. The risk involve in this phase is high and involves potentially significant losses. From the lenders' perspective, the construction risk is the most important in the sense that their loan security- underlying assets of the project, would be of little value if the project fails at this phase. Therefore, lenders are likely to require recourse to the sponsors' other resources before the physical asset is completed.

Completion Risk

Project can be delayed due to all sorts of reasons, but poor interface coordination and late design changes are very common. As BOT projects rely on the income from the completed facilities to service their debts, the rolled-up interest from a delayed project can be substantial and can seriously damage the projected revenue stream. Fro example, the Channel Tunnel project was allegedly delayed by late changes in the signaling system specification and thus resulted in one-year delay out of a seven-year contract.

A recent trend is to require the contractors to provide guarantee on completion time in the form of performance and completion bond. In returns, they assign segments of completion risk to the equipment and material suppliers. In this case, the completion risk is transferred to the surety or bond issuer, for which a premium is charged.

Some sponsors prefer a turnkey arrangement in which the contracted company is responsible for completion of the whole project, but these are difficult to obtain for BOT projects. However, a lump-sum contract requires the contractor to comply with specific timeline and fulfill the completion of predetermined critical stages of the project. This can be measured by a rate of minimum operating efficiency. Less positive measures include the imposition of heavy liquidated damages based on expected loss. On the other hand, more positively, it is also common to use performance incentives for the work completed before the deadline.

Sometimes the delay might be resulted from the unforeseen underground condition. This also results in substantial losses on cost and time depending on the site condition. Under BOT arrangement, usually the cost for changed condition is not covered by the contract due to the nature of the lump sum, fixed-price contract. To avoid or mitigate this risk, the contractor usually includes a risk premium in his bidding cost.

Cost Overrun Risk

Any cost overrun must be borne by the sponsor or contractor, but it may be funded by lenders or by precommitted cost overrun arrangement. A common question aroused from cost overrun risk is that the syndicate of loans might question the feasibility and viability of the project on going and is likely to take several actions to threaten the consortium already on the down side.

The overrun risk can be mitigated in the following methods:

- Establish a price escalation clause in the off-take contracts
- Additional capital injected by project sponsors. For example, Eurotunnel had gone through several major equity offerings to meet its increasing construction cost
- Use completion bond issued by the indemnity companies to mitigate the risk
- Fixed price lump sum contract. Most BOT projects are arranged in lump sum contract. However, the effectiveness of fixed price contracts depends on the degree in which the host government can avoid uncertainty and changes to specification
- A standby contingency fund from original lenders. In many BOT projects, the host government provide a contingency fund to alleviate the risk in the event of force majeure
- Establish an escrow fund for completion from sponsors

Performance Risk

Sponsors and contractors may fail to meet the requirement of quality or fail to provide serviceable end product to fit the specification. Under such condition, like completion risk, can result in the delay of the project and thus increase the cost. In order to mitigate this risk, contractors and sponsors can purchase a performance bond from surety. Surety assumes this risk with a charged premium paid by the contractors who are unwilling to risk the damages caused by unacceptable performance. The other advantage for buying a performance bond is to reduce the chance of time consuming legal process for which all damages are covered by indemnity clauses provided by the third party.

2.4.5 Operation Phase

Operation cost overrun risk

Labor and material used during operation of the completed facility, such as fuel in a cogeneration plant, may turn out to be more expensive than anticipated. Contractual arrangement similar to those described in the construction phase, including price escalation clauses in the off-take contracts, are appropriate.

Sponsor Performance Risk

Operation and maintenance contractors may not meet the quality standards. Like any other performance risk, this is borne by the contractors.

Liability Risk

The risk of death or injury on the operating facility may be allocated to the insurance company by prepaying the premium.

Equity Resale Risk

Contractors and other sponsors may not be able to sell their share in a project upon its completion because the secondary market for sponsor equity positions can be very limited. Because of this limited secondary market, some sponsors prefer to use a subordinate loan for project capital – one that supports senior borrowings from third party. As debt, the borrowing will eventually be paid. The sponsor lender can preserve the advantage of an equity stock position through stock conversion rights under the subordinated loan agreement.

Off-take Risk

The risk that the project may not meet revenue projections because of market price changes occurs in all types of projects. It is referred to as, generally, the overall economic risk of the project. Off-take agreement may guarantee the minimum revenue generated from the purchasers. Sometimes government may guarantee no second facility for a specific time. For example, in the case of Malaysia North–South highway project, the government guaranteed to provide additional finance in the event of a drop in traffic volume in the fist 17 years. Another good example for using such kind of incentives is the Sydney Harbor Tunnel project. Under the so-called "revenue stream Agreement", the project company will receive a guaranteed cash flow based on the agreed projections of tunnel and bridge traffic. The government has to pay for the shortfall if the traffic falls below 10% of the forecast demand.

2.4.6 On-going Risk

Interest Rate Risk

Changes in interest rate affect the cash flow of the lenders who use fixed-income securities. Coupon swaps are a convenient way to hedge interest risk. A coupon swap is an exchange of one coupon or interest payment for another that has a different configuration but the same principle amount. Lenders in project finance usually have access to certain floating and fixed-rate debt markets.

Exchange Rate Risk

Exchange rate affects international project in which project revenues and expenditure are paid in foreign currency.

To mitigate this risk, financial manager can convert the exposed cash flows into the desired home currency. Short-term transaction can be readily hedged in the foreign exchange forward or future markets. However, for a longer term hedging, it is more appropriate to hedge with either long-date forward currency or currency swap. Financial manager can also convert the exposed cash flow into the desired currency using currency-collateralized loans and foreign exchange options. In the case of Malaysia North-South Highway, the government guaranteed the project company that it would make the shortfalls if any adverse exchange rate movement exceeds 15% on its offshore debt, or if interest rate movement exceeds 20% on its floating rate offshore debt. These guarantees instilled confidence in the lenders that the project company will still be able to complete the project under adverse money market.

Underlying is a summary table for risks involved in BOT project, the parties assuming the risk, and the mechanism used to allocate the risk.

Table 2.5 BOT Project Risk Summary

Risk	Participant	Mechanism
Development Phase		
Technology Risk	Sponsors	Equity Subordinated debt
Credit Risk	Sponsors, Lenders	Credit rating agency
Bid Risk	Sponsors	Equity
Construction Phase		

Completion Risk	Contractors Sponsors Contractor	Performance Incentives & guarantees; Turnkey Contracts
Cost Overrun Risk	Sponsor Contractor	Fixed price contract & completion bond
Performance Risk	Sponsors	Performance bond
Operation Phase		
Cost Overrun Risk	Sponsors	Fixed price contract
Performance Risk	O&M Contractors	Equity, performance guarantees
Equity Resale Risk	Sponsors	Subordinated Debt
Off-take Risk	Sponsors	Take-and –pay; take-or-pay; advanced payments
Liability Risk	Insurance Company	Insurance contracts

3 Case Study: Hong Kong Cross Harbor Tunnel

3.1 Project Background

The project is important in the sense that it marks the beginning of BOT development in Hong Kong. The project was outset at the 1950s with the need for fixed cross harbor link, which the government of the day could not afford to build. In the 1950s, the data shows that there was a 27% increase in the bus passenger per annum due to the increasing number of illegal immigrant. At that moment, the main transportation to link up the city of Victoria on Hong Kong and the Kowloon on the mainland was carried by ferry services. In 1954, a feasibility studies show that the tunnel is the best option, and in 1956 the government proposed that private sector might be allowed to participate in this project with its own financing.

Following a long and complicated process, a Hong Kong consortium was formed in 1965 comprising Wheelock Marden & Co., Ltd, Hutchison international Ltd, Kowng Wan Ltd, and Sir Elly Kadoorie Successsors Ltd, operating under the title of 'the Cross Harbor Tunnel Company Limited'. Tenders for the construction work were invited in 1966, but uncertainty caused by the Cultural Revolution in China meant that the lenders were more unwilling to fund the project. The construction contract was not signed until 1969 while a negotiation with Lloyd's Bank Ltd, of London for a loan of £14.7 million backed by UK export credit guarantees were successfully concluded. The relevant legislation, the Hong Kong Tunnel Ordinance (CAP 203) was enacted in June of that year. The construction contract was awarded to a consortium led by Costain International Ltd. The tunnel opened to traffic ahead of schedule in August 1972 with a toll of HK$5.

Table 3.1 Details of the Hong Kong Cross Harbor Tunnel project

Principle	Date
Joint consulting engineers' report	April 1961
Granting of franchise to HKCHT	August 1965
Project out to tender	October 1966
Tenders returned	February 1967
Contract signed	June 1969
Work began at site	September 1969
Tunnel completed across harbor	February 1972
First traffic through tunnel	August 1972
Tunnel opened formally	October 1972

(*Source*: A. J. Smith: Privatized Infrastructure)

3.2 Project Analysis

The franchise is 30 years from the start of construction work and the government retains all rights of ownership on and over the land. The franchise company was required to have a minimum of paid up share capital of not less than HK$ 80 million.

The costs for which the project company had to pay the government include the following:

- HK$75,000 per year for use of the land of approaching road during the concession period.
- HK$12,355 per year for the rental of area upon which any toll structures are build
- A royalty to government of 12.5% on all operating receipt

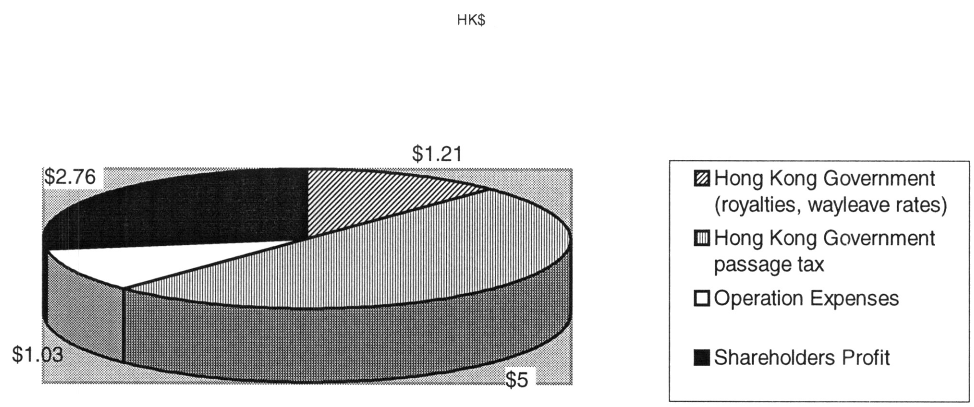
- HK$ 12 million for the construction of road works and approach roads by the government

Within one year, the tunnel was approaching its design capacity. By 1979 the tunnel was approaching its design capacity of 90,000 vehicles per day, and by 1984 traffic was running at over 100,000 vehicles per day. Present day traffic flow is about 120,000 vehicles per day. After four years (1976) of operation, the tunnel began to make profit, and by 1977 all debt was paid off. By the early 1980, the project was described as a "cash cow". A 1986 local newspaper article stated:

> the Cross Harbor Tunnel Company generates the sort of profits that many firms only dream of – HK$ 144 million after taxes on a turnover of HK$ 269 million.

Their financial model identified interest rates as the controlling sensitivity factor, and the scenarios they projected the interest rate as 6, 7, and 8%. However, during the period of in which the tunnel was built and paid for, the prevailing interest rate was 5%.[1] In 1974, the Cross Harbor Tunnel Co. Ltd offered 25% of its equity to the public after first refusal by the ferry companies. Within a year, the market price of the shares tripled. A HK$5 passage tax was imposed by the government, raising the toll to HK$10. Among the HK$10, the government receives about 61% of the total toll revenue. **Figure 3.1** shows the distributions of revenue among the parties. The company report for 1992 gave 44,912,073 vehicle journeys for the year which equates to 85 vehicles/minute going through 14 booths. The same report gives the operating profit after tax as HK$236,362,000 which translates to $450/min. This early example of BOT has been approved a success in all aspects.

Figure 3.1 Distribution of Revenue



This BOT do create a win-win situation for all parties- lenders are happy for the debt are paid off quickly; the shareholders are happy for the project is profitable; the users are happy as evidenced by their continued patronage. There are several factors contributing to this success:

- The cash flow stream is one of the most important factors in BOT project. To create such win-win situation, the financial projection based on the forecasting of traffic volume is very important. The forecasting was done by the UK Road Research Laboratory. Their report gave three scenarios of prediction termed as minimum, probable and possible traffic. From **Table 3.2**, we can tell the prediction is very accurate that the cash flow projection falls in the expected range.

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[1] Asia Magazine. February 1993.

- Higher than expected traffic flow was generated by the vibrant economic. The GDP at that time increased at an average of 6.8% each year reaching a level of US$14,545 between 1981 and 1991.
- Construction cost overrun and completion delay risk are efficiently avoided. This is done by adoption of new construction techniques by a team of experienced contractors and consultants
- Lower than expected interest rates (8%) for the construction phase
- Early completed of the project. The initial schedule was 54 months but the actually period is 35 months, which is almost one and half year ahead meaning a earlier cash flow generated and debt payoff
- The political risk are largely mitigated by the sponsor of Britain's prime minister Harold Wilson in pushing through loan agreement without Hong Kong Government guarantees

This project, certainly one of the first true modern-day BOT project, shows that government was taking an approach in many ways similar to the historical pattern of British colonial administration. The administration government would be willing for the private sectors to involve if they were prepared to take the risks.

As mentioned before, the clauses for the payment of the construction of roads, and the rental for using ancillary roads show that government was unwilling to take any risk of the project. In such case, all of the risks involved are 100% assumed by the concessionaire and lenders, and all these risks were appropriately mitigated or compensated by the vibrant market. However, as we can see from this early scheme, if one possible damaging outcome occurs, the franchisee would be easily in a financial difficulty without the back up of local government. In such case, the risk exposure to the consortium is relatively higher to the other BOT schemes with the supporting from the host government directly or indirectly. Therefore, from the sponsors' perspective, this relies on a more efficient risk management during the development, construction and operation phases.

However, usually things don't go so smoothly. The economic may fluctuate thus the demand may not be expected; the interest rate may not be as low as expected thus resulting in a higher borrowing cost. Therefore, in order to achieve a win-win solution, the host government should take part of the risk instead of leaving it to the sponsors and lenders. As we can see from the next chapter, the local economic is on the downside while the Taiwan's BOT project is on going. As a result, the consortium almost failed to acquire the required funding and resulted in the delay of the construction.

Table 3.2 Predicted and Actual Traffic Flows for Hong Kong Cross Harbor Tunnel

Year	Actual	Predicted	
		Probable	Minimum
1972	26174	38509	24787
1973	34190	40562	26118
1974	38915	42615	27450
1975	41626	44669	28781
1976	49480	46723	30113
1977	59348	Not given	31445
1978	74121	Not given	32776
1979	87178	Not given	34108
1980	95632	Not given	35439
1981	104613	Not given	36771

1983	108187	Not given	39435
1984	100763	Not given	40767

(*Source*: Joint Consulting Report 1961)

4 Case Study: Taiwan High Speed Rail Project

4.1 Introduction

4.1.1 Project Background

The concept of private sector participation in the infrastructure project is not new in itself. In France, most major infrastructure facilities (railways, electricity, etc) established in the late 19^{th} and early 20^{th} centuries, were initiated by some foresighted businessmen who considered these projects as economically viable and technologically feasible. The same thing occurs in the United States and many other industrialized countries.

In Taiwan, there are three reasons for government to adopt the BOT scheme toward High Speed Rail project.

First, after the rapid economic growth during the 60s and 70s, Taiwan had accumulated abundant capital resources to finance its own infrastructure projects. At that time, most of the infrastructure projects are funded directly by government as it could finance the project with adequate capital instead of pledging outside resources. After the 80s, however, due to the increasing size of project and the complexity involved, projects need more tremendous investments, which might soon wear down the government's budget. Second, government attempted to distribute more resources on the other areas, such as education, high-tech research, art and social welfare. This reallocation of resources thus resulted in a big gap between the desired and available funding for project financing. Third, government is continuing to pursue an aggressive program toward the high-tech industry, which has made Taiwan as the 3rd largest countries in computer hardware production. The international financial community continues to recognize Taiwan's economic strength and potential to grow through their investments in large-scale projects. Taiwan's economic achievements have resulted in an average increase of 6.4% per capita income over the past 10 years (1988-1998)[1]. In order to meet the requirement for future growth, a rapid public transportation system is needed to keep pace with economic growth.

Therefore, a new delivery system is needed to cover this gap while at the same time support the development of the infrastructure project. Under these circumstances, one important approach proposed for building new infrastructures facilities is the build-operate-transfer (BOT) concept. The Taiwan High Speed Rail System (THSR) linking Taipei and Kaohsiung is first selected as a justification in which HSR is funded, built, and operated by the Taiwan High Speed Rail Corporation, Ltd. (THSRC) for a defined period (35 years of operation concession and 50 years of land development). This railway system provides a new and rapid link along the West Corridor, which is the most populated area on island. Most of the economic activities are distributed along this Corridor acting as a transportation artery connecting Taipei (North) and Kaohsiung (South).

4.1.2 Project Development

In the early time of the project, the government planned to develop a new transportation link connecting West Corridor by fiscal budget. After a long time of feasibility study, technical research and statute legislation, the government decided to

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[1]ROC Ministry of Economic Affairs Report.

switch from the original scheme to BOT approach, which allowed the private sectors to participate in infrastructure project. Soon after the delivery mechanism had been decided, the project was contracted out with a total of NT$ 431.6 billion (US$ 14.4 billion). In the following, the detail of how this transition occurs and how the contract was awarded will be discussed.

The HSR has been part of Taiwan's long-term policy since 1989. The High Speed Transit System 2020 (HSTS) study completed in 1990, outlined pairs of arterial transport systems linking major cities. HSTS also outlined a High Speed Rail system to collect and distribute inter-city passenger trips along the West Corridor. Following describes how the project developed and finally transited to the BOT.

In 1989, the Ministry of Transportation and Communications (MOTC) pursuant to section 1113(3) of the Environmental Planning and Assessment Act 1989 (EPA), exhibited an Environmental Impact Statute (EIS)[1] in respect of the proposed two tracks around 400 km in length from Sung-Sang (next to downtown Taipei) to Dro-Inn (next to downtown Kaohsiung). As a result of the EIS process and in view of the submissions received, which indicated a broad community concern over the project, the Government convened a Commission of Inquiry. [2]

In 1991, the Commission of Inquiry suggested that the project should not be constructed under fiscal constraints, and an upgrading of the existing north-south traditional rail system with improvement in other transportation vehicle should be implemented in priority. As a result, the Government did not accept the Commission's findings.

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[1] ROC Ministry of Transportation and Communication
[2] MOTC #1173 Report.

In September 1992, the then Minster of MOTC announced the preparation of an EIS relating to a HSR link for West Corridor. As a result of the EIS, a proposal containing the main elements of the HSR and accessing transit links, and land acquisition form State owned enterprises emerged. The MOTC was the proponent of the proposal within the meaning of the EPA Act and proposed a fixed price construction project with a HSR Authority bearing operation responsibility.

A formal decision, in accordance with the EPA 1989 to build the HSR link was made in 1993 by the Minster of MOTC. At the Legislative Yuan's Capital Works Committees meeting of 1995, the Premier of Council of Economic Planning and Development advised the MOTC granted approval for the POHSR to call form expressions of interest for the construction, financing, and operation of the HSR. The Capital Works Committee of Cabinet has given its approval for the MOTC to seek Expressions of Interest from private sector participation and has not committed the provision of Government funding for the project. The document of Seeking Expressions of Interest explicitly stated that the registered private sector proponent will be expected to bear all the construction risk and traffic risk and that bids should be developed on this basis

Invitations for Preliminary Proposals to finance, design, construct, operate, and maintain the HSR were received in 1997 from two proponents: Chinese HSR Consortium and Taiwan HSR Consortium. MOTC-instituted Assessment Panel evaluated each proposal against the published criteria and declared the Taiwan HSR Consortium was the first priority selection to negotiate on the project. The Assessment Panel considered that the THSRC proposal provided the best offer for provision of the link and recommended THSRC to undertake a more detailed investigation and submit an affirmative offer.[1]

Finally, the Government signed up the Construction & Operation Agreement (C&O A) with the Consortium for the design, construction, operating, and maintaining of the project. The Taiwan High Speed Rail Corporation (THSRC) was formed and registered in May 1998 and the C&O A was signed in July the same year. The concession calls for THSRC to build and operate the Taiwan High Speed Rail for a period of 35 years. It also grants THSRC the right to undertake property development around station areas for a period of 50 years. Underlying is the timetable for the development of THSR BOT project.

Table 4.1 Timetable for the development of HSR project

Time	Important Milestones
Jan. 1989	MOTC Institute of Transportation Commissions AmDec and Chinese Engineering Consultant Incorporation to perform a High Speed Rail feasibility study.
July 1990	Executive Yuan approves the establishment of High Speed Rail Preparatory Office (now changed to Bureau of Taiwan High Speed Rail)
June 1992	Executive Yuan approves High Speed Rail route
Nov. 1994	Legislative Yuan passes enactment of the "Statute for Encouragement of Private Participation in Major Transportation Infrastructure Projects"
Jan. 1995	Legislative Yuan passes High Speed Rail Plan with attached condition that private investment must be 40% or greater
April 1995	Environmental Protection Administration, Executive Yuan, reviews and approves the environmental impact assessment for the High Speed Rail Plan.
Oct. 1996	Bureau of Taiwan High Speed Rail announces that it will solicit private investment in construction of the High Speed Rail system via a BOT model.
March 1997	The Executive Yuan agrees in principle to add Miaoli, Changhua, and Yunlin stations.
Sept. 1997	The selection committee evaluates Taiwan High Speed Rail Consortium as having the best application proposal.

[1] Guidelines for Private Sector Participation in the Provision of Infrastructure

Dec. 1997	Contract negotiations between Bureau of Taiwan High Speed Rail and the Taiwan High Speed Rail Consortium are completed.
May 1998	The Taiwan High Speed Rail Corporation is formally established.
July 1998	The MOTC signs a construction, operation and station area development contract, a memorandum items committed by government and a contract performance memorandum with the Taiwan High Speed Rail Corporation.

Sources: BOTHRS

4.2 Risk Analysis

4.2.1 Problems

THSR BOT project currently fall behind a lot from its initial schedule. According to the C&O Agreement, the project was supposed to start the construction work in June 1998, but not until August 1999 did the THSRC secure sufficient financing for the project. There are three main reasons for this delay:

1) The concession company cannot acquire sufficient loans from banks to start the project. The syndicate of bank is lack of confidence in the viability of the project and lack of any security for their loans, in this sense that they consider the investment is too risky and the expected return is not enough to cover their risk.

2) Fault by government. The government was responsible for most of the preparation work, including land acquisition, approaching road construction and the related statue legislation. There is a delay in the land acquisition, which is agreed to be 100% acquired before the construction starts.

3) Asia Crisis. After government contracted the project, the Asia Crisis hit almost every east-Asian country including Taiwan. The result is obvious that banks and financier were tightening their lending policy and took a more precautious

approach toward risky investment. Besides, the sponsors were also suffering losses from the currency exchange especially in the imported material and foreign technical support.

Although most of the failures occur in the development phase so far, the other risks do exist in other phases will also be discussed. The answers for these problems can be concluded from the previous case study and the risk management model mentioned before.

4.2.2 Risk Allocation

Based on the previous case study and several techniques stated before, the risks associated with the THSR Project are first identified and group by different phases of the project. Then the methods of how these risks are mitigated and allocated among different parties are discussed.

Development Phase:

1) **The land acquisition delays risk**. The **government** should assume this risk. As stated in the contract, there is no rigid time schedule for delivery of the land.[1] This put the consortium in a more risky situation. As proved from the case, part of the construction work is delayed by the land acquisition process. By establishing the exemption provisions or force majeure clause, the risk of consortium can be shifted while the government is unable to provide the land according to the time schedule. A good example is the Indonesia toll road projects (Sidney Levy, *Build, Operate, Transfer*), the government takes a successful role in expediting the process. Government should communicate with the legislative body to dispatch

[1] HSR BOT contract chapter 3: Execution Provisions

the budget and the change of statutes. Besides, government should enforce the acquisition law more determinedly to avoid any disturbance or delay which might cause losses to the project.

2) **Credit Risk**. This is one of the most important risks involved in our case, since most of the delays are caused by the inability to acquire sufficient loans. Although the consortium consists of many top end companies, the creditworthiness is still low due to the inexperience of the involving parties, and thus creditworthiness is solely based on the credit of the project. In order to solve this problem, government should play a very important role as a facilitator/guarantor or investor in the project. To increase the credit of the sponsors or project, there are two approaches to solve this issue.

- First, government takes part in the loan portfolio as a creditor, such as providing "soft loan". In accordance with Article 22 of the Statute for the Encouragement of Private Participation in Major Transportation Projects (SEPP), the government provides a US$ 9.3 billion favorable mid- or long-term loan to the project company[1]. A good example is the successful Malaysian North/South Highway BOT project[2], in which the government allocated a loan of US$235 million towards construction costs of the project, repayable over 25 years a fixed annual interest rate of 8%. From the government perspective, as an investor, it is required by the public to be more active on the operation and management of the project. From the

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[1] BOTHSR website: Financial report.
[2] C Walker & Smith: Privatized Infrastructure: Chapter 14.

lenders' perspective, this provides the lenders some kind of level of guarantee that the project is economically viable.

- Second, establish an agreement to secure the senior debt. The security under a secure loan can be of any asset, predetermined rights or the on-going project. However, there is no guarantee that a security agreement can be easily perfected and enforced if the principal is in difficulty. Government can reinforce the secured agreement by guarantee the lenders that a minimum portion of the secured asset would be liquidated to the syndicate. According to the recent report[1], the THSRC has already secured sufficient loans under the condition that the government commit the loan of Long Term Fund and assist in establishing the Tripartite Contract, which sets out payment procedures and methods of the price for the enforced purchase that will be made upon the expiry of C&O Contract. This is to protect the best interests of syndicate.

Construction Phase

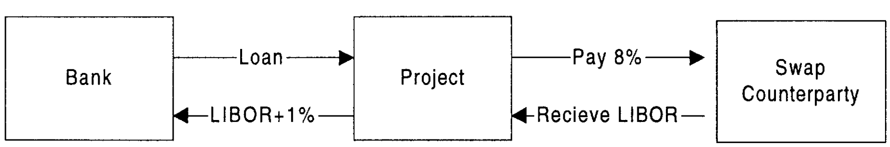
3) **Completion Risk/Performance Risk.** This risk is usually assumed by the sponsor and the government. The consortium (THSRC) has to provide a $500 million completion bond until six months after the entire HSR line is complete and operational.[2] This risk is allocated partially to the contractors and subcontractors once the project is mobilized into the construction phase in the form of providing performance or completion bond. This risk is reduced by the active and fully participation of the government in the project as a supervisor. For

[1] Newsletter of BOTHSR, February 05, 2000.
[2] HSR BOT Contract Chapter 3: Execution Provision

example, the MOTC request the consortium to provide management report on the progress in the design and construction of the HSR, and the contents of the design examination report shall be set out in the quality guarantee plan. This helps to track the problems regarding to the project instantly instead of facing a failure at the final stage.

4) **Interest Rate Risk.** Under the current agreement, the government agreed to cover all the losses due to the changes of interest rate from the date of the contract submitted to the end of the concession period. In addition, the interest rate on long-term fund is fixed. For the other floating-rate basis loans from the commercial banks, the risks can be eliminate by entering into an agreement with a financial institution under which it agrees to pay fixed rate of interest and receive a floating rate of interest. This scheme can be illustrated as **Figure 4.1**. The project sponsors receive a loan from bank by paying LIBOR PLUS 1% interest; by entering into another swap contract, the sponsors pay a fixed rate interest of 8% and receive a LIBOR in return, so the total interest rate the sponsors have to pay is fixed at 9%.

Figure 4.1 An Interest Rate Swap



Source: John Finnerty. Project Finance

5) **Foreign Exchange Risk.** The Asia Crisis had totally collapsed the local economics. One obvious effect is the devaluation of local currency. In Taiwan,

the currency is devalued almost 30%.[1] Though the revenue is paid in NT$, some of the expenditures, such as consulting fee, railway electrical sub-system construction and imported material are paid in foreign currency. This results in the increasing of the costs. According to the estimation of the THSRC, the total amount due to this loss is around US$ 0.5 billion.[2] The consortium neglected this economic risk since the then economics was vibrant and almost no one would expect a financial crisis. This risk is usually assumed by the sponsor. The sponsors can reallocate this risk in the currency future or forward market for the short-term cash flow; for a long-term cash flow or payment, it is more appropriate to hedge the risk in currency swap market.

6) **Reliability Risk.** This risk is assumed by the sponsors and contractors. The consortium is requested to provide submit an insurance pal to the MOTC for their reference and records within three months after signing the BOTC.[3] The contractors, suppliers and professional consultants are also required to apply for insurance plan under the regulation of Comprehensive Property Insurance and Public Accident Liability Insurance.

Operation Phase

7) **Income Risk**. From the Hong Kong Cross Harbor case, for the type of toll road BOT project, the income projection depends largely on the prediction of demand. In that case, the actual demand is higher than the expected due to the strong vibrant economic, which stimulated the local demand. In respect of income stream, it is very risk in the sense that the market will fluctuate intensively with

[1] Ministry of Economic Affairs: Statistics Information Database
[2] THSRC website: financial report of HSR.
[3] HSR BOT Contract Chapter 3: Insurance

the economic, which might totally out of the control and expectation. One widely used method is to provide a guaranteed market, for which the government and the sponsors share the income risk. This arrangement includes the traffic volume support agreement, and the “no second facility” protection. In the case of traffic volume support the government guarantees a minimum of level of revenue. “No second facility” protection, where the government guarantees that there would be no competing facilities for a specific time, could provide the consortium with a monopoly, so this technique is used with cautious. In addition, the government also granted the rights to develop the commercial real estate along the transportation facility. This incentive attracts the sponsors for the potential revenue projection based on the expected prosperity of the surrounding area.

8) **Political Risk**. Tax incentives. Providing the concession company a tax deduction on income as an incentive to promote the future operation of the project and relief part of the tax burden. Besides, the government guarantees the tax rate would be fixed during the operation phase to reduce the risk of change of policy.[1]

4.2.3 Summary

Based on the above risk analysis, most of the risks, whether already mitigated or not yet specified in the contract, the government does take an important in the risk sharing, no matter in the role of a facilitator, guarantor or a regulator. Recently, the role of government has assumed more and more importance in securing project finance. As competition for available financial resources intensifies, the lenders look on more solid evidence of investment. In this sense, the sponsors need more solid and strong supports

[1] HSR BOT contract Chapter 3.

from the government to increase its creditworthiness and mitigate its risks as well. In THSR case, one year after the project contracted out, the syndication lenders finally committed to the loan, based on the participation of government in the form of a favorable loan and a guarantee from the government that the best interest of the lenders would be protected. Besides, the government also plays a significant role that makes it easier for both consortium and lenders to assess and reduce the various political and economic risks involved. Following is a summary table of the role of government in the risk sharing of THSR BOT project.

Table 4.2 Role of Government in Risk Sharing Mechanism of THSR Project

Risk	Role and methods used by Government
Land Acquisition Risk	Regulator: enforcing acquisition law. Facilitator: expedite the budgetary legislation.
Credit Risk	Loan Creditors: long-term favorable fund; Guarantor: Tripartite Contract.
Completion/Performance Risk	Supervisor: supervise the C&O process Consumer: keep maximum interests of the public
Interest Rate Risk	Provide a fixed interest rate loan.
Reliability Risk	Regulator: Request insurance for all parties under current statute.
Income Risk	Guarantor/Promoter: guarantee the minimum revenue.
Political Risk	Promoter: promoting the project, such as tax reduction.

5 Conclusion: Role of Government

In chapter 1 and chapter 2, we discuss how the risk is managed and what type of risks are associated with BOT project. In chapter 3, through studying the HK Cross Harbor Tunnel project, the risks associated with this toll-road type BOT project are identified and the approaches used to mitigate the risks are also discussed. Finally, the main objective of this thesis is to apply the risk management model build in previous chapters attempts to examine and testify the on-going project, Taiwan High Speed Rail Project, to find out what the problem is and how the project was deferred at its initial stage.

Through these analyses and comparisons, it demonstrates a clear point that the government plays a critical role in the risk allocation mechanism of BOT project. Although the role of the host government is an owner in the BOT contractual structure, there are many facets in which the government also plays an important role to create a win-win situation. This can be characterized as two groups: traditional (passive) role and active role. The traditional role of government is identified from a historical perspective and clearly demonstrated in the typical BOT contractual structure as a regulator and inspector. The active role refers to government taking a more positive and dynamic role as a facilitator/guarantor, promoter and customer to assist in the success of the project. The main topic covered by this paper is to give an overview on the different facets of government and how it helps to reduce and allocate the risks among the other parties.

5.1 Passive Role: Owner as Regulator/Inspector

It is government's theoretical role to intervene the private business and protect the maximum interests of the public it represents. These safeguards might be legal or economic, and the extent of intervention depends on the general level of economic development and the government's own perception of the stability in the society. In THSR project, there are some aspects, in which the government appropriately intervenes as a regulator/inspector:

a) Government's role as regulator will usually be give effect through its legislative powers. For example, in our case, the land acquisition law is enforced by the government, which takes the advantage of its authorities toward public interests. Others statutes, such as the Public Accident Liability Insurance, requires all the parties involved are under this cover. This is also to protect the public interests in case of any damage to the public property.

b) As an inspector, the government appropriately intervenes in the construction and operation of the facility. This is accomplished by each incremental step of each phase to correct any error or identify any operation problem before the whole system is failed, such as providing the operation statement each month or by each critical time stand. This is specifically appropriate in our case since both side (regulator and sponsors) are lack of experience in this debuting BOT project thus resulting in increasing the risk of failure. The purpose of this intervention is to ensure that the facility is constructed, used and maintained in accordance with the specifications and agreements.

Besides the above statements where we can see the proper role of regulator/inspector in this project, I would also like to point out some issues that need to improve. My recommendations are as follow:

a) As a regulator, the government should enforce the law more determinedly such as to avoid the land acquisition delay.

b) Although this is the first BOT project in Taiwan, there will be many projects introduced or proposed in the near future. It is urgent for government to establish a mechanism for ensuring compliance with the requisite rules and regulations for BOT project.

c) Inspection on the monopoly of the THSRC. Although it is essential to provide a guaranteed market as an incentive for the sponsors, the government is also required to pay attention to this issue to avoid the negative effects such as overpricing and unsatisfactory services.

5.2 Active Role: Owner as Facilitator/Guarantor/Investor

Basically, there are two ways for government to facilitate the use of private sector investment in public infrastructure project. First, by making it easier for private sector to assess, control and reduce the various political, sovereign and economic risks involved. Second, by using a variety of inducements and guarantees to make the investment more attractive to potential funders in terms of increased returns or in terms of greater safeguards for the revenue stream.

In THSR, the role of government as a facilitator is as follow,

a) Tax incentives. Provide tax deduction on revenue stream.

b) Interest rate. Provide a favorable fixed interest rate long-term loan.

c) Guaranteed market. Establishing "No second facility" agreement to guarantee there will be no similar facility to compete with the current project.

d) Property development rights. Government granted the rights to the sponsors to develop the commercial real estate along the line of the transportation facilities. This is one of the most important incentives for the sponsors.

My recommendations for improvement are as follow:

a) As a facilitator, the government should speed up the budgetary legislation for land acquisition. Until now, the legislative body approves only 80% of the total cost.[1]

b) The currency exchange rate is very unstable while most Asian countries are suffering from the financial crisis. It is an effective and powerful incentive to attract international funders, construction companies or electrical system designers by inducing the exchange rate guarantees. It can also reduce the risk of cost overrun assumed by the sponsors. In fact, as mentioned before, the THSR final total cost is increased by around 5% due to the cost increase in imported materials and supplies.

c) As far as we know, not until the government does approve the soft loan did the syndicate lenders commit to their financial support to the consortium. Although this put the government in a debt holders' position, a emphasis on public interest and to create a win-win situation is more important than anything else. This reveals a more convincing evidence of the important role of government as a facilitator.

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[1] BOTHSR website. "Financial Report"

The government acts as a guarantor mostly on the trilateral relationship between the sponsors and the lenders. The bankers are the one who are concerned about whether their loans would be paid in accordance to the contract. So it is very important for the lenders to evaluate and assess the project revenue stream based on the creditworthiness of the project and the project company. However, since there is no relative previous history regarding the project, the creditworthiness of the project is so low that the syndicate banks are unwilling to take the risk. My suggestions for the government to increase the creditworthiness of a risky, debuting project are as follow:

a) Debt holders. By providing the long-term soft loan, the government is assumed to actively participate in the risk/return portfolio of the project for a specific time, in which reduces the creditworthiness risks born by the lenders.

b) Tripartite Agreement. As a guarantor for the tripartite agreement, the government guarantees the syndicate banks of the project asset as a security and the minimum default reimbursement. This is to ensure the maximum profits of the lenders are protected.

5.3 Summary

Due to the inexperience in BOT project, Taiwan government, in High Speed Rail Project, committed the mistake that it considers itself as simply a host owner with minimum risk. In order to create a win-win situation, an aggressive and active participation of the host government is necessary. Government can accomplish this objective by taking the role of facilitator, guarantor, investor, and regulator and assume part of the risks to create *the maximum benefits of the public and society.*

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